

YC4E(4110)系列

柴油机使用维护说明书

Operation and Maintenance Manual for Diesels

-----YC4110 series

Yuchai Machinery Co. Ltd

玉柴机器股份有限公司

2007. 12

Executed standard

本说明书执行标准

型号 Diesel type	执行标准 Executed standard
YC4110ZQ	Q/YA271—2003 YC4110ZQ(I)系列柴油机技术条件 Q/YA271—2003 YC4110ZQ(I)series diesel engine technical specifications
YC4110ZLQ	Q/YA292—2003 YC4110ZLQ(I)系列柴油机技术条件 Q/YA292—2003 YC4110ZLQ(I)series diesel engine technical specifications
YC4110ZLQ	Q/YA414—2003 YC4110ZLQ(II)系列柴油机技术条件 Q/YA414—2003 YC4110ZLQ(II)series diesel engine technical specifications

柴油机生产许可证编号:

Diesel Engine License No:

企业名称 Name of enterprise	品种规格 Variety and specification	许可证编号 License No.	有效期 Term of validity	发证日期 Issuing date of license	说明 Description	上报部门 Department reported to	存档号 Filing No.	省别 Province
玉柴机器股份有限公司 Yuchai Machinery Co. Ltd	多缸柴油 ≤ 132.00kW、> 58.82kW 车用 Multi cylinder diesel engine, power ≤ 132.00 KW and > 58.82KW for vehicle	XK06—205—00188	2008.07.01	2003.07.02	发证 Industrial Production Permit of China	机械产品审查部 Inspection Department of Mechanical Products	903	广西 Guangxi

柴油机标牌位置:

Location of the nameplate:

柴油机标牌位于进气管顶面。发动机型号和出厂编号打印在气缸体排气侧中间的下缘平台上。

Nameplate of a diesel engine is located on the top surface of the air intake. The engine model and the ex-works identification number series number (see the figure left) also are stamped on the bottom flange platform at the middle of exhaust side of the cylinder block

尊敬的玉柴顾客：

欢迎您加入玉柴机器用户行列，中心希望玉柴机器能给您带来滚滚财源和长久的好运。本系列产品采用先进的技术设计，质量可靠、使用寿命长，具有良好的动力性和经济性。为了使机器的优越性能得到更好的发挥，并保证机器的安全运行，青年在使用之前首先详细阅读本使用说明书，并特别注意以下的“安全行车注意事项”。

Respected customers of Yuchai:

Thank you for choosing a product of Yuchai. We sincerely wish it brings you more fortune and good luck. Advanced designs, which guarantee reliability and longevity with high performance and fuel efficiency, are used in our products. In order to enhance engine operation and safety, please first read the manual in detail and pay special attention to following the precautions for safe driving.

安全行车注意事项！

Precautions for safe driving

1. 机油压力感应塞、水温感应塞、特别是机油压力过低报警

器这三个零件非常重要，凡有失灵者，须立即更换，以确保这三个零件能正常工作。否则易造成因缺油烧坏曲轴或因缺水致使气缸过热而开裂。

The oil pressure transmitter, water temperature sensor and, especially, the oil warning lamp are very important; if something goes wrong with any one of them, replace it immediately and ensure that it operates normally. Otherwise, the crankshaft may burn out due to lack of oil and the cylinder head overheat and crack due to lack of water.

2.凡在保养过程中清洗了机油滤清器滤芯或更换滤芯时，应先灌满机油再安装，而且安装完成后，必须起动柴油机，并使其怠速运转，然后下车仔细观察各滤清器有无渗漏现象，若有则须及时排除，否则容易造成缺油烧坏曲轴。

If the oil filter element is cleaned or replaced during maintenance, it should first be filled with oil and then re-installed. Moreover, after installation it is necessary to start the engine and run it at idle speed, and then to get out of the driver's cab and check carefully for leakage. If leakage occurs, repairs should be performed immediately, otherwise this will cause crankshaft failure due to lack of oil.

3.再次出车时，启动柴油机后怠速运转 3~5 分钟后再轻踩油门踏板加速，待柴油机热机，各种仪表正常工作后，方可起步运行。切莫冷车突然加大油门。在冷态下突然大幅升高转速，会损坏各种仪表及其相应零件，加速柴油机运动件的磨损，从而缩短柴油机的使用寿命。

Every time before driving the vehicle, the diesel engine should be started first and run at idle speed for 3 to 5 minutes to warm-up and make all instruments function at normal status. Do not press the accelerator pedal abruptly when the engine is cold. Increasing speed rapidly may damage all kinds of instruments and their corresponding parts, accelerate wear of moving parts, and shorten the engine's life.

4.应避免高速、大负荷运转这台下突然熄火停机，应逐渐降速、降负荷，带速运转 3~5 分钟后再停机。

Avoid stopping engine abruptly at high speed and under heavy load operating conditions. Decrease engine speed and load gradually, and then stop the engine after idle operating for 5 to 10 minutes.

5.增压柴油机要按照说明书的要求严格控制好供油提前角。当柴油机功率下降时，应先检查进气管路是否有漏气现象，空气滤清器是否已堵塞，并特别注意热态下空滤至增压器进气口之间的管路再突然加速时是否有被吸扁现象，然后再作进一步的调整或维修。

The injection advance angle of the turbocharged diesel engine should be adjusted strictly in accordance to the directions in the manual. While the diesel engine power is decreasing, first check for leakage in the intake system and see whether the air cleaner has been clogged or not. Pay attention to the flattening of the hose between the air cleaner and turbocharger inlet when suddenly revving a warm engine and then, if necessary, adjust or repair it.

6.凡发现汽车及柴油机工作不正常时，要立即停车及时拆除故障，决不能让汽车带病运行。

Whenever the vehicle or diesel engine experiences a problem, stop it promptly and perform repairs immediately. Forbid running a malfunctioning vehicle.

7. 检查发动机时，不要直接触摸发动机的高温部件（例如排气管），不要停机后马上打开水箱盖，以免烫伤。

When checking the engine, do not touch the high temperature

components (such as the exhaust pipe) directly, and do not open the water tank immediately after stopping the engine to avoid being scalded.

8.凡新机运行达 1500~5000 公里时,须及时到玉柴的委托技术服务站进行走合保养,否则不予实行柴油机的质量保修。

When a new engine has run 1500-2500km, after break-in maintenance should be performed immediately at an authorized technical Yuchai service station, otherwise maintenance can not be implemented under warranty.

9.冷却系统的冷却液必须是防冻液,否则由此引起的质量故障,不予实行三包。

The coolant of the cooling system must be an anti-freeze solution; otherwise, trouble caused by this can not be remedied under warranty.

10.柴油机在气温为 -15°C ~ 40°C ,海拔高度为 2000 米以下(高原机除外)的环境条件下能正常工作,禁止在水浸、火灾环境下工作。在风沙大、粉尘多的环境下,应注意清理空气滤清器滤芯灰尘,滤芯如有破损应马上更新。在气温低于 -15°C 或气温高于 40°C 或海拔高度超过 2000 米时,用户应向玉柴技术、服务部门咨询,采取有效措施以保证柴油机能正常工作。

A diesel engine can run normally only under definite environmental conditions. The required temperature range is from -15°C to 40°C , and the altitude should be below 2000m. It is prohibited to make it run submerged under water and in fire conditions. If the environment is of heavy sand or dust, please pay more attention to cleaning the air filter element and if the filter element is damaged, replace it at once. When the temperature is lower than -15°C or higher than 40°C or the altitude is higher than 2000m, the user should consult with a technical Yuchai

service station and measures should be taken to ensure the normal operation of the engine.

11.正常使用和维护保养柴油机，否则会增加柴油机的噪声、烟度、排放污染物，从而造成环境污染。噪声、烟度、排放污染物增加的主要原因及排除方法在第四章中的第三、第四部分已有说明。

Please operate and maintain the diesel engine correctly. Otherwise, noise, exhaust soot, and pollutant emission of the diesel engine may increase, causing environmental problems.

12 根据包装箱外的注意事项进行吊运、运输，贮存柴油机的环境应通风、干燥、清洁、无腐蚀性物质。

Hoist and transport the engine in accordance with the precautions described on the outside the packaging case. The place for storage of the engine shall be well-ventilated, dry, clean and free of corrosive substances.

13.天气寒冷用户在仿效柴油机冷却水时必须同时打开水箱盖。

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安全警示

- 为了使您的柴油机保持良好的排放，请您注意以下事项：

1. 不得随意扩大发动机的应用范围，如放大发动机油量、提高供油前角及私自改装发动机。
2. 更换喷油器时应把喷油气铜垫和各缸喷油器总成一对一应装好。
3. 柴油率氢气的油水分离器应按使用说明书的要求及时放水。
4. 空气滤清器根据使用情况不定期清理滤芯灰尘，安装滤芯时检查有无破损，如有破损应马上换新件，经空滤后到增压器进气口连接管路及接头卡钻箍应保证绝对密封可靠，否则容易损坏增压器并引起窜油、窜气、烧瓦、抱轴等发动机严重故障。
5. 用户不能有意请油泵维修人员加大油量，更不能自行进行油泵调整。否则非常危险。

● **有可能让您受到伤害的事，千万莫做！**

1. 发动机运行时，不得擦拭、加注润滑油或调整发动机。
2. 宽松的衣服和长发不得解禁移动或转动部件，更不要用手触摸移动或旋转部件！
3. 发动机工作时及工作后 1 小时内，排气管及增压器等零部件表面温度很高，身体不能接触，否则容易烫伤。
4. 在发动机高温时，不得马上打开冷却水箱加注盖，因为危险的高温冷却液将会泄出伤人，柴油机如发生开锅，不要马上停机加冷却水或冷却液，应使柴油机在怠速运行至少 5 分钟以上，然后停机加冷却水，再怠速运行，利用放气开关放气，再停机加液，再怠速，如此反复多次才能加够冷却液，确保安全及柴油机正常工作。
5. 在发动机高温时，或冷却液加压时，不得打开冷却系统的加注盖，因为危险地高温冷却液将会泄出。

● **有可能引起火灾甚至爆炸的事，要牢记心中！**

1. 每天出车前应仔细检查发动机的工作情况，有无漏油、漏气、漏水现象，特别是有漏燃油、机油及排气泄漏时，应及时排

除。

2. 向油箱加注燃油时，不得吸烟或有货源靠近。
3. 发动机及汽车上的电线、油管、橡胶或塑料气管、水管等易燃件不得靠近排气管、增压器等高温或高速旋转部件。转向助力泵油罐、转向泵、方向机只见的连接管路如有漏油应马上排除，橡胶连接管等可燃物距离排气管、增压器等高温部件必须有 100mm 以上的安全距离，并有可靠的隔热措施。
4. 燃油系统高低压管路不允许与硬件相碰撞摩擦，各种电器线路更不允许与高低压油管干涉。
5. 油压感应塞原装为电器线路及仪表，决不允许私自改装为用橡胶或尼龙管路连接机械直通仪表。
6. 排气管及增压器安装部位不允许漏气，垫片破损应即使更换玉柴正宗配件，排气管与消声器连接法兰处决不允许漏气，管路破损不许焊接修理。应马上换新件。
7. 转向助力泵油罐、转向泵、转向方向机只见的连接管路如有漏油应马上排除，橡胶连接管路距排气总管 100 毫米以上。
8. 对于启动马达、充电发电机接线，要求在接线两端加防护套，以便接好线路后可以用防护套罩住接线裸露金属部分。
9. 汽车厂接线时不得把柴油管路、电器线路捆绑在一起固定；如果柴油管路、通气通油管路等捆绑在一起固定，也应在管路建加装隔离、防振防护措施。建议柴油管路、电器线路、通气通油管路等单独固定，固定时应考虑在与其他物体接触时可能导致摩擦破损的部位加装隔离、防振防护措施。

前 言

YC4E(4110)系列柴油机是玉柴机器股份有限公司为满足市场需求而开发的新产品,该机型是在YC6G型柴油机的基础上开发设计的,是轻中型载重骑车及中巴车等理想的配套动力。

YC4E(4110) series engine is a new product that To meet demand and development of the market. It is self developed by Yuchai on the basis of YC6G engine and an excellent choice to power medium bus and light-duty vehicles.

本说明书主要介绍YC4110、YC4E系列柴油机的基本结构和使用保养方面的初步知识,同时,对如何处理柴油机一般常见故障也作了简单的介绍。希望用户在使用柴油机的保养维护工作,保证发动机的正常工作,这样才能确保用户获得最大的经济效益。

The manual presents the technical specifications, the main accessories, the main technical structure and basic knowledge about operating and maintaining of the engine. Meanwhile, it also illustrates some of the primary troubles and troubleshooting methods. The user can understand and master the operation and maintenance of the YC4110 series diesel engine by reading this manual in detail, which would increase its economic benefit.

随着生产的发展和不断满足用户的要求,该系列机型也会不断地改进和提高,除特殊的变型设计和大的结构改进外,本说明书不再作更改,因此过了一定的时间后,说明书的介绍与柴油机的时机结构可

能有一定的出入，请用户给予谅解并加以注意。

Along with the development of the consumer market and production techniques, the diesel engine will be improved and modified continually. In general, the manual will not be changed except for great design modification, and so some contents may differ from the actual diesel engine after a period of time. Please pay special attention to the differences.

另外，由于我公司的柴油机配套的汽车品种波段增加，因此其变型品种也不断增加，本说明书只对基本型详加说明，其余变型产品的改进，本书不再一一列举，请用户给予谅解并加以注意。

Moreover, though the product modifications are increasing continually, the manual only shows the basic type diesel engine and does not enumerate them.

玉柴技术中心负责对本说明书的解释，并由玉柴技术服务中心负责对用户的技术咨询工作。

The technical development center of Yuchai company is responsible for the explanation of the manual, and the technical service center for advising the customers.

玉柴机器股份有限公司
Yuchai Machinery Co. Ltd.

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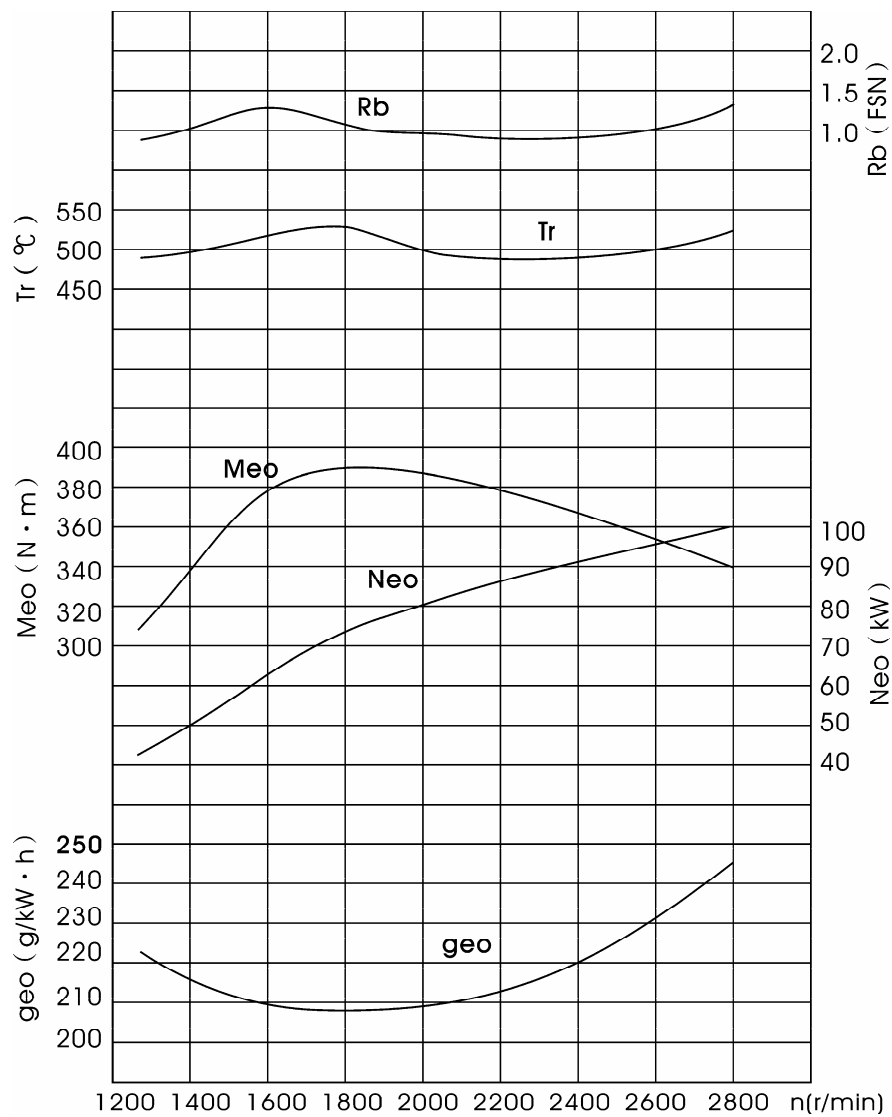
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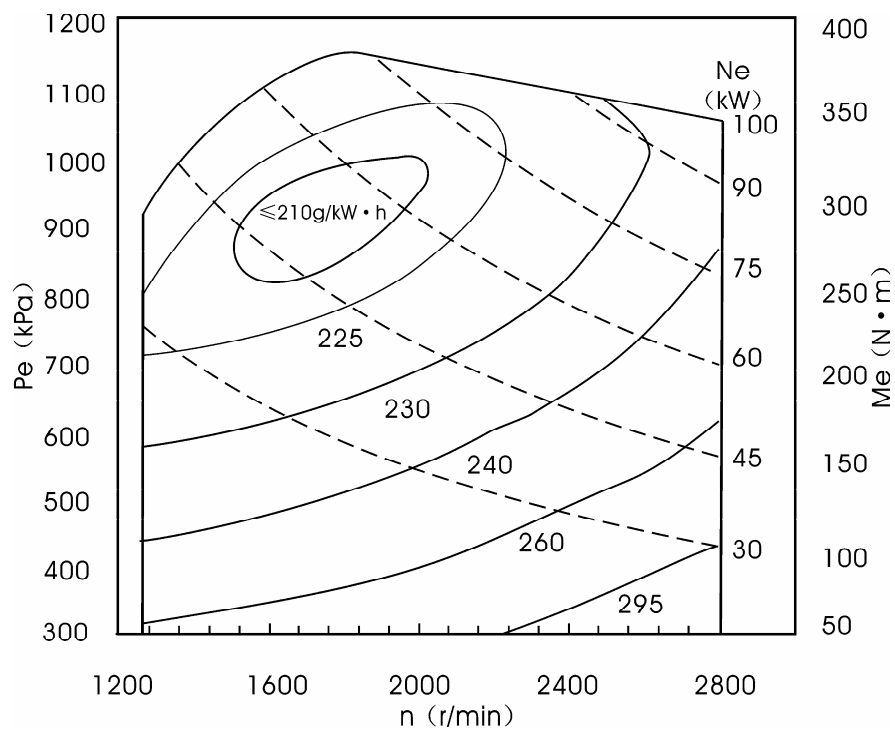
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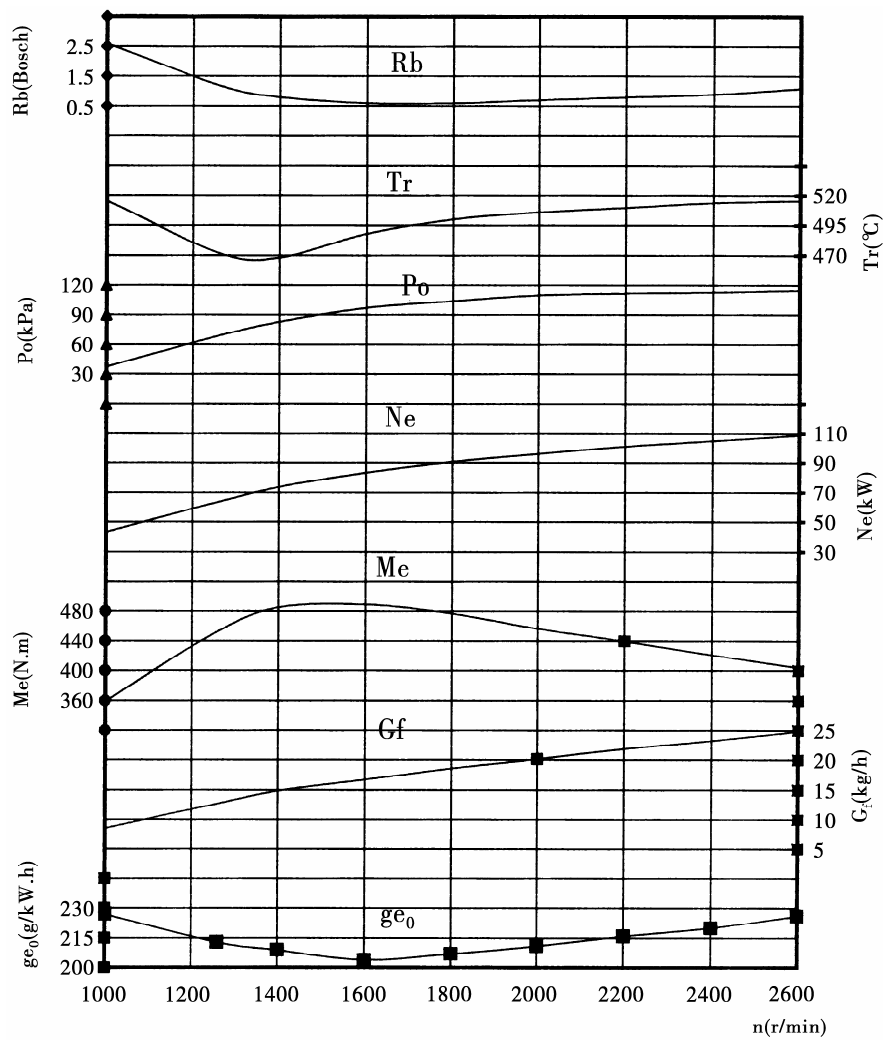
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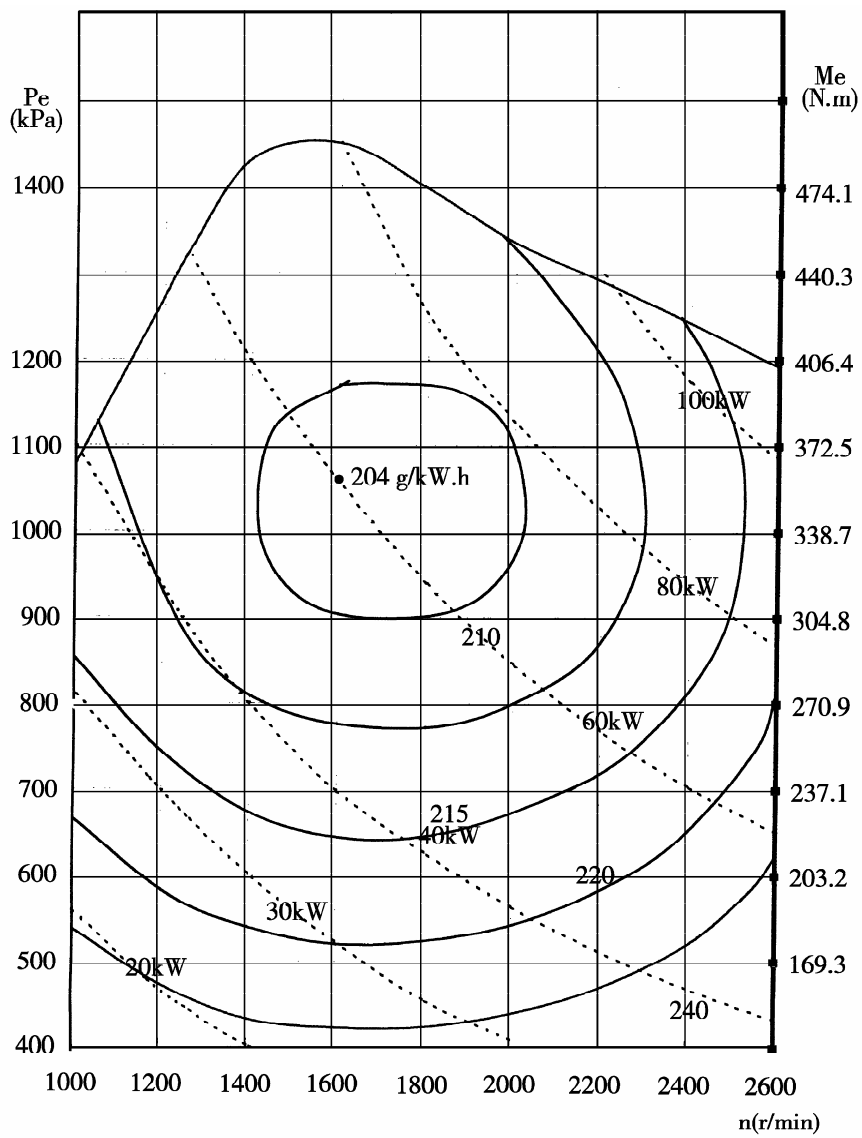
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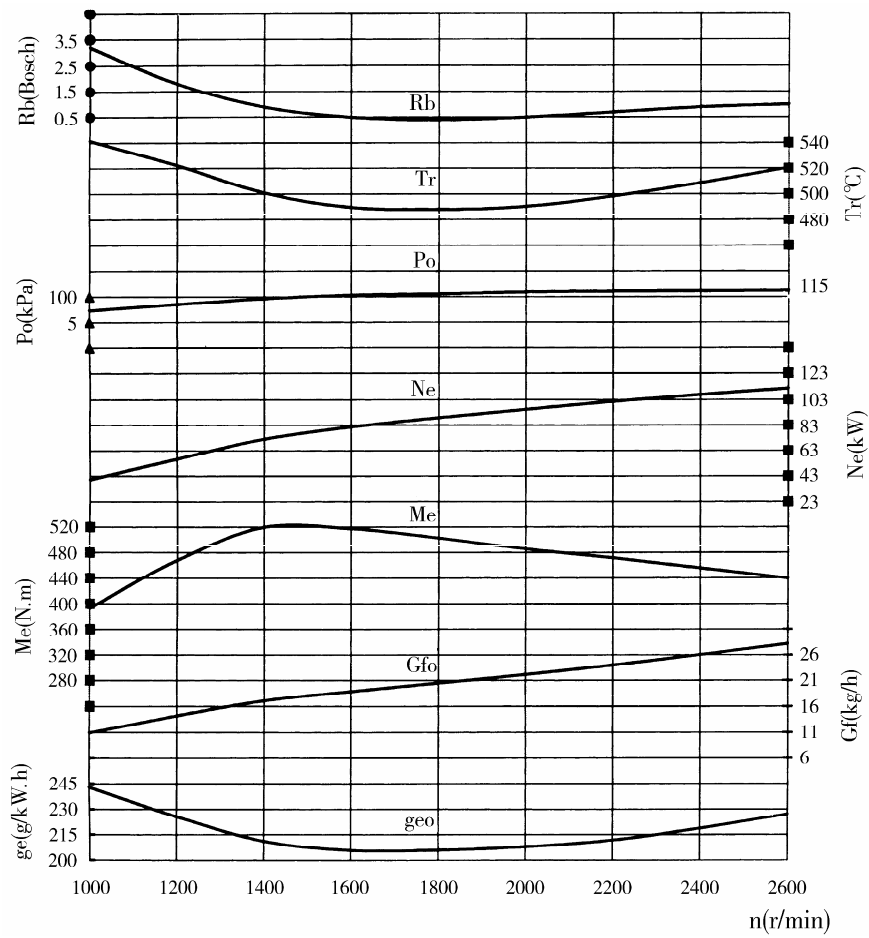
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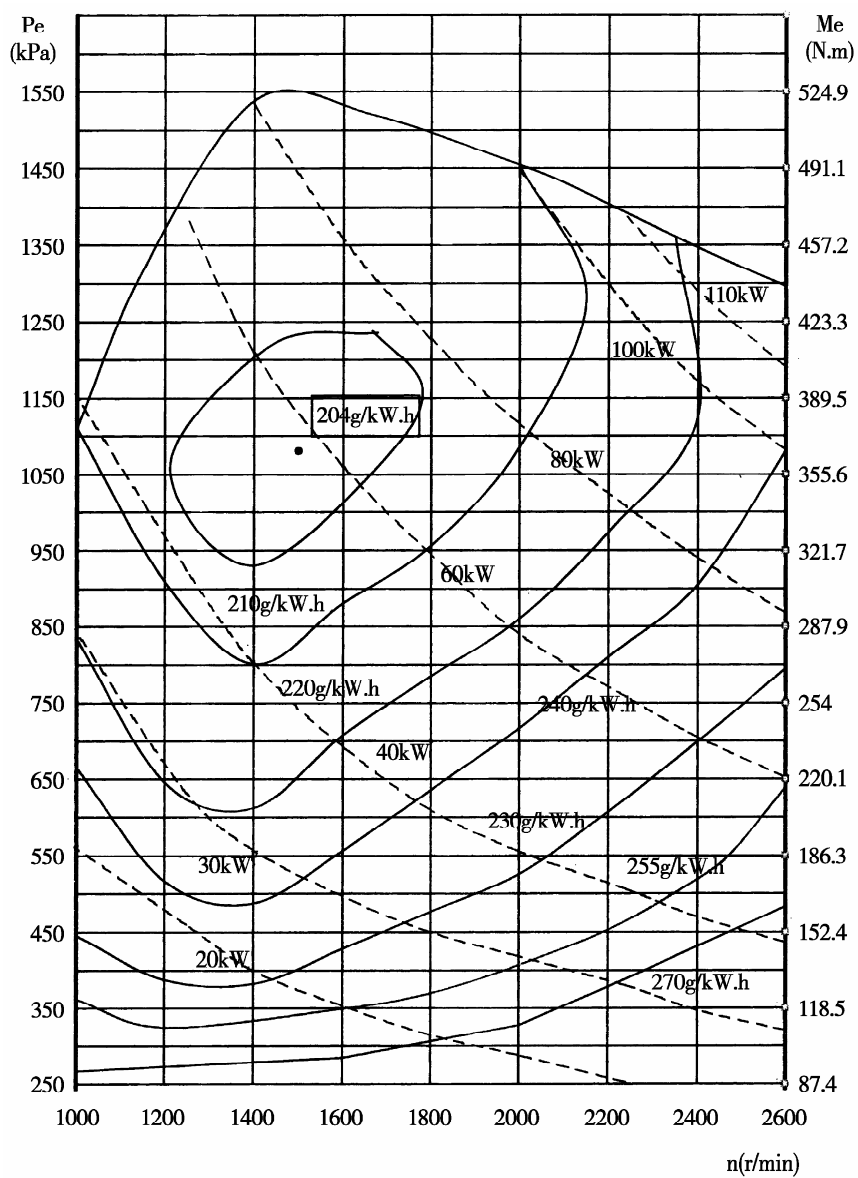
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第一章 YC4E（4110）系列柴油机

YC4E(4110) Series Engine

主要技术规格及主要附件规格

Basic Specification of Engine and Specifications of Main Components

一、 主要技术规格

Basic Specification of Engine

机型 model	YC41 10ZQ	YC4110 ZLQ	YC4E160 —20	YC4E15 —20	YC4E14 0—20	YC4E1 35—20
型式 type	立式、直列、水冷、四冲程					
进 气 方 式 Air intake way	增压 Turbo chargi ng	增压中冷 Turbocharging and inter-cooling				
气缸型式	干式 Dry					
燃烧室型式 Type of combustion chamber	直喷式 Direct injection type					
气缸数 Number of cylinders (piece)	4					
气缸直径(mm) Cylinder bore (mm)	110					

活塞行程(mm) Piston stroke (mm)	112					
活塞总排量(L) Total displacement of pistons (L)	4.257					
压缩比 Compression ratio	17.5: 1					
排放执行指标 Emission	欧 I		欧 II			
标定功率(kW)	100	110	118	110	105	100
标定转速 (r/min) Rated power (kW)	2800	2600; 2800	2600	2600	2800	2800
最大扭矩 (N • m)	392	490; 450	520	490	430430	392
最大扭矩转速 (r/min) Max. torque (N·m)	1600 ~ 1800	≤1700	1400~1600		1600~1800	
全负荷最低燃 油耗 (g/Kw.h) Min. fuel consumption rate at full load (g/ (kW·h)	220	215				

机燃油消耗比 (%) Oil-fuel consumption ratio (%)	≤0.5	≤0.3
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续表

机型 Model code	YC41 10ZQ	YC4110 ZLQ	YC4E160 —20	YC4E15 —20	YC4E14 0—20	YC4E1 35—20
排气温度 (°C) Exhaust temperature (°C)	≤550					
最大烟度 (FSN) Soot (BSU)	≤3.0					
工作顺序 Fire order	1—3—4—2					
曲轴旋转方向 Rotation direction of crankshaft (face to output end)	逆时针 (从飞轮端看) Counterclockwise					
润滑方式 Lubrication system	压力、飞溅混合式 Combination of splash and pressure					
冷却方式 Cooling system	闭式强制循环水冷却 Pressurized circulating liquid cooling					

起动方式 Start system	电起动 Electric	
整机净质量 (kg)	380	
外形尺寸(长× 宽×高)(mm)	847.5×664×843	952.4×702×930.3

注：标定功率、最大扭矩、全负荷最低燃油指进气温度 25℃，进气干空气压 99kPa，水蒸气分压 1 kPa，进气总压 100 kPa 时测量值。如实验时环境温度与此不符时，应按《汽车发动机性能试验办法》中列出的计算公式进行修正，标定功率允差±5%，其他转速下功率允差±6%。

Note: The rated power, max. torque, and Min. specific fuel consumption at full-load refer to the measurement values in the state that the charge temperature is 25℃, dry air pressure is 99kPa, vapor pressure is 1kPa, and the total intake pressure is 100kPa. If the experiment condition is not accordance with these, those should be modified in according to the formula mentioned in The Experiment Measurement of Engine Performance. The rated power tolerance is ±5%, and the power tolerances in other speeds are ±6%.

二、 主要附件的规格及型号

Accessories specifications

- (注：1.除 530 机型的喷油泵以外，其余机型喷油泵型号以龙口厂为准，增压器以上海联信、喷油器以无锡欧亚为准，其余各厂家产品参考排放公告。
2.起动机、发电机、空气压缩机邓福建可因配套不同车型调整)

机型		YC4110 ZQ	YC4110 ZLQ	YC4E160 —20	YC4E1 5—20	YC4E14 0—20	YC4E135 —20
喷 油 泵 Fuel injecti on pump asse mbly	型式 model code	BHT4PA 110R13 04	VE4/12 F1400	BHT4PA110R1304		V4E/12 F1400	BHT4PA1 10R1304
	型号 type	单列柱 塞式 in-line plunge r	轴向柱 塞分配 式 P-type pump	单列柱塞 式 in-line plunger	轴向柱塞分配式 P-type pump		单列柱 塞式 in-line plunger
	柱塞直 径 (mm) plunger diamete r(mm)	Φ 11	Φ 12	Φ 11	Φ 12		Φ 11
	柱塞行 程 (mm) plunger stroke(mm)	11	3.2	11	3.2		11
	出油阀 直径 (mm) delivery valve diamete r(mm)	Φ 7		Φ 7			Φ 7

调速器	型号	TRQKV3 15/140 0PA130 4		TRQKV375 /1400PA1 304	TRQKV 315/1 400PA 1304		TRQKV31 5/1400P A1304
governor type	型式	全程式 mechanical minimum-maximum governor					
输油泵	型式	活塞式	叶片式	活塞式	叶片式	活塞式	
fuel supply pump type	供油压力 fuel supply pressure(MPa)	≥ 0.10					
高压油管	长×外径×内径 (mm) Dimensions (length × width × height) (mm)	590× Φ6× Φ1.8	590× Φ6× Φ1.8	590×Φ6 ×Φ1.8	560×Φ6×Φ1.8		590× Φ6× Φ1.8
	型式	多孔针阀式 P 型					
	喷油器壳体型号	KBEL-P 004D	KBEL-P 004	KBEL-P00 4D	KBEL-P P004	KBE LP- 004 B	KBELP -004 KBE LP-0 04

喷 油 器	机型 mode code	YC4110Z Q	YC411 0ZLQ	YC4E160—20	YC4E15 —20	YC4E140 —20	YC4E 135 —20
	喷油嘴 壳体型 号	DLLA150 P082	DLLA1 48P08 2	DLLA150P082	DLLA148 P153	DLLA139 P005	DLLA 148P 152
	开启压 力(MPa) injection pressur e(MPa)	26±0.1					
	喷孔数	5× Φ0.28	6× Φ0.2 4	5× Φ0.28	6× Φ0.2 4	6× Φ0.25	5× Φ0.2 7 6 × Φ 0. 24
柴油 滤清 器 Fuel filter	型式 type	纸质滤芯旋转式 paper element and rotation					
	型号 model code	2CX0710					
增 压 器 Turbo charg er	型式 type	径流式					
	型号 model code	TB28	GT2559	TB31	GT2559	TB28	GT255 9
机油	型式	纸质滤芯旋转式					

滤清器 Oil filter	型号 model code	JS0818					
机油泵 Oil pump	型式 type	转子式 rotor					
	流量 (L/min)) flow rate(3000rpm, 0.45MPa)(L/min)	转速 3000r/min, 压力 0.45Mpa 时为 65L/min					
水泵 Water pump	型式	机械离心式 axial flow					
	标定转速 (r/min)	3800					
水泵 Water pump	流量 (L/min)) flow rate	260					
水泵 Water pump	扬程 (mH2O)	14					
皮带 Belt	型号 model code	充电机皮带 B960, 水泵皮带 belt B960 for charging generator belt A1200 for water pump					
机型 model code		YC4110Z	YC4110Z	YC4E160—	YC4E15	YC4E140	YC4E1

		Q	LQ	20	—20	—20	35— 20
调 温 器 Th er m os tat	型式 type	腊式 wax					
	型号 model code	EQ145					
	开启温度 （℃） opening temperatur e(℃)	70±2					
	开启温度 （℃） opening temperatur e(℃)	78±2					
起 动 机 St art er	型式 type	直流电机					
	功率（kW） power(kW)	4.8	5.2				
	电压（V） voltage(V)	24					
发 电 机 Ch	型式	永磁式或无刷励磁式					
	型式 model code						
	功率（kW） power(kW)	0.75	1			0.75	1

ar gi ng ge ne rat or	电压 (V) voltage(V)	28			
发 电 机	接地方式 earth connection type	负极搭铁 negative earth terminal			
发 电 机	转向 rotational direction(fr om driving end)	顺时针（从驱动端看） clockwise			
空 气 压 缩 机 Air co m pr es so r	型式 type	永磁式或无刷励磁式			
	型式 type	单缸水冷活塞式 single cylinder air-cooled			
	额定排量 (L/min) flow rate(2000r pm)(L/min)	175	248	175	248
	排气最大压 力 (MPa) working pressure(M ax.)	0.8			

发 电 机	润滑方式	压力强制飞溅润滑
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三、柴油机主要技术数据

Main technical data for diesel engine

1.配气定时（以曲轴转角计）：

Valve timing (at crankshaft angle)

（冷态气门间隙：进气门 0.4mm、排气门 0.45mm 时）

(Cold valve clearance: where intake valve 0.4mm, exhaust valve 0.45mm)

进气提前角： $14^{\circ} \pm 5^{\circ}$

Intake valve advance open angle: $14 \pm 5^{\circ}$

进气滞后角： $44^{\circ} \pm 5^{\circ}$

Intake valve lag close angle: $44 \pm 5^{\circ}$

排气提前角： $56^{\circ} \pm 5^{\circ}$

Exhaust advance angle: $56 \pm 5^{\circ}$

排气滞后角： $12^{\circ} \pm 5^{\circ}$

Exhaust Intake valve lag close angle: $12 \pm 5^{\circ}$

	YC4110ZQ	YC4110 ZLQ	YC4E160- 20	YC4E15 0-20	YC4E1 40
			E0400	E0500	E0800
2.静态供油提前 角：(°CA) Static	11~13	8~10	7~9	7~9	7~9

fuel supply advance angle (before TDC) (° CA)					
3. 喷油器开启压力 (MPa): Fuel nozzle opening pressure(Mpa):	26±0.5	26±0.5	26~27	26~27	26~27

4. 气缸压缩余隙(mm):

Cylinder compression clearance (mm)

0.8~1.2 0.8~1.2

5. 各种主要螺栓拧紧力矩 (N·m) :

Various tightening torque (N.m) of main bolts

气缸盖螺栓: 180~260

Cylinder cover bolt: 180-260

主轴承螺栓: 180~260

Main bearing bolt : 180-260

连杆螺栓: 150~230

Connecting rod bolt: 150-230

飞轮螺栓: 170~220

Flywheel bolt: 170-220

飞轮壳螺栓: M12: 100~120

M16: 140~160

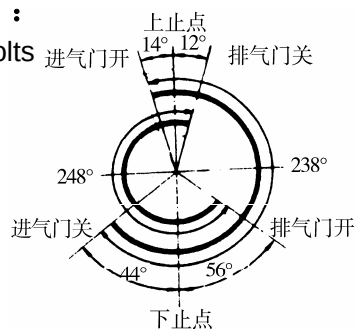


图 1 配齐相位图

6. 调速器控制转速

YC4110ZQ

YC4E (4110ZLQ)

Crucial speed controlled by governor (engine crankshaft):

最低空车转速(r / min): 700~750 700~750

Minimum speed for zero load (r/min): 700--750 700—750

最高空车转速(r / min): ≤3150 ≤3220

≤2950

Maximum speed for zero load (r/min):

(标定 2800(标定 2600r / min 时)r / min 时)

7. 机油压力(Mpa) Oil pressure (MPa)

0.3~0.6 0.3~0.6

8. 各种温度范围 Various temperature range

排气温度(°C): ≤580 ≤550

Exhaust gas temperature(°C):

机油温度(°C): ≤105 ←

Oil temperature(°C):

出水温度(°C): ≤95 ←

Water outlet temperature(°C):

9. 机油容量(L): 18 (其中油底壳 16)

Oil capacity (L): 18 (16 in oil sump)

10. 主要零件配合间隙(详见表 1)

表 1 柴油机主要零件的配合间隙 (或过盈) 表

Main parts fit clearances (shown in Table 1)

Table 1 Main parts fit clearances (interference)

序	配合部位	规定值 Prescribed	配合 Type	配合公差
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号 Ser ial nu mb er	Description	dimensions (mm)	of fit 性质	(mm) Assembly tolerance (mm)
1	排气门座孔/ 排 气 门 座 Exhaust valve seat insert/exhaust valve seat	$\Phi 44_0^{+0.025} / \Phi 44_{+0.10}^{+0.12}$	过盈 interference	0.075~0.12
2	进气门座孔/ 进 气 门 座 Intake valve seat insert/ intake valve seat	$\Phi 50.5+0.03 \quad 0 / \Phi 50.5+0.14 \quad +0.12$	过盈 interference	0.09~0.14
3	气缸盖气门 导管孔/气门 导管 Cylinder head valve	$\Phi 15.9 \quad 0 \quad -0.025 / \Phi 15.9+0.023 \quad +0.013$	过盈 interference	0.013~0.048

	guide hole/valve guild			
4	气门导管孔/ 排气门 Valve guide/exhaust valve stem	$\Phi 9.4+0.095 \ +0.069/ \Phi$ $9.4+0.018 \ +0.001$	径向 间隙 radial clearance	0.051~0.094
5	气门导管孔/ 进气门 Valve guide/intake valve stem	$\Phi 9.4+0.095 \ +0.069/ \Phi$ $9.4+0.044 \ +0.026$	径向 间隙 radial clearance	0.025~0.069
6	气门下沉深 度 Valve recession height	$\Phi 25 \pm 0.02/ \Phi 25-0.04$ -0.07	径向 间隙 radial clearance	0.9 ± 0.15
7	气门摇臂轴 座孔/气门摇 臂轴 Rocker arm seat insert/ rocker arm shaft	$\Phi 110+0.035 \ 0/ \Phi 109.86$ ± 0.0075	径向 间隙 radial clearance	0.020~0.09
8	气缸套/活塞	$\Phi 110+0.035 \ 0 \ / \ \Phi$	径向	0.133~0.175

	裙 下 部 Cylinder sleeve/lower part of piston skirt	109.86±0.0075	间隙 radial clearance	
9	气门挺柱孔/ 气 门 挺 柱 Valve tappet/cylinder block tappet hole	$\Phi 25.146+0.025 \quad 0/ \Phi$ $25.1+0.031 +0.018$	径向 间隙 radial clearance	0.015~0.053
10	凸轮轴承孔/ 凸 轮 轴 衬 套 Camshaft bearing bore in cylinder block /camshaft bearing bush	$\Phi 64.376+0.026 \quad 0/ \Phi$ $64.4+0.102 +0.066$	过盈 clearance	0.064~0.126
11	凸 轮 轴 衬 套 孔/凸 轮 轴 衬 套 Camshaft	$\Phi 60.7+0.070 \quad +0.044/ \Phi$ $60.7-0.032 -0.058$	径向 间隙 radial clearance	0.076~0.128

	bearing bush/camshaft bearing bush			
12	正时惰齿轮 衬套孔/惰轮 轴 Timing idle gear bush/idle gear shaft	$\Phi 50.813+0.025 \quad 0 / \Phi$ $50.813-0.043 -0.056$	径向 间隙 radial clearance	0.043~0.081
13	正时惰齿轮/ 惰 轮 轴 Timing idle gear/idle gear shaft		轴向 间隙 axial clearance	0.05~0.38
14	活塞环槽高/ 第一道气环 高 Top ring groove height/top ring height	$2.695 \pm 0.015 / 2.605 - 0.01$ -0.03	轴向 间隙 axial clearance	0.085~0.135
15	活塞环槽高/ 第二道气环 高 Second	$2.5+0.10$ $+0.08 / 2.5+0.030 +0.015$	轴向 间隙 axial clearance	0.05~0.085

	ring groove height/second ring height			
16	活塞环槽高/ 油环高 Oil ring groove height /oil ring height	3.5+0.04 +0.02/3.5-0.010 -0.025	轴向 间隙 axial clearance	0.03~0.065
17	活塞环压入 Φ 110 00 内径量规内 闭口间隙 End gap when ring inserted in the gauge of Φ 110.00(inner diameter)		第一道气 环 第二道气 环 第三道气 环 first gas ring second gas ring third gas ring	0.40~0.60 0.35~0.55 0.30~0.55
18	连杆大头轴 承孔 (带轴 瓦)/连杆轴颈 Connecting	红 : Φ 66.040~66.075/ Φ 65.985~66.000 蓝 : Φ 66.035~66.070/ Φ 65.970~65.985	径向 间隙 radial clearance	0.04~0.09 0.05~0.10

	rod bearing (with shell)/crankpin			
19	连杆衬套孔/ 活 塞 销 Connecting rod bush/piston pin	4110ZQ/ZLQ Φ 40+0.032 +0.025/ Φ 40 0 -0.006	径向 间隙 interference	0.025~0.038
20	活塞销座孔/ 活塞销 Piston pin/pin boss	4110ZQ/ZLQ Φ 40+0.012 +0.005/ Φ 40 0 -0.006	径向 间隙 radial clearance	0.005~0.018
21	主轴承孔(带 轴瓦)/主轴颈 Cylinder block main bearing (with shell) /crankshaft journal	红 : Φ 85.731~85.765/ Φ 85.644~85.656 蓝 : Φ 85.721~85.751/ Φ 85.631~85.644	径向 间隙 radial clearance	0.075~0.121 0.077~0.120
22	机体气缸套 孔/气缸套外 径 Bore in	红: Φ 115+0.018 0/ Φ 115 0 -0.011	径向 间隙 radial clearance	0.012~0.040 0.018~0.046

	cylinder block for cylinder sleeve/outer diameter of cylinder sleeve	蓝: $\Phi 115+0.035 +0.018/ \Phi$ $115+0.011 0$		
23	曲轴止推面/ 曲轴止推片 Crankshaft thrust face/thrust disk		轴向 间隙 axial clearance	0.10~0.2
24	凸轮轴止推 面/凸轮轴止 推板 Camshaft thrust face /thrust plate	$4.7+0.024 -0.026$	轴向 间隙 axial clearance	0.05~0.22
25	齿轮之间的 啮合侧隙 Backlash of gear in mesh		齿侧 间隙 gear backlash	0.07~0.30

26	进气门与摇臂间隙(冷态) Intake valve/ rocker arm (cold state)		间隙 clearance	0.40 ± 0.05
27	排气门与摇臂间隙(冷态) Exhaust valve/ rocker arm (cold state)		间隙 clearance	0.45 ± 0.05
28	压缩余隙 Compression clearance		间隙 clearance	0.8~1.2
29	上止点时活塞高出机体顶面值 Piston crown over cylinder block top surface at TDC		间隙 clearance	0.20~0.45

30	缸套凸肩高度 The height from the cylinder block surface to the cylinder liner flange top surface			0~0.08
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第二章 柴油机的基本结构及维护方法

Fundamental structure and maintenance

一、 气缸体

Cylinder block

气缸体采用整体式龙门结构，机体裙部采用曲面设计，布置了合理的加强筋，与油底壳的结合面较宽。整个气缸体有足够的强度和刚度。

The cylinder block uses an integral portal shaped structure and is made of the alloy grey cast iron and strengthened with equally spaced reinforced ribs. The whole cylinder block has adequate strength and

rigidity due to its wider junction plane with oil sump.

气缸体采用干式缸套结构，缸套与缸孔之间采用间隙配合，并分组装配。

The cylinder block matched with dry liner which is fastened in the cylinder bore through interference fit and assembled in group to guarantee the heat transfer well.

气缸体顶面有 18 个螺孔，通过这些螺孔固定气缸盖。底面有安装主轴承盖的螺栓孔。主轴承盖装配须对号入座，主轴承盖上的箭头指向发动机前端，不允许互相调换或装错方向。安装主轴承螺栓时，不允许一次拧紧到位，应从中间档开始，依次向两端分三次均匀拧紧。

There are 18 threaded holes in the top surface used to fasten the cylinder head by cylinder head bolts. The threaded holes in the bottom of the cylinder block are used for mounting the main bearing covers which should in their own shoes, and the arrows on them should point to the front end of the engine. Exchange and mis-direction are not allowed. Main bearing bolts should be evenly tightened for both ends by turns in three times:

第一次拧紧力矩：60N · m ~ 80N · m

Tightening torque for the first time: 60N · m ~ 80N · m

第二次拧紧力矩：120N · m ~ 140N · m

Tightening torque for the second time: 120N · m ~ 140N · m

第三次拧紧力矩：180N · m ~ 260N · m

Tightening torque for the third time: $180\text{N} \cdot \text{m} \sim 260\text{N} \cdot \text{m}$

每拧紧一次，应回转曲轴，以检查其灵活性。

After each tightening, rotate the crankshaft to check for its flexibility.

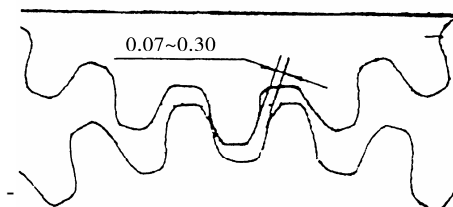
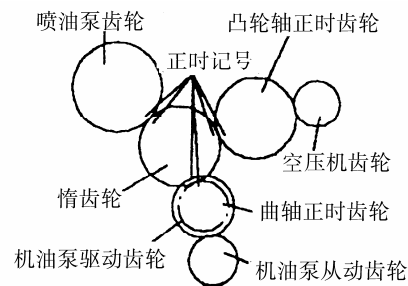
机体上装有活塞冷却喷钩。

气缸体右侧(从前端看)装有排气管、空压机、机油冷却器、机油滤清器。左侧装有进气管、喷油泵、起动机、发电机等。The exhaust manifold, turbocharger, air compressor, bottom ventilator, and oil cooler are mounted on the right of the cylinder block (as seen from the front of the cylinder block). The intake manifold, generator, injection pump and starting motor are mounted on the left.

气缸体前端面是正时齿轮室，室内装有正时齿轮、机油泵等。齿轮室采用齿轮室盖板加齿轮室结构。齿轮室上装有止点指针，减振器上打有刻度标志，用来检查供油正时和配气正时。齿轮安装时对准装配记号，以免影响使用性能。齿轮侧向间隙要求为 $0.07 \sim 0.3\text{mm}$ (图

2)。

In the front of the cylinder block is the timing gear housing containing the timing gear. There is cover on it. The marks on the timing gear housing and damper are used to check fuel



supply timing and valve timing. During gear installation, the marks must be aligned to prevent affecting the engine performance, and the gear backlash should be set to be between 0.07~0.30mm

气缸体后端装有飞轮壳、飞轮、曲轴后油封座、离合器等。气缸体的下部装有储存润滑油的油底壳。油底壳横跨于正时齿轮室后油封座之间。

The flywheel housing, crankshaft rear seal retainer and clutch are mounted on the back of the cylinder block. The oil pan to store lubricating oil is mounted on the bottom of the cylinder block. It is spanned between the timing gear housing and rear oil seal.

图 2 齿轮系级齿轮间隙

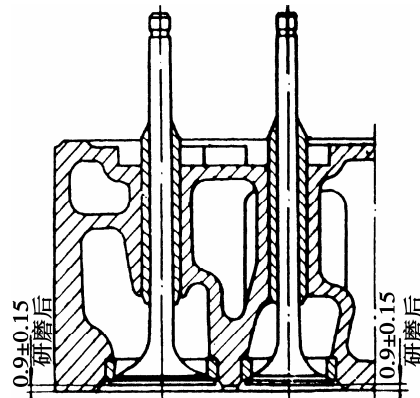
二、 气缸盖与配气机构

Cylinder head and valve train

气缸盖采用四缸一盖整体式结构，结构紧凑。每缸设有进排气门各一个，进、排气道分置两侧，这样可以防止进气加热。按直喷式燃烧系统的要求，进气道为螺旋气道。喷油器安装于进气道一侧。在进排气门与喷油器之间的高温区，设有专门喷水孔冷却，使缸盖底面温度分布趋向均匀。气缸盖底面的进排气口装有高强度耐

热钢制成的气门座圈，磨损后可以更换。气门装入气缸盖后，气门与气门座进行研磨，研磨后密封带宽度为 $2.12 \pm 0.5\text{mm}$ ，气门下沉量为 $0.9 \pm 0.15\text{mm}$ (图 3)。

The cylinder head appears as an integral structure. Every cylinder has one intake valve and one



exhaust valve, and intake and exhaust ports are arranged on opposite sides of the cylinder head respectively to prevent heating up the charge. As required by the direct injection combustion system, the intake port should be spirality. Injectors are mounted on the side of the intake ports. Special cooling spray water hole are designed in the high temperature area which is between the intake valve and injector to make the temperature of the bottom of the cylinder head distribute well. Valve seat inserts made of high quality heat resistant steel are mounted in the intake and exhaust ports of the cylinder head to form durable valve-seat pairs and can be replaced after wearing out. The valves rub with valve seats after installed into the cylinder head, which can produce seal zones whose width is $2.12 \pm 0.5\text{mm}$. The recession height after valves are installed on the cylinder head is $0.9 \pm 0.15\text{mm}$.

图 3 气门下沉量检查

气门导管也可以更换。
为了防止机油从气门导管间隙中进入气道，在气门导管上方装有密封装置。为保证使用性能，气门导管压入气缸盖后，保证导管顶面至气门弹簧座面的距离为 20.3 ± 0.6 mm(图 4)。

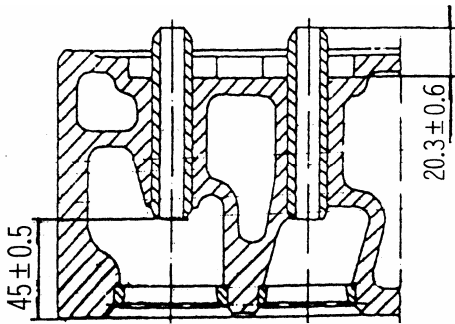


图 4 气门导管安装

The valve guides can also be replaced. Valve stem seals are mounted at the top of the valve guides to prevent oil from entering the intake ports from the valve guide clearance. After the valve guide pressing into the cylinder head, the distance between the valve guide top surface and valve spring seat surface should be 20.3 ± 0.6 mm for guaranteeing the performance,

气缸盖螺栓按每缸 6 只布置，每两缸之间有两只螺栓共用，共 18 只(其中 5 只长螺栓同时起固定摇臂轴支座的作用)。
There are 18 cylinder head bolts, 6 bolts per cylinder, 2 of which are shared by the two neighboring cylinders. Among these bolts, 5 longer bolts are also used to fix the rocker arm supports.

由于气缸盖螺栓所受的预紧力较大，为减少变形，保证密封

+14	+6	+3	+11	
+18	+10	+1	+7	+15
+16	+8	+2	+9	+17
+12	+4	+5	+13	

可靠，对气缸盖螺栓拧紧力矩的大小及顺序应予严格控制，其最后拧紧力矩为 $180\sim 260\text{N}\cdot\text{m}$ ，注意需分三次均匀拧紧(图 5)。

Because cylinder head bolt bears a larger pretightening force, magnitude and sequence of tightening torque of cylinder head bolts should be strictly controlled to reduce deformation and ensure reliable sealing. The cylinder head bolt should be tightened by hand first and then tightened in place by using a torque wrench or wrench; it is not allowed for the bolt to have any interference with the cylinder head bolt hole. The last time cylinder head bolts should be tightened to a torque of between $180\sim 260\text{N}\cdot\text{m}$.

第一次： $60\sim 80\text{N}\cdot\text{m}$

First time, tighten it to $60\sim 80\text{N}\cdot\text{m}$

第二次： $120\sim 140\text{N}\cdot\text{m}$

Second time, tighten it to $120\sim 140\text{N}\cdot\text{m}$

第三次： $180\sim 260\text{N}\cdot\text{m}$

Third time, tighten it to $180\sim 260\text{N}\cdot\text{m}$

图 5 缸盖螺栓拧紧顺序图

气缸垫置于气缸盖底面与气缸体顶面之间。在气缸盖螺栓拧紧后，与气缸盖底面、活塞顶部等组成燃烧室，同时对循环冷却水和机油起密封的作用。

The cylinder gasket is located between the bottom of the cylinder head

and the top of the cylinder block. After the cylinder head bolts are tightened, the gasket with the bottom of the cylinder head and the top of piston forms the combustion chamber , and seals cooling water and oil.

本机采用顶置式气门机构，由气门组和气门传动组构成。气门组包括气门、气门内外弹簧、气门锁夹、气门杆油封、气门导管、气门弹簧座(图 6)；气门传动组包括凸轮轴、挺柱、推杆、摇臂、凸轮轴正时齿轮等零件。其部分装配关系见下页（图 7）。

The engine overhead valve mechanism is composed of the valve assembly and its driving train. The valve assembly includes the valves, valve springs, spring seats, and lock halves and so on, as seen in Figure 6, as well as valve stem seals, valve guides and valve seats. The valve driving train contains the camshaft, tappet, push rod, rocker arm, and camshaft timing gear. Their relationship is shown in Figure 7.

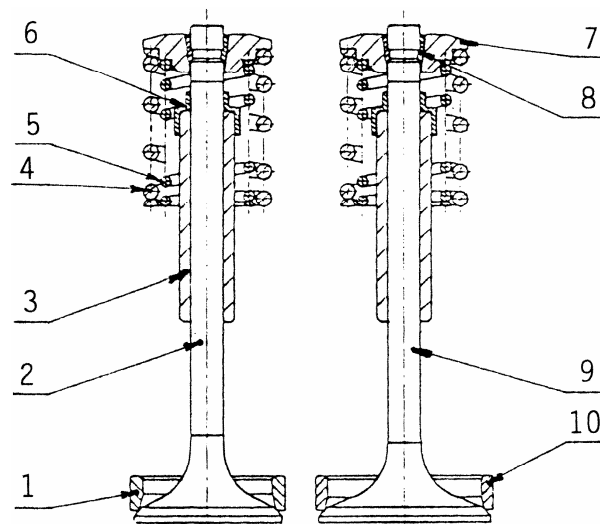


图6 进、排气门结构

1. 排气门座 2. 排气门 3. 气门导管 4. 气门外弹簧 5. 气门内弹簧
6. 气门杆油封 7. 气门弹簧上座 8. 气门锁夹 9. 进气门 10. 进气门座

Figure 6 intake valve and exhaust valve

- 1, exhaust valve seat; 2, exhaust valve; 3, valve guide; 4, valve outer spring; 5, valve inner spring; 6, valve stem oil seal; 7, valve spring upper retainer; 8, valve locker; 9, intake valve; 10, intake valve seat

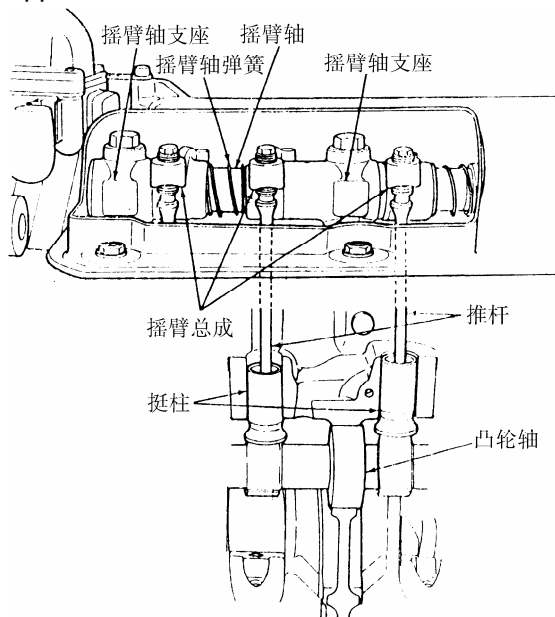
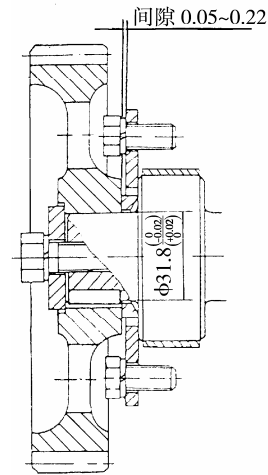


图7 摇臂、推杆与挺柱

Figure 7 Rocker arm, push rod and tappet

凸轮轴为全支承下置式结构，凸轮表面采用冷激处理。第 I 道凸轮轴衬套上有输送机油至气缸盖的油孔，装配时应注意保持油道畅通。凸轮轴的轴向间隙靠止推片来控制，其值为 0.05～0.22mm，应注意止推片内装有隔套，其有大倒角的一面装配时应朝向凸轮轴轴颈。(见图 8)

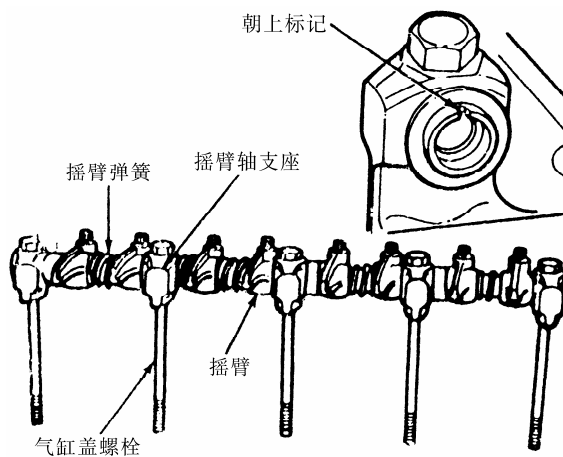


The side arranged camshaft is of fully supported structure and cold quenched on the cam lobe surface. There is a hole in the first bushing to deliver oil to the cylinder head, so it is important to make sure the oil passage is unobstructed during installation. The axial clearance of the camshaft controlled by thrust washer must be between 0.05~0.22mm. The thrust washer has a spacer in it. During installation, the face with the big chamfer should be towards the camshaft journal, Figure 8.

图 8 凸轮轴前端装置图

Figure 8 Components in front of the camshaft

摇臂轴为整体式，支撑在 5 个摇臂支座上，应注意，摇臂轴的一端有一个作为标记的槽口，装配时应注意使该槽口朝上，并以这一端作为摇臂的前端。摇臂轴上的孔和油槽应朝下，见



(图 9)。

图 9 摇臂和摇臂支座

Figure 9 Rocker arms and rocker arm shaft supports

The rocker arm shaft is integral and supported on 5 rocker arm shaft supports. There is a groove mark on one end of the shaft which should be upward and taken as the front end during assembly. The oil holes and grooves on the shaft should be downward

拆装气门弹簧时要使用专用工具见 (图 10)。

Dismantling and installing valve springs requires use of a special tool, shown in Figure 10

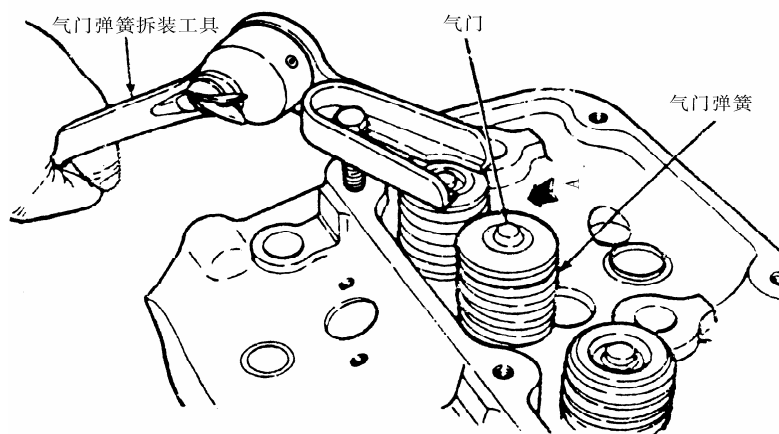


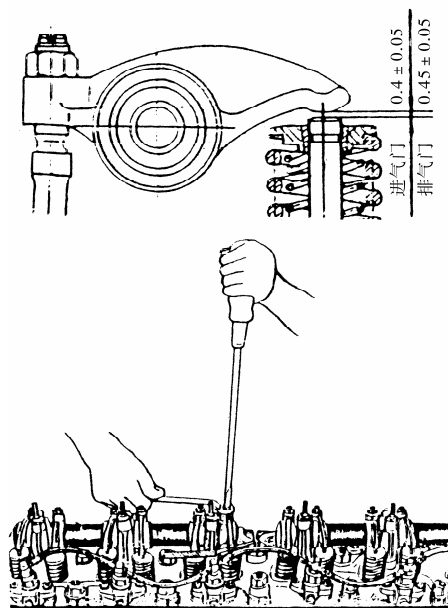
图 10 气门弹簧的拆装

Figure 10 Removal and installation of the valve springs

为保证柴油机的正常工作状态，用户应按要求定期检查调整气门间隙。在冷态时，进气门的间隙为 $0.4 \pm 0.05\text{mm}$ 。排气门的间隙为 $0.45 \pm 0.05\text{mm}$ 。气门间隙检查调整的方法是：把曲轴转到第一缸压缩上止点位置，此时可检查调整第 1、2、3、6 气门，再把曲轴转过 360° ，此时，可检查调整第 4、5、7、8 气门，气门间隙的调整可通过调整螺钉来实现，调整时先把锁紧螺母拧松，用起子把气门调整螺钉按需要旋进或旋出，然后用厚薄规检查摇臂与气门端的间隙，符合要求后拧紧锁紧螺母 (图 11)。

In order to ensure the diesel engine work normally, the valve clearances should be checked and adjusted in regular. When the engine is in a cold state, the intake valve clearance is $0.4 \pm 0.05\text{mm}$,

and the exhaust valve clearance is 0.45 ± 0.05 mm. The method of checking and adjusting valve clearances is as follows: Rotate the crankshaft to the position that the first piston is on the compression TDC, when the No. 1,2,3 and 6 valves can be adjusted; and then rotate the crankshaft 360° , when the No. 4,5,7 and 8 valves can be adjusted. The adjustment can be achieved by adjusting bolts. First, loose the tightening nut of the adjustment bolt and screw the adjustment bolt out and in. Then check the clearance between rocker arm and the end of valve stem with feeler gauge. If it is accordance with the requirement, fasten the tightening nut, Figure 11.



气缸盖罩顶面设有加机油口和呼吸器。进气管为铸铝件，进气管垫片为整体式，更换垫片时，要将缸盖和进气管的相应部位清洗干净。排气管为整体式铸铁件，支管垫片为4片。

There is a hole on the cylinder head cover top surface for adding oil and a crankcase ventilation pipe on the side of the cylinder block. The intake manifold is made of cast aluminum. Its gasket is integral. When it is replaced, the corresponding surfaces on the cylinder head and intake manifold should be cleaned. The exhaust manifold is of integral cast aluminium construction and has 4 gaskets to the cylinder head.

图 11 气门间隙的检查及调整

Figure 11 Checking and adjustment of the valve clearance

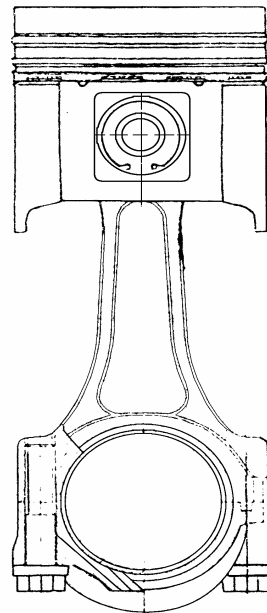
三、 曲柄连杆机构

Crankshaft-connecting rod mechanism

活塞与活塞销采用间隙配合，装配时，将连杆小头置于活塞两销孔中间，把销装入销孔内，用软金属锤轻轻敲打。装入后活塞与连杆应能摇动自如，无阻滞现象。

The piston and piston pin are clearance fit. Position the small end with a soft metal hammer, and then insert the piston pin into the pin bore and tap it lightly. Make sure the piston and connecting rod wiggle smoothly after installation.

活塞连杆组装入缸套时，活塞顶部箭头必须指向发动机前端，连杆螺栓的拧紧力矩为 $150 \sim 230 \text{ N} \cdot \text{m}$ ，需分三次均匀拧紧(图 12)。上紧后应保证曲轴转动灵活。每个活塞上装有两道气环和一道油环，第一道为梯形环，具有很好的抗粘结卡环效果，第二道为锥面环，具有很好的封气封油效果。安装时活塞环



上有标记“TOP”的一面向上，第三道为螺旋胀圈式组合油环。为保证密封性能，活塞环的轴向间隙及闭口间隙必须符合表 1 的规定。闭口间隙测量的方法是将活塞环平放入气缸套孔内(可用活塞推平)用厚薄规测量环的闭口处间隙(图 13)。

During installing the piston-connecting rod assembly into the liner, the arrow on the piston top should point to the front end of the engine. The tightening torque of connecting-rod bolt is between 150~230N.m, and should be tightened in three steps (Figure 13). Make sure the crankshaft rotates freely after tightening.

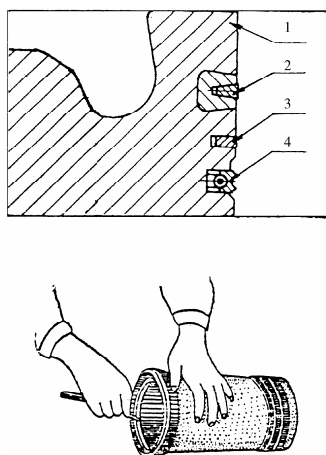


图 12 活塞连杆图

Figure 12 Piston- connecting rod assembly

图 13 活塞的安装及闭口间隙的测量

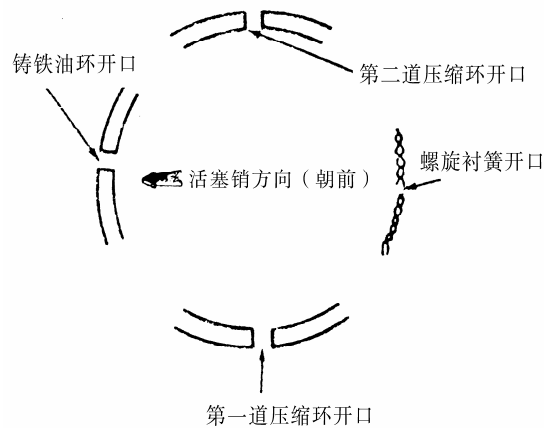
1. 活塞
2. 第一道气环
3. 第二道气环
4. 油环

Figure 14 Installation of the piston and measurement of the piston ring end clearance

1, piston; 2, top compression ring; 3, second compression ring; 4, oil ring

活塞连杆组装入缸套时，活塞环开口应置于规定的位置(图 14)，以保证密封性能。活塞环的印记应在活塞环开口的左侧。活塞通过活塞冷却喷钩喷机油冷却，它可保证活塞有效的冷却而不至于过热。注意不可拆掉活塞冷却喷钩不用。

During piston-connecting rod assembly installation, the orientation of the piston ring gap is shown in Figure 15, which can guarantee good sealability. The mark of piston ring



should be in the left of the ring gap. The piston is cooled by oil sprayed by the piston cooling nozzle, which can prevent the piston overheating. Do not remove the piston cooling nozzle. There is one cooling nozzle per cylinder in normal engine, but two in turbocharged engine.

曲轴中间档装有止推轴瓦，防止曲轴前后窜动，必须保证曲轴轴向间隙为 $0.07 \sim 0.2\text{mm}$ (图 15) 。 The crankshaft idle gear has a thrust shell to prevent the crankshaft from endwise movement. The axial clearance of the crankshaft must be between $0.07\sim 0.2\text{mm}$, Figure 15.

图 14 活塞环开口方向

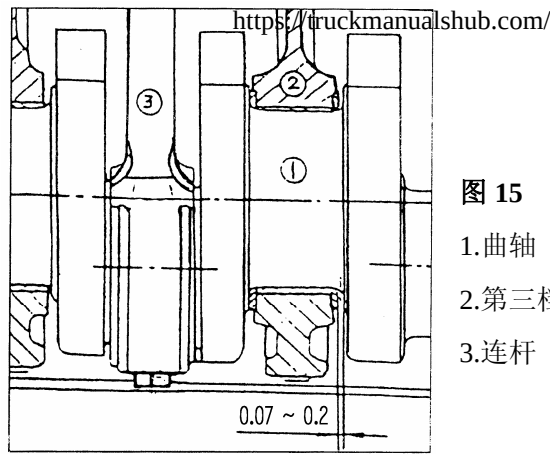


图 15 曲轴轴向间隙图

- 1.曲轴
- 2.第三档主轴承
- 3.连杆

Figure 15 Crankshaft axial clearance

1, crankshaft; 2, the third main rearing; 3, connecting rod

曲轴后油封装在后油封座内。后油封座装在气缸体后端面，在垫片的相应部位涂上密封胶，见（图 16）后油封装好之后，按（图 17）的顺序拧紧螺栓，分两次拧紧，第一次至 $8 \sim 11 \text{ N} \cdot \text{m}$ ，第二次至 $12 \sim 20 \text{ N} \cdot \text{m}$ ，装后油封时要使用专用工具，见（图 16）。

The rear oil seal is mounted in the rear oil seal bracket which is on the rear end of the cylinder block. Sealant should be spread on the corresponding bracket gasket, Figure 16. After the installation of the rear oil seal assembly, tighten the bolts following the order shown in Figure 18 in two steps. First, tighten all bolts to $8 \sim 11 \text{ N} \cdot \text{m}$ and, once this is done, then tighten all bolts again to $12 \sim 20 \text{ N} \cdot \text{m}$. Special tools should be used during installation, Figure 17.

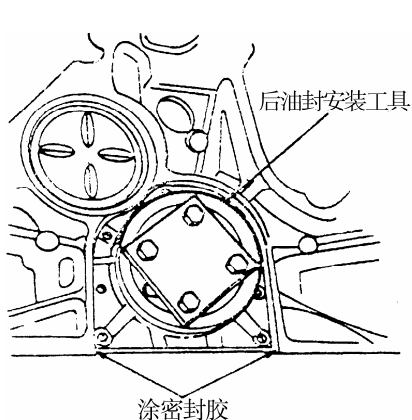


图 16 曲轴后油封座垫片的涂胶

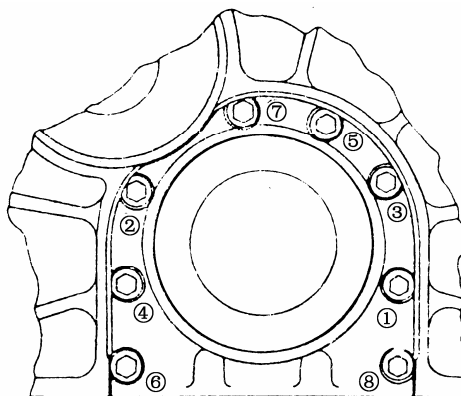


图 17 后油封座螺栓的拧紧顺序

Figure 16 Position of spreading sealant on crankshaft rear seal bracket gasket and tool for installing rear seal
Figure 17 Tightening order of rear seal bracket bolts

飞轮以 7 只螺栓固定在曲轴后端的安装法兰上，飞轮螺栓应以对角交叉分多次均匀拧紧，拧紧力矩为 $170\sim 220\text{N}\cdot\text{m}$ 。

The flywheel is fixed on the rear end flange of the crankshaft with 7 bolts. The bolts should be tightened in several times in a cross sequence. The tightening torque is between $170\sim 220\text{N}\cdot\text{m}$.

离合器为膜片弹簧离合器或螺旋弹簧离合器。

The clutch is a diaphragm spring clutch or coil spring clutch.

曲轴皮带轮减振器与曲轴前端为过盈配合，螺栓拧紧力矩为 $270\sim 300\text{N}\cdot\text{m}$ 。

The crankshaft belt pulley damper and the front end of crankshaft are clearance fit, the tightening torque of bolts is between $270\sim 300\text{N}\cdot\text{m}$.

四、燃油供给系统

Fuel system

燃油供给系统的功用是根据柴油机的工作要求定时、定量、定压地将柴油以雾化的状态按一定的供油规律喷入气缸内，并使其与空气迅速而良好地混合和燃烧。它的工作情况对柴油机的动力性和经济性有着重要的影响。柴油机夏季使用 0 号、10 号，冬季使用 0 号、-10 号、-20 号、-35 号，(GB252 一级品或优级品)轻柴油。

The diesel fuel system must inject the right amount of clean fuel to each cylinder at the correct time with a controlled rate and pressure, adequately atomize the fuel and rapidly mix it with the air in the cylinder for good combustion. The diesel power output, fuel economy, noise and emissions (including exhaust soot) are all dependent on the fuel system. YC4110 series diesel engines use 0#, 10# fuel in summer, and 0#, -10#, -20#, -35# (GB252— first grade or high-quality grade) light diesel fuel in winter.

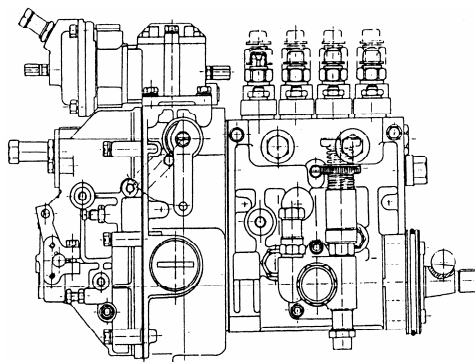


图 18 : P 性喷油泵外型结构示意图

Figure 18 Outline of A-type fuel injection pump

柴油机喷油泵为 P 型泵或分配泵，P 型泵其外形结构如图 18 所示。分配泵使用说明见附录一。使用时应注意：

(1)放完油泵内腔空气。

De-aerate in the fuel injection pump should be completed

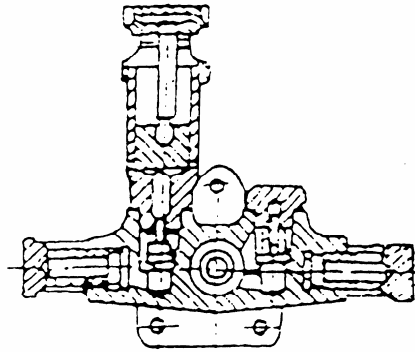
(2)检查供油提前角是否正确，若不正确需调整。

Check whether the fuel supply advance angle is correct, and adjust it if necessary.

(3)检查断油装置是否起作用，若不起作用需妥善修复。

Check whether the fuel cut-off device works, and repair it properly if necessary.

YC4110ZQ 柴油机静态供油提前角为 $11 \sim 13^\circ \text{CA}$ ，YC4110ZLQ 柴油机为 $8 \sim 10^\circ \text{CA}$ 。提前角不符时应进行调整，检查提前角时，松开第一缸高压油管与油泵的连接螺母，慢慢转动曲轴，当出油阀紧帽中的油面开始波动时即停止转动曲轴，此时定时指针在减振器定时刻度上的指示值即为供油提前角度。



The static fuel supply advance angle of the YC4110Q is $11 \pm 2^\circ \text{CA}$, that of the YC4110ZLQ is $8^\circ \sim 10^\circ \text{CA}$. The static fuel supply advance angle should be adjusted if

necessary. When checking the advance angle, Unscrew the nut which connects the high pressure fuel line for the No.1 cylinder and fuel injection pump, crank the crankshaft slowly until the fuel level in the delivery valve holder begins to fluctuate. At this time, the timing value indicated by the pointer on the gear housing and the dial on the belt pulley damper is the fuel supply advance angle.

图 19 输油泵结构图 Figure 19 Outline of P-type fuel injection pump

输油泵的结构如图 19，输油泵上设有手动驱动装置，用来排除燃油管路的空气，使用时拧转手柄紧帽，手柄即会升起，然后向下压手柄，如此往复运动，即能从油箱里吸取柴油供给油路各油腔，同时松开放气螺塞，排除空气，使用完毕，应将手柄紧帽旋紧，以免柴油机工作时 空气进入供油系中，另外，进油接头螺栓内有一小滤网，用了一段时间后应取下清洗，以免因堵塞而影响供油。

The construction of the fuel supply pump is shown in Figure 19. The hand priming pump on the fuel injection pump aims to de-aerate in the fuel line. The process is as follows: unscrew the locking nut for the knob, and the knob will lift, then press the knob repeatedly in order to suck fuel from fuel tank to all fuel passages and chambers. At the same time, loose the de-aeration bolt to let out the air. At last screw the locking nut for the knob to avoid the air entering into the fuel supply system during the engine operation. Meanwhile there is a small strainer

in the inlet fuel line joint bolt. After a period of time, remove and clean it in order not to detriment the fuel supply because of clogging.

YC4110ZQ 柴油机使用的是 R801 全程式调速器(见图 20), 调速器及冒烟限制器上的调整螺钉均有铅封, 发生故障时用户不能拆除铅封自主调整, 应送交玉柴在各地的维修中心。

The adjusting bolts for governor and soot limiter on the YC4110ZQ engines is of lead sealing before their leaving the manufacturer. Users should not remove the lead sealing and adjust them freely, otherwise the engine's operation will be detriment, Figure 20.

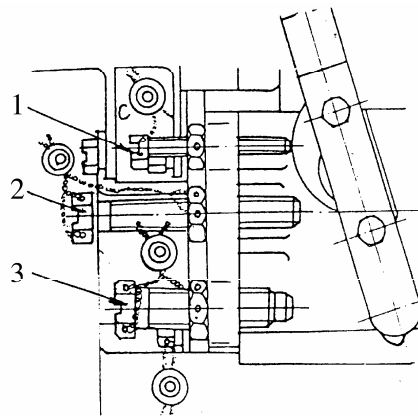


图 20 油门限位

1.怠速限位

2.二级油门限位

3.全油门开

注: 柴油机工作 70 小时或汽车行驶 2500 公里后把二级油门限位螺钉退除

Figure 20 Control lever's limiting position

1. idle position; 2. second grade position; 3. maximum position

Note: After 70 hours or 2500km of the engine operation, quit the bolt used to limit the second grade position for the control lever

冒烟限制器(或称增压补偿器)通过真空补偿管路与进气管

联接，限制发动机低转速时增压器低增压压力期间的燃油量，使供油量与燃烧室的有效空气量密切配合，以确保烟度不超标，而又能发出足够大的动力。结构见（图 21），当增压压力下降时，弹簧推动膜片，沿减油方向拉动控制拉杆，这样就限制了发动机的供油量。注意真空管路不能随意拆除或有堵塞和穿孔现象，否则将影响柴油机的正常使用。

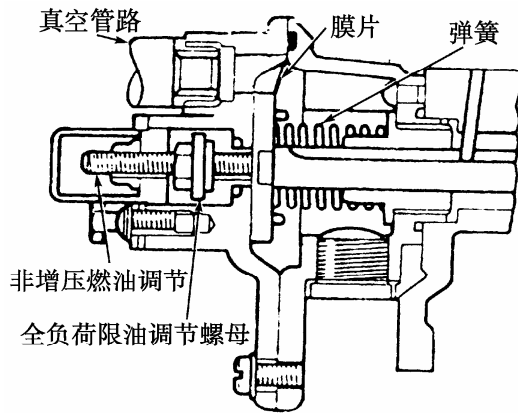


图 21 冒烟限制器

YC4110ZLQ 柴油机调速器为 RQV-K 型机械全程式调速器，结构见（图 22）。

该调速器能稳定怠速和限制超速，而且能自动调节油量，控制柴油机在允许转速范围内的任何转速下稳定地工作。各种转速下的油量控制，是通过摇臂与全负荷限位块的不同位置的接触实现的。调速器发生故障时，不宜自行拆修，应及时送交玉柴维修站。

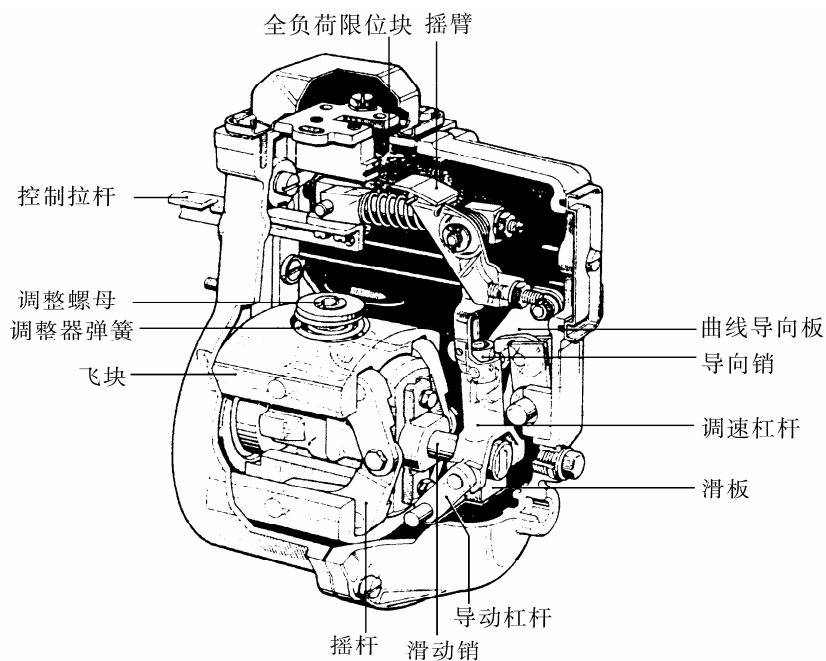
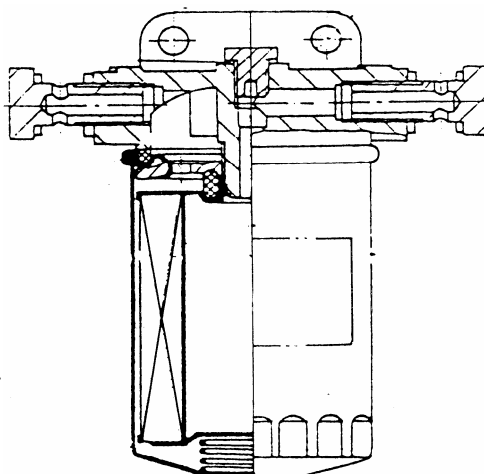


图 22 RQV - K 调速器

柴油滤清器为纸质滤芯旋装式，如图 23。汽车每行驶 10000 公里(或每累计工作时间 250 小时)，应更换柴油滤器整体滤芯，以免因滤芯阻力过大而引起供油不足。安装柴油滤器时，先用清洁的柴油加满新的滤清器，以免因燃油系中进入空气，引起起动困难，运转不



稳。然后用少量清洁的机油润滑橡胶密封圈，再安装滤清器。特别注意：应同时更换汽车底盘上燃油箱之后的初级柴油滤清器滤芯。

The fuel filter is of paper element rotation type, Figure 23. The whole filter element should be replaced every 100000km (or accumulated 250 hours) in order to avoid the insufficient fuel supply with too large resistance through the element. During the installation of the fuel filter, fill with the filter with clean fuel to prevent the air from entering the fuel supply system, thus making the engine start difficultly and run unstably. Then lubricate the seal ring with little clean fuel and install the filter. Pay special attention to this: the element of the first fuel filter which locates after the fuel tank on the vehicle chassis should be replaced at the same time.

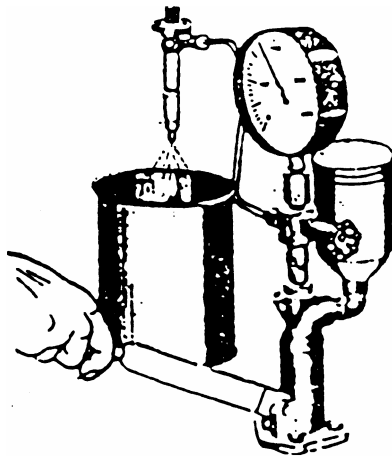


图 23 柴油滤清器

Figure 23 Fuel filter

喷油器为长型多孔式，该偶件精度高，不能互换。喷油器的喷油压力为 $26 \pm 0.5\text{MPa}$ 。喷油器的开启压力的调整是通过改变调压弹簧的预紧力来实现，拆下喷油器壳体，增加或减少弹簧座上垫片的厚度，可增大或降低喷油压力。喷油压力的调整应在专用试验台上进行，如图 24 所示。

The fuel injector belongs to long multi-hole type. The precision pair of the injector is of DLLA150P082. As it has high precision, it should not be interchanged. The opening pressure of the injector is $26 \pm 0.5 \text{ MPa}$. It is determined by the preload of the pressure adjusting spring. The preload can be adjusted by changing the pressure spring shim thickness on the spring seat and checked on the injection test rig, Figure 24.

图 24 喷油压力调整示意图

喷油器喷射的油束应均匀。雾化质量应良好，即油粒细小均匀，喷油时声音清脆，无滴油现象，见图 25。

The spray should be uniform. Its atomization should be good, that is the granularity should be small and uniform and the sound should be with high frequency and the dripping should be avoided.

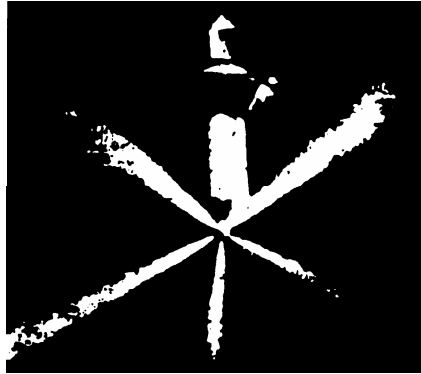


图 25 油束雾化图

Figure 25 Schematic for spray atomization

喷油器安装在气缸盖上，应保证喷嘴突出气缸盖底面的高度，YC4110ZQ 喷嘴凸出高度为 $3.6 \pm 0.1 \text{ mm}$ ，YC4110ZLQ 为

3.0±0.1mm，可通过调整喷油器前端的铜垫来调整(图 26)，拆装喷油器时应注意其前端垫片不能丢失或错装，否则会影响喷嘴伸出高度，从而影响柴油机的性能。

The injector is installed on the cylinder head. The height over the bottom surface of the cylinder head should be guaranteed with 3.6 ± 0.1 . It can be adjusted through the copper shims at the front of the injector, Figure 26. During the removing and installing the injector, the copper shims should not be lost or mis-installed, otherwise it will affect the protrusion height of the injector and detriment the engine's performance.

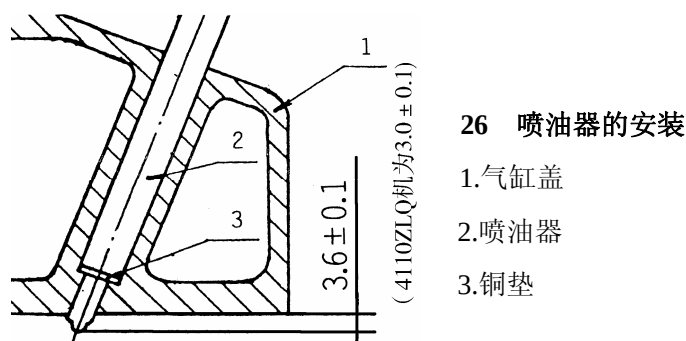


Figure 26 Installation of injector

1. cylinder head; 2. injector; 3. copper shim

五、润滑系统

Lubricating system

润滑系统的任务就是把清洁的、压力和温度适宜的润滑油

送至各磨擦表面进行润滑，使柴油机各零件能正常工作。

YC4E、YC4110 系列柴油机使用 20W / 50CD、20W / 50CF-4 / SG 级(使用外界温度为-15℃~50℃)或 10W / 40CD、10W / 40CF-4 / SG 级(使用外界温度为-25℃~30℃)机油，或与环境相适应的不低于 GB11123CD 级的其他机油。

应定期检查油底壳内油面的高度，油面高度应保证处于油标尺上下限刻度之间(图 27)，不足时应及时加足。YC4110ZLQ、YC4E 机油容量为 18 升，其中油底壳容量约 16 升。油底壳下部设有放油螺塞，供更换机油时放油用。

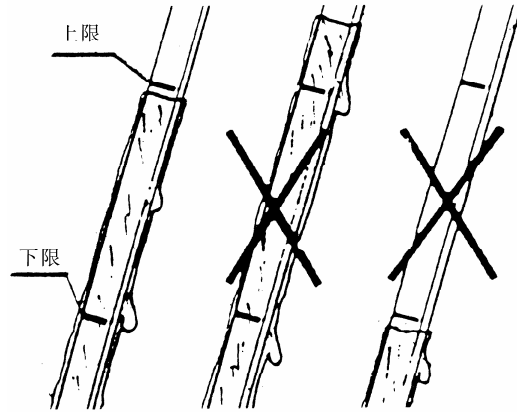


图 27 机油量的检查

Figure 27 checking of the oil level

The task of the lubrication system is to deliver clean oil that has suitable pressure and temperature to the friction surfaces, which can make every component work well. YC4112 series diesel engine usually use 20W/50CD, 20W/50CF-4/SG grades oil (surrounding temperature should be between -15 and 50℃) or 10W/40CD, 10W/40CF-4/SG

grades oil (surrounding temperature should be between -25 and 30°C), or other oil which grade lower than GB11123CD grade.

机油滤清器为纸质滤芯旋装式，型号为 JS0818(图 28)。汽车每行驶里程 10000 公里(或每累计工作时间 250 小时)，应更换滤清器。安装滤清器时，先用清洁的机油加满新的滤清器，然后用少量清洁的机油润滑橡胶密封圈，再安装滤清器。

The oil filter is of paper screw-on type (Js0818), Figure 28. It should be changed after driving 1000 km or 250 hours (accumulative total). During new filter installation, fill it with clean oil at first, next lubricate the rubber seal washer with a little clean oil, and finally new filter can be mounted.

柴油机运行时，如机油压力低，可用起子调整机油限压阀调整螺钉，旋进油压升高，退出油压降低，直调至 0.4MPa ，如不行，则需认真检查润滑油路中的故障(图 29)。

If the oil pressure is low when the diesel engine is running, the pressure can be adjusted to 0.4 MPa by the oil pressure limiting valve adjusting bolt. If the bolt is screw in, the pressure will rise; If the bolt is screw out, the pressure will drop. If that do not work, the lubrication line should be checked. Figure 29. During new filter installation, fill it with clean oil at first, next lubricate the rubber seal washer with a little clean oil, and finally new filter can be mounted.

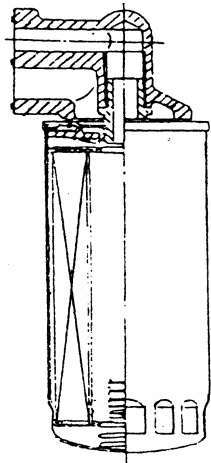


图 28 机油滤清器

Figure 28 oil filter

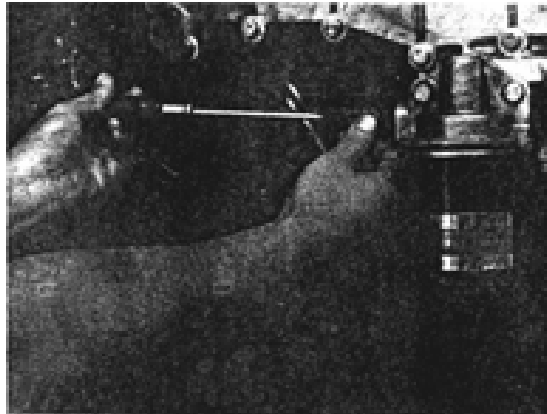


图 29 机油压力的调整

Figure 29 adjustment of oil pressure

六、冷却系统

Cooling system

冷却系统采用强制闭式循环水冷却系统。冷却液应采用防冻液，具体参看附录一防冻液及使用说明。柴油机出水温度控制在 $80\sim 95^{\circ}\text{C}$ ，机油温度控制在 $90\sim 105^{\circ}\text{C}$ 较适宜。

The YC4110 series diesel engine adopts the closed water cooling system with pressurized circulation engine. The coolant should be

anti-freeze. Please refer to "Anti-freeze solution and its application guide". During the normal operation, the outlet coolant temperature is generally controlled from 80 to 95°C. Oil temperature is generally controlled from 90 to 105°C.

水泵及风扇是冷却系统的主要部件，一般汽车每行驶 2000~2500 公里，应从水泵上的黄油嘴给水泵轴承腔加注一次黄油。

The water pump and fan are the main parts in the cooling system. Generally speaking, every 2000~2500km, lubrication grease should be injected into the water pump's bearing chamber through the filler.

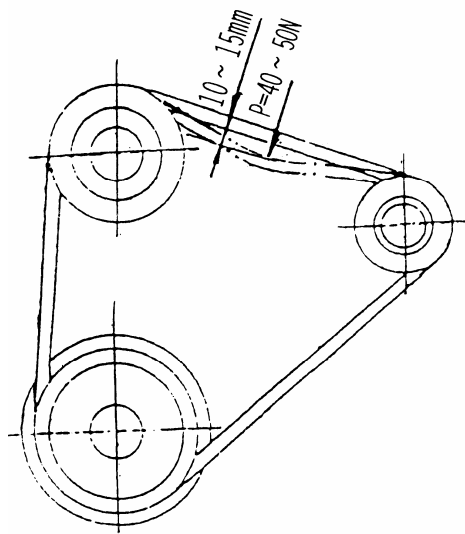
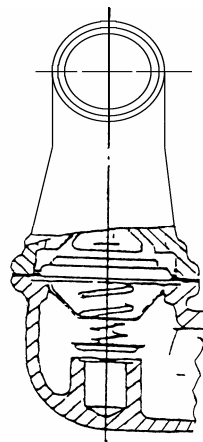


图 30 皮带传动及松紧度检查

Figure 30 Belt driving and the check of its



looseness **图 31 节温器安装图** Figure 31 Installation of thermostat

皮带的松紧度应适宜，不能过松或过紧，一般在两带轮之间向里加 20~40N 作用力时，皮带能弯进 10~15mm 为宜(图 30)。皮带的规格型号为：充电机皮带 B960、水泵皮带 A1200。

The tension of the belt should be proper. Insufficient tension or Excessive tension must be avoided. The belt deflection by pushing on the belt midway between pulleys with 20~40N should be 10~15mm. The belt's specification is as follows: the belt for charging generator is of B960 and that of the water pump is of A1200.

皮带松紧度的调整可通过调整充电发电机与调节板的相对位置来达到，充电机往外摆，则皮带张紧，往内摆则皮带放松。

The tension of the belt can be adjusted through the relative position between the charging generator and the adjusting plate. When the charging generator is swung outwardly, the tension increases, and inwardly decreases.

柴油机使用过程中，不要轻易把节温器拆掉，以免影响柴油机的正常工作状态(图 31)。

During the engine operation, the thermostat should not be removed freely, otherwise it will detriment the engine's normal operation.

七、增压和中冷系统

Turbocharger

YC4110ZQ、YC4110ZLQ 和 YC4E 型柴油机均采用废气涡轮增压系统。其工作原理（如图 32）所示。柴油机排气管 1 接到增压器的涡轮壳 4 上，柴油机排出的高温和有一定压力的废气经涡轮壳 4 进入喷嘴环 2，由于喷嘴环的通道面积由大到小，因而废气的压力和温度下降，而速度却迅速提高。这个高速的废气气流，按着一定的方向冲击涡轮 3，使涡轮高速旋转。废气的压力、温度和速度越高，涡轮转动越快。通过涡轮的废气最后排入大气。因为涡轮 3 与压气机叶轮 8 固装在同一根转轴上，所以叶轮与涡轮以相同的速度旋转，将经过空气

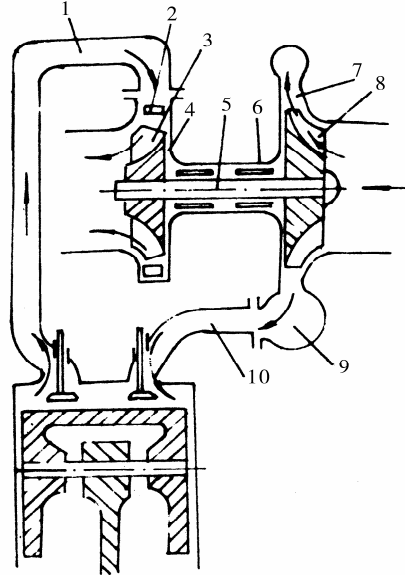


图 32 废气涡轮增压柴油机工作原理图

1.排气管 2.喷嘴环 3.涡轮 4.涡轮壳 5.转子轴

6.轴承 7.扩压器 8.压气机 叶轮 9.压气机壳 10.进气管

Figure 32 The working principle of turbocharger diesel engine

1. exhaust pipe; 2. nozzle ring; 3. turbine impeller; 4. turbine housing;
5. rotation shaft; 6. bearing; 7. diffuser; 8. compressor impeller; 9.
compressor housing; 10. intake pipe

Since the turbine impeller (3) is mounted on the same shaft as the compressor impeller, the compressor is forced to spin with same speed. The compressor pulls the air cleaned by the air filter into the compressor housing. The air pressurized by spinning compressor impeller goes into the cylinder. The increased density can make more air go into the cylinder and under the good matching with the fuel injection system, increase engine power output and improves fuel economy.

图 33 旁通式涡轮增压器示意图

Figure 33 Schematic of turbocharger with waste gate

旁通阀式增压器是在涡轮进气口处增加一个废气旁通阀及受增压压力控制使其开启、关闭的执行机构。当增压压力大于某一预定值，足以克服执行器中弹簧预紧力时，曲柄使旁通阀打开，使部分废气通过旁通阀流入涡轮后排气管，从而减少进入涡轮的废气流量，使增压器的转速下降，避免增压器因超速损坏。旁通式涡轮增压器与柴油机的匹配是以中低速区域进行的，所以带旁通阀增压柴油机具有良好的低速性能。

涡轮增压器和增压柴油机在性能上有着密切的关系，如果增压器的性能改变，将直接影响到柴油机的性能。为了使增压柴油机保持良好的综合性能，同柴油机一样，增压器在使用过程中必须用正确的方法和进行良好的保养。由于整个进排气系统各接头处漏气时会影响增压器的工作，因此必须经常检查外部接头的紧固情况。

The turbocharged diesel engine is dependent on the turbocharger. The changing of the turbocharger's performance will affect the engine's performance. In order to guarantee the turbocharged engine with good integrating performance, the turbocharger must be used correctly and maintained well. As the leakage at the joints in the intake and exhaust system will affect the turbocharger operation, the outer joint's fasten condition must be often checked.

增压器系统常见故障及排除方法:

The turbocharger's troubles and troubleshooting methods are as follows:

故障原因 Possible causes	排除方法 Remedies
①进气系统堵塞 Intake blocked	检查空气滤清器与压气机之间的管路、压气机出口与进气管管路及进气管。清理通畅。Check the pipes between the air cleaner and the compressor, between the intake pipe and the compressor outlet. Clear them.
②进气泄漏 Intake leaky	检查空气滤清器与压气机之间的管路、压气机出口与进气管之间的管路，进气管与发动机连接处等是否有泄漏、可拧紧紧固螺栓。更换垫片等零件。Check the leakage at the connections between the air cleaner and compressor, between the compressor outlet and the intake pipe, between the engine and the intake pipe. Replace the seal

	gasket and fasten the locking bolt if necessary.
③ 排气系统阻塞 Exhaust blocked	维修或更换有关部件 Maintain or replace the related parts.
④ 排气泄漏 Exhaust leaky	检查排气管与发动机、涡轮进口与排气管，涡轮壳与中间壳，涡轮出口至排气管连接处，如有泄漏可更换密封垫片拧紧紧固螺栓。Check the leakage at the connections between the exhaust pipe and engine, between the turbine inlet and the exhaust pipe, between the turbine housing and the middle housing, between the turbine outlet and the exhaust pipe. Replace the seal gasket and fasten the locking bolt if necessary.
⑤ 压气机转子与压气机壳体、涡轮与涡轮壳相碰。 Turbocharger bearing is damaged and impellers touch housing	更换总成 Replace assembly
⑥ 进、回油管漏油 Fuel supply and return line leaky	更换垫片或油管 Replace

YC4110ZLQ、YC4E 柴油机采用了进气中冷技术，增压后的热空气通过空气中间冷却器后，进气温度进一步降低，进入气缸的空气密度提高，辅以供油系统喷入更多燃油以达到提高功率的目的，并改善经济性和环保性。其主要工作原理如下：

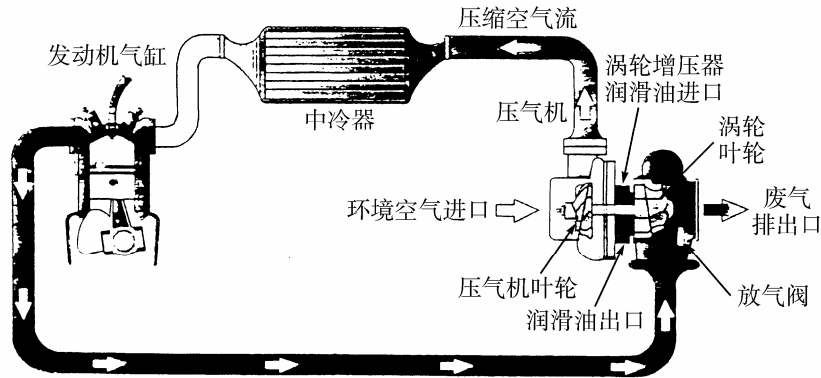


图 34 增压中冷柴油机工作原理

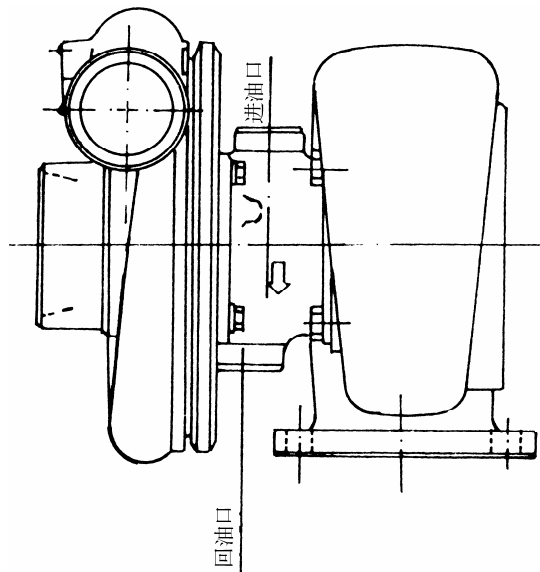
增压器为高速运转的精密机械，对装配技术要求很高，为保证增压器有较长的寿命，用户切勿自行解体增压器，否则不予质量保修。使用时应注意以下各点：

Because the turbocharger belongs to a high precision assembly and has strict assembly requirement, in order to increase the life span of the turbocharger, When a problem occurs for the turbocharger itself, send it to an authorized service center by Yuchai, otherwise the quality maintenance will not be guaranteed.

1. 在发动机起动后，润滑油压力建立以前，必须使发动机保持在怠速状态 3~5 分钟。

2. 在发动机停机之前，必须怠速 3~5 分钟，要使它的温度和转速逐步地从最大值降下来。
3. 预先润滑涡轮增压器。在更换润滑油或做任何维修(包括放出润滑油)之后或发动机长时间停放后(约一个星期以上)，涡轮增压器需要进行预先润滑，即先松开增压器进油接头(参见图 35)，注入干净润滑油，使增压器润滑系统充满润滑油。在发动机启动前要将曲轴盘动几次。启动发动机后，在进入高速运转前，让它怠速一段时间，以建立起整个润滑油循环的压力。

4. 低温启动发动机时必须谨慎。当环境温度过低或车辆长时间不用时会影响发动机建立正常的润滑油压力和流量。在这种情况下，发动机启动后必须怠



速 3~ 5 分钟才能进入正常工作状态。

5. 同时也要避免发动机长时间怠速运转超过 15 分钟。

中冷器的故障主要是漏气，漏气将使发动机功率降低，涡轮增压器增压压力下降，并使排气温度升高。应对漏气的中冷器进行焊补。裂缝漏气常发生在扁管与板翅、箱体与集气室焊缝处及箱体等处。检查的最好办法是对中冷器加压至 207kPa，涂肥皂水以找出漏气的准确部位。同时也应注意检查中冷器联接管路的密封性，可在上面涂上肥皂水，启动柴油机工作，观察是否有漏气现象

八、起动装置、电器系统与仪表

starter, electrical system, and indicators

电器系统原理图如图 36 所示。充电发电机采用硅整流发电机，额定电压 28V、功率 0 75kW，发电机为负极搭铁(接地)不能接错线，否则将会烧坏发电机(注：电路由于各汽车厂采用不同的调节器将有所变化，请用户注意相应的汽车使用说明书的说明)。

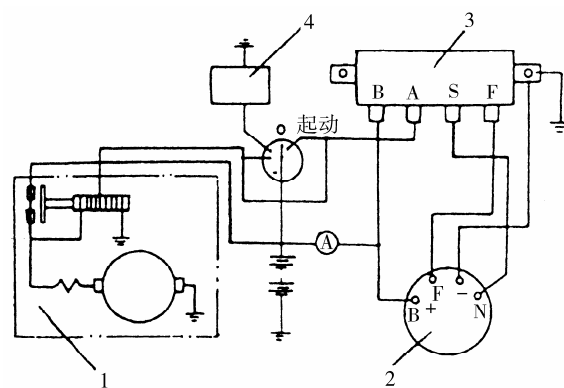


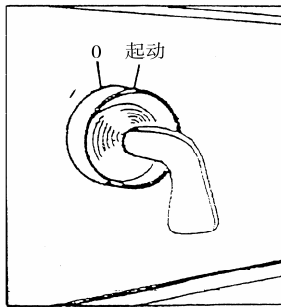
图 36 电器系统

- 1. 起动马达
- 2. 发电机
- 3. 调节器
- 4. 加热器

Figure 35 electrical system

1. starter;
2. generator;
3. regulator;
4. pre-heater

The fundamental of the electrical system is shown in Figure 35. The generator used on YC4110 is integral silicon rectified generator. It has a rated voltage of 28V and a rated power of 0.75kW. The earth electrode of the generator is negative. If the positive post of engine is mistakenly connected to earth, the generator will be burnt. (Attention please: Circuit varies with different regulator used by different car makers. Car buyers should pay attention to the respective manual brochure.)



YC4110ZLQ、YC4E 柴油机起动电机为直流电机，工作电压 24V，最大输出功率 5.2kW。起动时应注意，起动电机持续工作时间不要超过 10 秒钟，否则容易烧坏。电机连续使用时，每两次的间隔时间应不少于 1 分钟。柴油机起动成功后，应立即

图 37 起动机的使用 将开关拧回“0”位，否则柴油机将会通过飞轮齿圈带动起动电机超速运转，使电机烧坏(图 37)。

Figure 37 Usage of the starter

The starter used on YC4110Z_LQ diesel engine is of AC starter and has an operating voltage of 24V and maximum output power of 4.8kW. Do not keep the starter running for more than 10 seconds at a time or it will

be burnt. And if the engine fails to run after cranking, the cranking should not be repeated within at least one minute. When engine begins operating, the key should be switched back to zero position. If not, driving pinion will still engage flywheel and diesel engine will drive starter at a high rotating speed and will cause the starter to burn. (Figure 37)

九、转向泵 Steering pump

1. 转向泵带有滤网，滤网位于转向泵的阀座之中。

The steering pump has a screen filter, located in the valve seat.

2. 请在走保时清洗滤网，走保后按每 5000km 清洗一次滤网。当转向显得沉重时，有可能是转向泵的滤网不干净，请拆开阀座清洗滤网。清洗时请注意保持泵体及阀座的清洁度。

Please clean the screen filter during maintenance after the break-in period. After that, clean the screen filter every 5000 km. If the vehicle is difficult to steer, the screen filter of the steering pump might not be clean. Dismantle the valve seat to clean it. When cleaning, please keep the pump body and valve seat clean.

3. 其余的维修保养与原来没有加装滤网的转向泵维修保养要求相同。

Other maintenance should be the same as that of the pump

without installing the screen filter.

第三章 柴油机的使用和维护保养

Operation and maintenance of the diesel engine

一、柴油机的使用

Operation of the diesel engine

1. 起动前: Preparations before Starting the Engine

检查油底壳机油油面，确保机油足够，保证润滑，若不够，则应添加到机油标尺规定的位置； Check the oil quantity in the engine oil sump; if not, replenish the oil to the stipulated position on the dipstick.

检查水箱中的冷却液，保证正常冷却(玉柴系列增压机要求必须使用防冻冷却液)； Check whether the coolant inside the radiator is sufficient or not; if not, replenish the coolant in sufficient quantity as specified

检查排除燃油管路的空气和柴油滤清器的水，检查油量，若不够，添加燃油； Check whether the fuel quantity in the fuel tank is sufficient or not; if not, replenish the fuel to the sufficient quantity as specified

检查电器系统(各连接线路、开关接线等是否牢固可靠，电瓶电解液是否充足，若不够，加足电解液)； Check whether the whole electrical system works normally and the battery is sufficiently charged or not, and replenish the battery with a sufficient quantity of the electrolyte.

检查皮带，松紧度应适宜，皮带过松打滑使水泵、风扇的工作不正常，冷却效果差，发动机水温高，过紧则使皮带轮轴受力过大、皮带寿命缩短；

检查汽车底盘和操纵装置，禁止汽车带病行驶。

2. 起动：

完成起动前准备工作并确认符合要求后，才可以起动柴油机(冬天天气寒冷时需对柴油机预热后才能起动)，起动柴油机时，持续起动时间不能超过 10 秒钟；二次起动的时间间隔不应少于 1 分钟；若连续三次均无法起动，则应检查原因，排除故障，再行起动。起动后检查：

机油压力：在怠速时不能低于 0.1MPa，压力过低，发动机润滑不良会造成各运动副磨损；

水泵工作情况良好，确认冷却液已进入柴油机水套内循环无“三漏”、异响现象；

各汽车仪表的工作情况。发现有不正常现象，必须立即停车检查排除，必要时送修。

3. 运行： Starting of Engine

柴油机冷机起动后，从怠速到低中速下空载运转热机 5 分钟后才起步，热机起动时，在柴油机建立油压后才能起步，确保发动机润滑良好； Warm up the vehicle unloaded by running the engine successively at the low and medium speeds after it is started.

禁止大油门高速高负荷运转柴油机，应逐渐提高柴油机转

速，水温上升到 60℃ 以上，发动机充分润滑、受热均匀后才能正常运转； Do not accelerate abruptly, Speed up slowly. It is not allowed for the engine to work with heavy loads and a high speed only when the engine coolant temperature is higher than 60℃ and the oil temperature higher than 45℃.

一般情况下少用或不用排气制动阀，频繁使用，会对发动机造成严重损坏，如气门锁夹弹出、气门松脱、断裂，增压器受损等；

汽车在行驶阶段，司机应经常注意观察车上各种仪表，随时掌握发动机的运行情况，发现不正常情况必须立即停车检查排除，必要时送修。

4. 停车: Stopping of Engine

停车前怠速运行 3~5 分钟后才熄火，特别是高转速高负荷运转时更应如此；避免急速停车，发动机高速运转时增压器叶轮转速可达 12 万 转/ 分钟以上，急速停车会使增压器无润滑造成轴承和转子烧坏。这一点，用户必须特别要注意； 每次停车后，必须及时排除在运行期间所发现的故障，并经常进行必要的检查，保证柴油机正常的技术状态； It should be avoided for the engine to stop suddenly. Before stopping run the engine for 3~5 minutes at a lower speed to cool down the engine, then run the engine at the idle speed for 2~3 minutes, and only in this case you can stop the engine

按发动机保养规定要求及时切实做好柴油机的技术维护保养工作。

5. 油品选用：（推荐使用正宗的玉柴牌润滑油）

柴油的选用：使用符合国标 GB252 优级品或一级品轻柴油，排放要求高的使用低硫柴油。

机油的选用：使用不低于国标 GB11122-1997 中的 CD 级机油，增压中冷柴油机建议使用更高一级的机油(CF 级或以上)

	轻柴油（GB252 优级品或一等品）				
使用条件	$\geq 4^{\circ}\text{C}$	$\geq -5^{\circ}\text{C}$	$\geq -14^{\circ}\text{C}$	$\geq -29^{\circ}\text{C}$	$\geq -44^{\circ}\text{C}$
油品牌号	0 号	-10 号	-20 号	-35 号	-50 号
机油（不低于 GB11122-1997 中的 CD 级）					
使用条件	夏季	$\geq 0^{\circ}\text{C}$	-15°C	$\geq -30^{\circ}\text{C}$	
油品牌号	15W/40CD (40CD)	15W/30CD (30CD)	100W/30CD	5W/30CD	

经常检查机油，发现变稀、变黑时立即换油，建议正常条件下行驶 10000—11000 公里内更换机油，恶劣条件下要缩短换油周期。

二、柴油机的维护保养

●用户必须在新车行驶 1500～2500 公里内到玉柴服务站进行走合保养并记录走保情况；

●走保后每 1 万公里内到玉柴服务站进行一次强制保养，要求 5 万公里内强制保养不少于三次；

●发动机在使用期间，还应按以下要求进行例行维护保养，其中的第 1、4 项由用户自行进行，第 2、3 项由专业维修保养人员进行；

●空气滤清器是保证柴油机吸入清洁空气的关键零部件，要经常检查进气系统密封情况和保养、更换空滤器，确保柴油机不出现早期磨损。

序	项目	保养周期	保养项目
(一)	日常维护	每日	1.检查燃油箱油量； 2.检查冷却水水箱冷却液量； 3.检查油底壳内油面高度； 4.检查“三漏”情况； 5.检查皮带松紧度； 6.检查各附件装置的紧固情况； 7.排除柴油油水分离器的水。
(二)	一级保养	每 2000 ~ 2500 公 里（或每 50 小时）	1.日常维护的所有项目； 2.缸盖螺栓的拧紧力矩； 3.检查、调整气门间隙； 4.检查、调整供油提前角； 5.检查喷油器的工作压力及雾化情况； 6.清洗输油泵进油滤网等。

(三)	二级保养	10000 ~ 11000 公 里 (或每 150 小 时)	1.一级保养的所有项目; 2.各管路、线路连接紧固情况; 3.给水泵加注钠基润滑脂; 4.重要螺栓螺母拧紧情况; 5.必要时更换机油; 6.检查主要零部件的紧固情况。
(四)	三级保养	50000 ~ 60000 公 里	1.拆开并清洗整机,清除积碳,油污和 结胶,清洗全部润滑油管、油道; 2.检查气门、气门座、气门导管、气门 弹簧、推杆、摇臂等零件的磨损情况, 必要 时修磨更换; 3.检查活塞环、气缸孔、连杆小头衬套 及连杆轴孔的磨损情况,必要时可更换; 4.检查主轴瓦(包括止推轴瓦)的磨损情 况,必要时更换; 5.检查齿轮的磨损情况及齿侧间隙,必 要时更换; 6.检查喷油器雾化情况,必要时研磨喷 油嘴偶件或更换; 7.检查机油泵内外转子及机油泵体,必 要时更换;

			8.检查发电机和起动机，清洗各零件、轴承，加注新的润滑脂； 9.检查增压器轴承的间隙，必要时更换涡轮增压器； 10.检查中冷器是否漏气，必要时修理。
(五)	三滤维护		1.经常检查、清洁空气滤清器； 2.按使用周期更换柴油、机油滤清器和空气滤清器滤芯。

第四章 柴油机的一般故障及其排除方法

柴油机在运行过一段时间之后，难免会出现这样或那样的

故障，如不及时解决，将会影响柴油机的正常工作。

为了使用户能及时处理一些力所能及的常见故障，我们在此介绍处理一般故障的简单知识，使用户能及时排除车辆运行中柴油机出现的一般故障，以便保证柴油机能持续正常运行。

这里介绍的故障排除知识是简单的，也是不全面的。因此用户在使用时尚请注意，如对柴油

机发生的故障及其原因判断不确切，最好不要擅自处理，以免造成更大的损失，而应该及时通知我公司或就近请专业单位协助处理。

柴油机的一般故障处理方法简介如下：

Diesel engine would be in trouble after operating for a period of time. If the troubles don't be removed in time, it would result in abnormal operation of the engine.

The manual presents simple troubleshooting methods, which tell users how to deal with the common troubles occurring during vehicles running and have engine operate normally.

Because the knowledge about troubleshooting is simple and not comprehensive, please pay more attention to it. When not being sure of the trouble causes, do not tackle it without authorization to avoid larger damage. It should be done that informing and consulting with technical Yuchai service center or other specialist company.

The troubleshooting methods are shown below.

一、启动困难或不能启动 Diesel engine can not start

故障原因 Possible causes	排除方法 Remedies
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1.电力不足或接点接触不良 Insufficient power or bad terminals connection contact	给蓄电池充电或更换蓄电池，检查各电器接触点是否有松脱现象或因锈蚀接触不良，查出后妥善处理。Charge or replace the battery. Check the loose of contacts of electrical equipment or bad contact due to rustiness and deal with it.
2.燃油管路堵塞，供油不足 Fuel pipe blocked or insufficient oil supply	检查各油路是否有杂物堵塞。清洗柴油滤芯。Determine the location of the clog and clear it. Clean filter element.
3.油路中吸进空气 Air exists in the oil line	检查各油管接头是否有松动、破损现象。如有，应排除或更换。故障处理后排除油路空气。Check the looseness and damage of the joints of the fuel lines, remove or replace them if necessary and then clear air in the oil line.

4.气缸内积油过多 Too much oil deposit in cylinder	先关闭油门、用马达转动曲轴，排尽缸内的多余积油，对大修和三保后的机子更应注意。 Closing the throttle, rotating the crankshaft by motor, draining excess oil deposit in cylinder, and especially pay more attention to the overhauled engine or the engine after third order maintenance
5.喷不出油或喷油很少，且压力低 Fuel supply pump does not apply fuel or applies fuel irregularly	检查出油阀是否漏油，柱塞弹簧或出油阀弹簧是否断裂，喷油器是否卡死，柱塞是否磨损过度。发现问题应及时排除。Check for leakage of the delivery valve and inspect whether the injector is worn-out, plunger is seized, and if the plunger spring and delivery valve spring is broken. Remove them in time.
6.活塞环过度磨损造成压力不足 Insufficient compression pressure due to piston ring much worn-out;	检查并更换新环。Check and replace the piston ring
7.气门漏气 Blow-by valve	检查气门间隙和气门密封情况，重新调整或研磨气门 Check the valve clearance and seal of valve. Grind or readjust the valve if necessary.
8.配气相位不对 In correct valve timing	对大修机子或三保后的机子应注意齿轮记号是否装对 For the overhauled engine or the engine after third order maintenance, pay

	attention to the timing marks alignment on timing gears.
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二、柴油机功率下降 Insufficient power output

故障原因 Possible causes	排除方法 Remedies
1.进气堵塞 Intake blocked 2.排气背压过高 3.增压系统压力不足 4.增压器工作失常，压气机、涡轮气流通道污染堵塞或损坏； 5.轴承失效； 6.涡轮、压气机背面间隙处有积碳、油泥 7.中冷器损坏、漏气 8.燃油管路漏油或堵塞	检查空气滤清器、进气管，清理或更换空气滤清器滤芯。Check the air cleaner, intake pipe, and clean or replace air cleaner filter elements. 检查气门定时，必要时调整；清理排气管。Check the working pressure or atomization of injector, replace plunger precision pair if necessary. 检查并排除管路和连接处的泄漏。

9.喷油泵柱塞磨损过大	清选或更换压气机壳、涡轮壳。
10.冒烟限制器膜片破损	更换。
11.增压补偿管损坏漏气	清洗。
12.喷油器雾化不良	修补或更换。
13.配气相位不对	检查油管及接头处的密封情况、燃油滤清器的堵塞情况，更换旋装式滤芯。
14.供油提前角提前或迟后	检查、更换。
15.调整器高速调整过低	更换。
16.气缸垫漏气	更换
17.气门密封不良	检查喷油压力、清理积碳、调整及修理。
18.发动机过热	检查并调整配气定时及气门间隙。
19.冷却液温度过高	
20.活塞环磨损过大，断裂	检查并调整。 检查并调整。 按规定力矩、顺序拧紧气缸盖螺栓或更换气缸垫。 研磨或更换重新研磨。

	检查并修理散热器、调温器，调整风扇皮带张紧力。 更换
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三、柴油机有不正常声音 Abnormal noise during engine operation

故障原因 Possible causes	排除方法 Remedies
1.供油定时不对或喷油器卡滞，气缸内出现敲击声 Incorrect injection timing or injector stuck and high frequency knock noise in cylinder;	检查喷油器，必要时更换针阀偶件，检查供油提前角，如发生变化应调到规定值 Check the injector, replace the plunger precision pair if necessary. Check the fuel injection advance angle, if it changes, adjust to the prescription.
2.活塞与缸套间隙过大引起的撞击声 Clash due to too large clearance between piston and cylinder sleeve	检查活塞与缸套的磨损情况，必要时更换活塞或缸套 Check the wear of piston and cylinder sleeve, replace them if necessary.
3.连杆瓦、主轴瓦与轴颈的间隙过大引起的撞击声 Clash due to too large clearance between connecting rod bearing bushing, main bearing bushing and journal	检查轴瓦和曲轴是否磨损过度，必要时更换新瓦或修磨曲轴并换用加大轴瓦 Check if the bearing bushing and crankshaft are much worn out, replace or press in the oversized bearing bushing if necessary. 检查并调整气门间隙，对大修机子应注意

4.气门碰活塞发出的有节奏的敲击声 Knock due to valve touching cylinder	配气相位是否正确。 Check and adjust the valve clearance. Inspect valve timing for the overhauled engine.
1) 5.曲轴轴向间隙过大引起的游动撞击声 Clash due to too large crankshaft axial clearance	检查止推片磨损情况，磨损过大时应更换 Check the wear of thrust plate, replace it if necessary.
2) 6.气门弹簧断裂引起的异常敲击声 Abnormal knock due to valve spring crack	应立即停机检查、更换损坏件 Stop immediately to check and replace the damaged parts.
7.传动齿轮磨损过大，运转时在正时齿轮室处可听到撞击声 Driving and driven gears worn-out and too large clearance. Slap can be heard near timing gear housing	检查齿侧间隙，视磨损情况更换齿轮 Check the gear backlashes and replace them if necessary.
8. 增压器喘振 Turbocharger surging	消除压气机通道、废气通道的积碳及污物 Clear the carbon deposit and contaminants in compressor and exhaust passages.
9.气门间隙过大，在气缸盖处有较大响声 Too large valve clearance and heavy	调整气门间隙 Adjust valve clearance 更换增压器总成 Replace the turbocharger assembly.

noise around cylinder head 10.增压器轴承损坏、转动件 与壳体相碰 Turbocharger bearing is damaged and impellers touch housing	
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四、排气烟色不正常 Exhaust with abnormal smoke colour

故障原因 Possible causes	排除方法 Remedies
1. 排气冒黑烟 Exhaust with black smoke	按功率不足各条作适当处理 Take proper measures according to the remedies for insufficient power output 检查喷油器工作情况，必要时更换针阀偶 件 Check the working conditions, replace the plunger precision pair if necessary.
2. 排气冒白烟 Exhaust with white smoke	
①喷油器喷油雾化不良 Bad atomization of injector	
②气缸中或柴油里有水 Water in cylinder or diesel	检查柴油，如有水应更换；如无水，则应 检查缸盖等零件有无损坏而引起冷却水 渗入气缸，检查出后更换损坏件。 Check diesel, and if there is water in it, replace it, otherwise, check the damage of cylinder head parts which may cause water leak, replace the damaged ones.
③在冷天时柴油机低速运 转，个别缸不工作 Some cylinder doesn't work when operating at low speed on	气温低时应关闭百叶窗，使柴油机工作温 度尽快上升，以避免长时间低温工作

cold day 3.排气冒蓝烟: Exhaust with blue smoke ①油底壳机油过多 Too much oil in sump ②空负荷低速运转时间过长 Operation at aero load and low speed for too long time ③活塞环卡死或磨损过大或方向装反, 使机油窜入缸内燃烧 Sticking, much wear or inverse installing orientation of piston rings, Oil blow-by and burn in cylinder ④气门导管磨损过大, 机油从导管与气门杆间隙窜入。 Oil seeps through the gap between valve guide and stem due to valve guide is much worn out. ⑤增压器回油管路堵塞	When the ambient temperature is low, close the shutter door and make operating temperature rise quickly to avoid running long time at low temperature. 检查油面, 过高时应放出 Check the level of oil, drain it if necessary. 尽量减少低速空载运行, 防止机油窜入缸内燃烧 Decrease time of the operation at aero load and low speed to avoid oil blow-by and burn in cylinder 必要时更换活塞环 Replace the piston ring if necessary. 检查气门与导管间隙, 过大的应予以更换 Check the clearance between the valve and guide, replace it if necessary. 清洗、修理 Rinse and repair. 检查并更换 Check and replace.
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Clogged oil return pipe of turbocharger ⑥增压器密封环磨损 Worn seal ring of turbocharger	
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五、机油压力不足 Too low oil pressure

故障原因 Possible causes	排除方法 Remedies
1. 油底壳油量不足 Insufficient oil in sump	加足机油 Add oil to adequacy. 检查具体原因，按具体情况处理，如清洗粗滤芯、集滤器网等 Check the detailed cause, and then clean coarse filter element or oil strainer screen
2. 机油管路堵塞或有泄漏 Oil pipe clog or leakage	检查调压阀，必要时更换 Check the pressure adjustment valve, replace it if necessary.
3. 调压阀失灵 Pressure adjustment valve failure	检查清楚后更换 Check if incorrect brand oil is used or oil temperature is too high. If the cause is the former, replace oil, otherwise find out the reason of the latter and then deal with it.
4. 压力表或感应塞失灵 Pressure indicator or transmitter failure	检查是否用错机油或油温过高，如机油不对应更换，如属油温过高要查出原因并处理
5. 机油过稀 Diluted oil	
6. 机油泵间隙过大. Too large assembly clearance of oil pump	

	Select proper oil. 检查, 如属轴向间隙大可减少纸垫, 如属径向间隙大则应更换机油泵转子 Reduce the paper gasket if axial clearance becomes larger; replace rotors if radial clearance becomes larger
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六、机油温度过高、过稀、消耗大 Too high oil pressure, much diluted oil, excessive oil consumption

故障原因 Possible causes	排除方法 Remedies
1. 柴油机负荷过大 Too high diesel engine load.	注意不能乱动油泵上的铅封加大油量, 使柴油机超负荷运行。长期超负荷使用会使机子早期损坏 Be care not to pull out the lead seal on the injection to avoid engine operating at over load
2. 使用机油不当 Incorrect engine oil grade	
3. 活塞卡死或磨损大, 使燃气下窜、机油上窜. Piston ring stuck or seriously worn causing gas blow-by and oil pumping-up	应按第二章第五节的规定牌号使用机油 Select oil according to brand prescribed by section five in chapter two
4. 活塞及活塞环上的油槽和油孔堵塞. Oil groove, bore of piston and piston	拆开、检查。清洗活塞, 必要时更换活塞环或缸套拆下、清洗干净后再装复 Dismantle, check and clean the piston and piston ring,

ring clogged	replace the piston ring and cylinder sleeve if necessary.
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七、出水温度过高 Too high water outlet temperature

故障原因 Possible causes	排除方法 Remedies
1.冷却水量不足，水流量过小 Insufficient cooling water or too small water flow	检查冷却水量是否足够，不足时应添加；皮带是否过松，松了时应调整；水泵有漏水时应进行修理 Check the level of cooling water, add enough water if necessary; check for looseness of the belt, adjust it if necessary; check for leakage in the water pump, repair it in time; check and replace the damaged thermostat.
2.节温器失灵 Thermostat failure	检查更换损坏的节温器 Check and replace the damaged thermostat.
3.水温表损坏，感应塞失灵 Water temperature indicator damage and water temperature sensor failure	检查实际温度与表指示温度是否相符，如不符则应更换感应塞或水温表 Check and compare the actual temperature with the indication, if they are not same, replace sensor or water temperature indicator.

八、喷油泵的一般故障及排除方法 Common trouble and troubleshooting remedies for injection pump

故障原因 Possible causes	排除方法 Remedies
1.不供油: Injection failure: ①油箱无油 No oil in oil tank. ②油路系统中混入空气或有泄漏现象 Air or leaks in oil line. ③油路堵塞 Oil line clogged. ④输油泵不泵油 Fuel pump failure. ⑤柱塞偶件磨损、卡死或弹簧断裂 Plunger precision pair worn out, stuck or spring cracked	检查、加足 Check the level of the oil and add oil to adequacy. 检查、放尽空气, 堵好泄漏地方 Check and drain away air, and stop up the leakage. 检查、清除堵塞 Check and remove blockage. 检查出原因后修复 Determine the location of the clog and clear it. 检查出损坏件后修复或更换 Determine the location of the damaged part and repair or replace it.
2. 出油量不足或不均匀: Insufficient or uneven outlet oil ①进油压力不足 Insufficient	检查输油泵有无毛病及油路有无堵塞现象, 如有应排除 Check the condition of fuel pump and blockage

inlet oil pressure. ②出油阀漏油或弹簧断裂 Leaky oil outlet valve or spring crack. ③柱塞偶件由于脏而失灵，或磨损过大 Plunger precision pair is out of order due to dirty or much wear. ④柱塞控制齿轮松动 Loose plunger control gear.	of oil line, if necessary, remove it. 漏油的重新对研，损坏时应更换零件 If there is leakage, lap in pair; if there is damage, replace parts. 检查、清洗油路及偶件，对磨损过的要更换 Check and wash the oil line and precision pair and replace the much worn one.. 检查是否松动，如松动应对正记号上紧；最好上试验台调整喷油泵 Check for the looseness of the plunger control gear, tighten to the signal if necessary; regulate the injection pump on test bench better.
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十、 调速器的一般故障及排除方法

Common trouble and troubleshooting remedies for governor

故障原因 Possible causes	排除方法 Remedies
1. 转速不稳（游车）； Unsteady speed (engine hunting) ①调速器飞锤或飞锤架张合不灵	检查出原因后进行修理，必要时更换零件并清洗干净 Determine the

活 Inflexible flyweight or flyweight holder of governor.	location of the troubles and then repair it, replace parts and wash it if necessary.
②怠速调整不当 Improper idle adjustment	重新调整怠速限位螺钉 Readjust the idle adjusting screw.
③调整器机件磨损 Governor components worn out	检查修理(由专业厂进行) Check and repair it. (By specialist manufactures)
	可由专业人员作适当调整或更换弹簧, 不能擅自乱调 Regulate properly
2. 标定转速达不到: Speed always lower than calibrated speed.	and replace the spring by professionals, do not do it without authorization.
①调整弹簧变形 Insufficient inlet oil pressure.	检查阻碍原因, 调整排除 Readjust the idle adjusting screw.
②操纵手柄不到位 Improper idle adjustment	检查、调整, 齿杆应滑动灵活, 齿圈不能松动, 否则应调整修复
③调节齿杆及齿圈有卡滞或松动 Adjusting rack and pull bar jammed or loose.	Determine the location of the blockage, then regulate and remove it.
2. 转速突然升高到不正常状态: Speed rising promptly to abnormal state	此时应立即拉停车手柄, 如不能停机应挂档刹车, 或用切断进气等方法迫使机子熄火 Check and adjust it, then ensure the rack slides flexibly and the gear ring is not loose, otherwise readjust and
①调节齿杆或油门拉杆卡死	

Adjusting rack or throttle pull bar stuck. ②调节齿杆和拉杆连接销脱落 The pin connecting adjusting rack and pull bar drops. ③调速弹簧断裂 Governor spring crack.	repair it. 调整修理 Regulate and repair it. 重新装回，必要时更换损坏件 Reinstall it, replace the damaged parts If necessary. 更换后重新上试验台调整喷油泵 Replace it and then readjust the injection pump on test bench.
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十一、离合器常见故障及处理方法 Common trouble and troubleshooting remedies for clutch

故障原因 Possible causes	排除方法 Remedies
1.离合器抖动：压盘倾斜或从动盘变形翘曲歪斜	校正离合器压盘和从动盘的变形，消除不规则接触。
2.离合器打滑：磨擦表面有油污，分离轴承调整不当磨擦表面严重磨损	清理油污，调整分离轴承位置，更换从动盘总成，减少载荷。
3.离合器分离不彻底：压盘或从动盘变形，传动片变形。	消除变形，调整自由行程或更换离合器。
4.离合器异常响动：离合器的零件松动，减震弹簧断裂或离合器	将松动零件铆紧，消除异物或更换从动盘总成。

中有异物	
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十一、发动机自行熄火 Engine stops by itself

故障原因 Possible causes	排除方法 Remedies
1.燃油用完 Fuel is used up	检查、添加，注意排除油路中的空气
2.油路堵塞或有大量空气进入 Oil line clogged or much air entering	Check and add fuel, and remove the air in the oil line.
3.发动机润滑油路不畅通，引起烧轴瓦 Bushing burned due to the blockage in lubrication oil line.	检查。清洗油路，排除油路中的空气，找出进气的原因并排除。Check and clear the oil line; remove air in oil line; Determine the location of the intake and then remove it.
4.柴油机过热拉缸，一般是由于缺水或水温过高引起的 Overheat piston scraping due to lack of water or too high water temperature.	如水温正常而突然停机多属于此种情况，应拆开油底壳检查、维修，更换相应的损坏零件。When the water temperature is normal, it will lead to engine to stop immediately. Dismantle the sump, check and repair it, then replace the damaged

	parts. 先让机子自行冷却（绝不允许加入冷水或用冷水冲）然后试着转动曲轴，如无卡滞可加入冷却水后起动。如转不动则应拆机检查。修复，更换损坏的零部件。 At first, make engine cool naturally (make sure not to add cold water or wash engine with it), then try to rotate the crankshaft. If it is jammed, start engine after adding cold water, or else move engine, check and repair it, then replace the damaged parts.
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附录一 博世 VE 型分配泵装配及供油提前角度的检查与调整

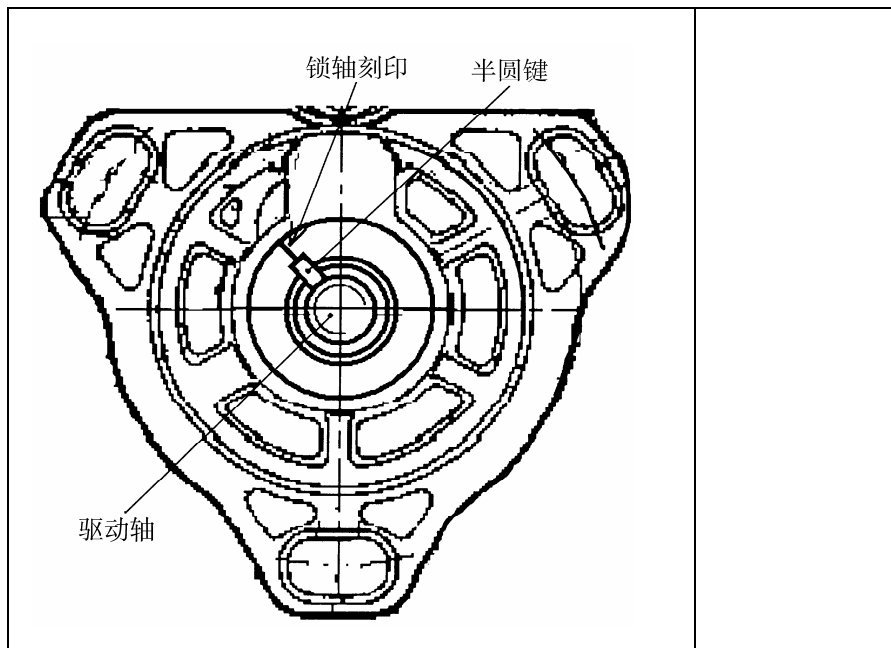
新泵装配: 新泵出厂时, 油泵驱动轴已被锁住, 应按以下步骤安装: 1.先将“O”形密封圈及油泵安装法兰装入油泵定位台肩, 压紧 3 个油泵紧固螺母; 2.装油泵驱动法兰, 压紧紧固大螺母时应夹住驱动法兰, 严禁强行固定泵体, 以免油泵驱动轴被强行转动; 3.将装好油泵安装法兰和驱动法兰的油泵总成装入齿轮室, 紧固油泵安装法兰; 4.准确地将发动机盘至一缸压缩上止点(越准确越好); 5.装油泵驱动齿轮, 并紧固。紧固时应用力平缓以免油泵驱动轴被强行转动; 6.确定油泵泵体和驱动齿轮均已正常紧固, 且发动机曲轴正处于一缸压缩上止点后, 松开油泵锁轴螺栓, 将随泵附带的“U”形垫片卡入锁轴螺栓下并压紧锁轴螺栓, 此时油泵驱动轴已被松开, 油泵就可以转动了; 7.装其他零部件。 注意事项: ● 油泵驱动轴在锁紧状态下, 严禁强行转动油泵驱动轴; ● 起动前, 应充分排出泵体及高压油管内空气; ● 油泵未转动时有某一缸出油阀滴油是正常现象;	拧紧力矩: 92.5 ± 2.5N • m
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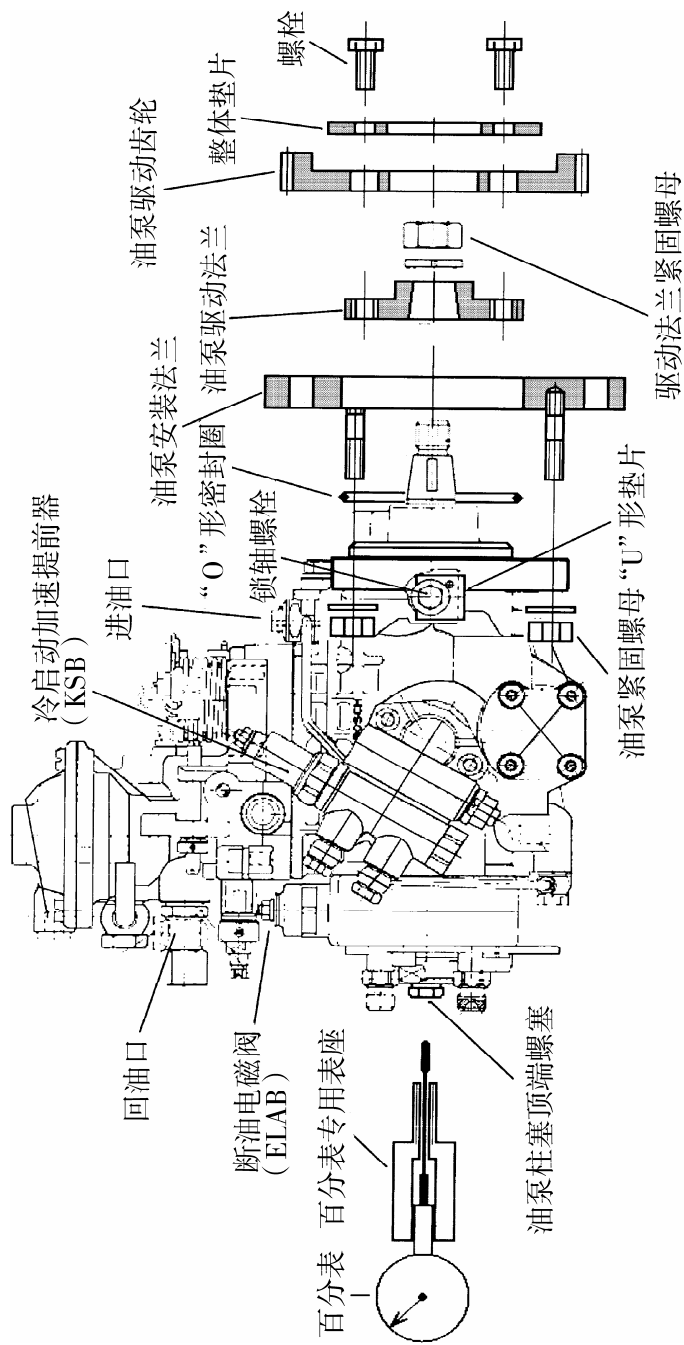
● 油泵驱动轴在自然状态下有一定的轴向窜动间隙是正常现象； ● 断油电磁阀(ELAB)和冷启动加速提前器(KSB)应同时接电，严禁发动机在 KSB 断电下长时间运转。	
因其他故障原因须拆下油泵或油泵齿轮，随后又将原封不动装回时，应按以下步骤锁住油泵驱动轴： 1.拆下油泵和正时齿轮前，准确地将发动机盘至一缸压缩上止点(越准确越好)； 2.松开油泵锁轴螺栓，取下“U”形垫片； 3.锁紧锁轴螺栓，此时油泵驱动轴就与新泵出厂时的状态一样了； 4.拆油泵齿轮、油泵等。 随后装回油泵或油泵齿轮时，按新泵装配方法进行。	
注意事项： ● 应避免在油泵驱动轴被锁紧之前就拆松油泵或油泵齿轮； ● 锁紧油泵驱动轴时，发动机曲轴应准确处于一缸压缩上止点； ● 油泵驱动轴在锁紧状态下，严禁强行转动油泵驱动轴。	
1.将曲轴预盘至上止点前约 20~30° CA(不要求是否一缸压缩上止点)； 2.拆下油泵柱塞顶端螺塞，装入专用百分表座和百分表； 3.前后盘动曲轴，观察百分表指针，在曲轴转动但百分表不动的位置上使百分表指针对零，此时油泵柱塞处于凸轮下止点； 4.按油泵工作旋转方向转动油泵驱动轴，直至百分表升程读数达	

到 0.30mm，此时观察到的曲轴相位即实际静态供油提前角。 注意事项： ● 百分表探头接杆应完全接触到柱塞顶端，可以通过检测柱塞最大升程来验证，最大读数应为 3.3mm 左右 ● 盘动曲轴过程中不应使发动机晃动过激以免百分表窜动后读数不准	
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静态供油提前角的调整 供油提前角与技术规范要求值不符时应按以下步骤进行调整： 1.按以上步骤 1~3 使百分表指针对零； 2.将曲轴准确地盘至要求的静态供油提前角； 3.如果百分表升程读数不是 0.30mm 则应松开 3 个油泵法兰紧固螺母和 1 个泵头支撑板紧固螺栓(都不必拆下，油泵泵体能转动即可)，然后相应地朝加大或减小提前角的方向扳动泵体，直至百分表读数达到 0.30mm； 4.锁紧油泵，再按前述方法检测供油提前角是否达到要求值，如已符合要求，拆下百分表及表座，装好柱塞顶端螺塞。 注意事项： ● 如油泵泵体转动到其法兰腰形槽极限仍达不到要	静态供油提前角： YC4110ZQ 10~13° YC4110ZLQ 8~10°
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求，则应检查油泵驱动齿轮是否安装正确，否则应调整齿轮安装角度直至使供油提前角完全达到要求值。 正时错乱后，应按以下步骤将油泵驱动轴锁定到出厂状态： 1.预先将油泵驱动轴盘至一缸供油相位，此时油泵驱动轴键槽应基本朝向泵体上对应的一道刻印处(不必完全对正)，如下图所示；	
2.拆下油泵柱塞顶端螺塞，装入专用百分表座盒百分表； 3.松开油泵锁轴螺栓，取下“U”形垫片； 4.在油泵驱动轴自然停留位置上百分表指针对零，此时油泵驱动轴可以轻松转动且百分表指针不会动； 5.按油泵工作旋转方向转动油泵驱动轴，同时观察百分表指针，直至百分表升程 读数达到出厂设定值(见右表)，锁紧锁轴螺栓。这样油泵驱动轴就被锁在了新泵出厂状态，此时油泵驱动轴键槽应正好对准泵体上的刻印。 注意事项： ●如无百分表和专用表座，则应直接转动油泵驱动轴，尽量使键槽对准泵体上的锁轴刻印(此法误差较大)。	油泵柱塞锁定行程出厂设定值(仅供参考)： YC4110ZQ、 YC4110ZLQ： 1.75mm





博世 VE 型分配泵安装示意图

附录二 防冻液及使用说明

Anti-freeze solution and its application guide

目前，在水冷式发动机上普遍采用的冷却介质是水，包括硬水和软水。河水、井水、泉水等富含矿物质的水为硬水，受热后矿物质沉积在水套和散热器内壁形成水垢，减弱柴油机的散热能力，严重时会出现缸套与活塞环擦伤，活塞卡死。而水箱结垢以后会导致水温升高而开锅。

Water, both hard and soft water, is widely used in water-cooled engines as a coolant. Water rich in minerals is called hard water and includes river water, well water, and spring water. After the water is heated, minerals are deposited in the water jacket and the radiator inner wall can easily form scales. Scaling weakens the heat transfer ability of the diesel engine and likely will result in cylinder sleeve and piston ring scratching as well as piston seizure. Scaling in water radiators may also lead to water boiling due to the rise in temperature. 因此，必须用软水作冷却液。常用的硬水软化方法是煮沸沉淀后除去沉淀物。更为彻底的方法是在硬水中加软化剂，如每升水加 0.5~1g 碳酸氢钠(纯碱)或 0.5~0.8g 氢氧化钠(烧碱)。Therefore, only soft water should be used as coolant. The common method for converting hard water to soft water is to remove sedimentary deposits after boiling. Adding special additives to hard water is the more thorough method (for example, adding 0.5~1g sodium carbonate, or pure sodium, or 0.5~0.8g sodium hydroxide, or caustic sodium, to 1L water).

用水作冷却液有很多缺点。1)易形成水垢。2)水的冰点是 0℃，冬季使用易结冰冻裂气缸体和散热器。3)水的沸点是 100℃，由于现代发动机普遍采用增压技术，正常水温为 95℃～105℃，夏季会经常出现开锅现象。4)冷却系统由六种金属铸铁、铸铝、钢、紫铜、黄铜及水箱焊缝中的焊锡组成，水，特别是含有杂质的水，对其有腐蚀作用，出现生锈和穴蚀现象。

Water as coolant has many disadvantages. 1) It easily forms scales. 2) Water freezes at 0℃, and it easily freezes when used in winter which will often lead to cylinder block and radiator cracking. 3) Water boils at 100℃. Normal water temperature is 95℃ to 105℃ due to the application of turbo-charging in modern engines. Therefore, it easily boils when used in summer. 4) The cooling system is made up of six kinds of metals, such as cast iron, cast aluminum, steel, copper, brass, and soldering tin in the water radiator soldering seam. The use of water, especially that which contains corrosive contaminants, results in rust and carvitation erosion.

防冻液，一般在冬季用来防冻的冷却液，由于克服了用水作冷却液的诸多缺点，是发动机一年四季均可使用的理想冷却液。

Anti-freeze solution is commonly used in winter, and can prevent the coolant from freezing. It is an ideal coolant due to overcoming many of the disadvantages of water, and can be used in all four seasons.

一、什么是防冻液？

What is anti-freeze solution

防冻液，全称“防冻冷却液”，是用于冬季防冻的冷却液。它的发展经历了一个很长的历史过程。最初在水里添加无机盐以降低冰点或提高沸点，继而又加入有机醇(乙醇、甲醇等)，近年来发展成为乙二醇型、丙三醇型防冻液。后者因价格贵受到限制。目前广泛使用的是乙二醇型。

The development anti-freeze solution and its application already have a long history. At first, inorganic salts were added to water to lower the freezing point and raise the boiling point. Then, organic alcohols (such as ethanol, methanol, etc) were used. Today, glycol and glycerol based anti-freeze solutions are in common use. The popularity of glycerol based solutions is limited by its high price, and so glycol based anti-freeze solutions have received wide application.

防冻液由原液、水和添加剂组成。原液为乙二醇，水为蒸馏水，添加剂包括防锈剂、防霉剂调节剂(缓冲剂)和抗泡剂等。

Anti-freeze solution is made up of raw alcohol, water and additives. The alcohol used is glycol and the water is distilled. Additives include antirust agents, anti-toxicity agents, PH regulating agents (buffering agents), antifoam agents, and other performing enhancing chemicals.

表 1 乙二醇物理化学性质

Table 1 Physical and chemical property of glycol

密度 (20℃) Density(@20℃)	1.113(g/立方厘米) 1.113 g/mL
闪点 Flash point	116(℃)
冰点 Freezing point	-13(℃)

比 热 (20 ℃) Specific heat capacity(@20℃)	2349 [J/(g • ℃)]
沸点(760mmHg) Boiling point (@760mmHg)	197(℃)
蒸 汽 压 力 (20 ℃) Vapor pressure (@20℃)	8(Pa)
蒸 汽 压 力 (100 ℃) Vapor pressure (@100℃)	2133(Pa)
热 导 率 (20 ℃) Thermal conductivity (@20℃)	2.889*0 004 [W/(cm • s • ℃)]

表 2 防冻液调制浓度和冰点

Table 2 Glycol concentration, density and freezing point with anti-freeze solution

冰点℃ Freezing point ℃	乙二醇 浓度% Glycol concentration %	密度 (20℃) Density (@20 ℃)	冰点℃ Freezing Point(@ ℃)	乙二醇 浓度% Glycol concentration%	密度 (20℃) Density (@20 ℃)
-10	28.4	1.0340	-40	54	1.0713
-15	32.8	1.0426	-45	57	1.0746
-20	38.5	1.0506	-50	59	1.0786

-25	45.3	1.0586	-45	80	1.0958
-30	47.8	1.0627	-30	85	1.1011
-35	50	1.0671	-13	100	1.1130

防冻液分为直接使用型和浓缩型，浓缩型防冻液不能直接使用，必须根据使用温度要求用软水按表 2 调制到一定浓度才能使用。

There are two types of anti-freeze solution. The first is the direct-use type; the other is the concentrate type. Concentrate type can not be used directly. It must be diluted to a particular concentration complying with the specifications in Table 2 according to temperature.

目前市场上出现一种长效防冻液，其真相是什么呢?长效防冻液仍然以乙二醇为主要成分。乙二醇具有抗冻和抗沸特点，是必不可少的成分，而且是保持冷却液传热特性的关键。区别如下：

If a new type of long life anti-freeze solution shows up on the market, it is important to be able to judge its utility. Glycol is still the basis for long life anti-freeze solutions. Glycol is an indispensable component in inhibiting water freezing and boiling. Furthermore, it is the key in keeping the heat transfer capability of the anti-freeze solution. The differences between types of glycol-based solutions are as follows:

特征 Characteristic	传统绿色冷却液 Conventional green coolant	长效橙黄色冷却液 Long life orange coolant
颜色 Color	绿色或蓝绿色 Green or green-blue	橙黄色或红色 Orange or red
标准 pH 值 Standard PH value	10.5	8.5
抗 腐 蚀 剂 Anticorrosion agents	硼酸盐磷酸盐和硅酸盐加黄色金属抗腐蚀剂，如甲苯三 唑 Adding metal anticorrosion agents (e.g. tolyltriazole) to borate, phosphate and silicate.	单羧酸盐和二羧酸盐如癸二酸和辛酸等有机盐加甲苯三 唑 Adding tolyltriazole to organic salts, such as Monocarboxylate and dicarboxylate , (e.g. sebacic acid and octoic acid)
污 染 感 受 力 Sensitivity to pollution	硬质水 Hard water	传 统 绿 色 冷 却 液 Conventional green coolant
平均保养寿命 Average	2-3 年 2 to 3 years	4-5 年 4 to 5 years

maintenance life		
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可见二者的区别在于抗腐蚀剂，因为长效冷冻液采用有机酸类盐，化学性能更稳定，因而寿命更长。

Thus, the differences between them lie in the added anticorrosion agents. Because long life anti-freeze solution is made up of organic acid salts, it has more chemistry stability and longer life.

二、优质防冻液具有五大功能

Five functions of good anti-freeze solution

1.防腐功能防冻液中有一组优良持久的缓蚀剂，通过各种试剂与金属达到一种平衡，在金属表面形成保护膜，并且可以把冷却系统中原有的腐蚀产物剥离下来，防止它继续腐蚀。试验证明合格的防冻液对金属的腐蚀要比水小 50 到 100 倍。

Anticorrosion — Anti-freeze solution contains a group of good, long-lasting corrosion inhibitors. It can achieve the equilibrium between reagents and metal, and form a protective film on the surface of the metal. Moreover, it can shell off the original corrosion in the cooling system and prevent further corrosion. Experiments indicate that corrosion by anti-freeze solution is 50 to 100 times lower than that by water.

2.防穴蚀功能穴蚀的原理是无数气泡打击金属所致。试验表

明，含有盐类、碱类的硬水比清洁的软水穴蚀速度大几十倍。而防冻液不含硬水，加入其中的消泡剂能抑制泡沫的产生。

Anti-carvitation erosion—Carvitation erosion is caused by air bubbles colliding with metal. Experiments indicate that corroding rate of hard water containing salts and alkalis is several tens times than that of clean soft water. Anti-freeze solution does not contain hard water, and anti-foaming agents added can prevent the formation of foam.

3.高沸点功能 防冻液的沸点一般在 $105^{\circ}\text{C} \sim 110^{\circ}\text{C}$ ，与水比更难开锅。

High boiling point— Anti-freeze solution boils at 105 to 110°C , which makes it more difficult to boil than water.

4.防垢功能 优质防冻液采用蒸馏水制造，并有防垢剂，所以不会产生任何水垢。

Anti-sludge—Good anti-freeze solution is composed of distilled water and contains anti-sludge agents, so scaling is inhibited.

5.防冻功能 防冻液的冰点是可以调整的，由不同的地方的使用温度来定，其冰点一般在 $-15^{\circ}\text{C} \sim 68^{\circ}\text{C}$ 之间。优质防冻液从外观上看清澈透明、不混浊、无杂质、无刺激性气味。具有以下性能：

Anti-freeze—The freezing point of anti-freeze solution can be adjusted, and is determined by the ambient temperature in different operating locations. Usually it freezes from -15 to -68°C . Good anti-freeze solution is transparent, clean and without irritating odor. Performance criteria are as follows:

1. 1)良好的防冻性能 Good anti-freeze performance.

2)防腐和防锈性能 Anticorrosion and antirust performance.

3)对橡胶密封导管无溶胀及侵蚀性能 No swelling and erosion caused to rubber parts.

4)防止冷却系统结垢的性能。 Prevent cooling system from scaling.

5)抗泡沫性能。 Antifoam performance.

6)低温粘度不太大。 Low viscosity at low temperatures.

7)化学性质稳定。 Stable chemical property.

三、如何选择和正确使用防冻液

How to select and use anti-freeze solution correctly

目前，防冻液的使用比较普遍，由于对防冻液的使用性能、使用要求和使用方法缺乏了解，给汽车带来不少麻烦。诸如难启动、管接头泄漏、胶管破裂、加不进水、散热器腐蚀和缸套穴蚀等。

These days, anti-freeze is in common use. Being short of knowledge of its performance in service, requirements, and methods of application may cause a variety of problems for a vehicle. Difficulty starting, leaky pipe joints, hose cracks, water not being added, radiator corrosion, and cylinder sleeve carvitation erosion are some of the troubles which may be experienced.

1 选择防冻液的原则 Guide to anti-freeze solution selection

1) 根据环境温度选择不同冰点的防冻液。

防冻液的冰点应比该地区历史最低气温低 10℃ 左右。

Select an anti-freeze solution with different freezing points with regards to ambient temperature. The freezing point of an anti-freeze solution should be approximately 10℃ lower than the historically

lowest temperature in the operating area

2) 按照车辆多少和集中程度选择。

Select it in terms of the amount of vehicles to be maintained.

车辆较多又相对集中的单位和部门，可以选用小包装的防冻液母液，这种防冻液母液性能稳定，由于采用小包装，便于运输和贮存，同时又可按照不同环境使用条件和不同的工作要求进行灵活的调制达到节约和实用的目的。车辆少或分散的情况下，可以选用直接使用型的防冻液。

Departments which have many and relatively centralized vehicles can select small packages of anti-freeze solution concentrate, because it is stable, and small packages are convenient to transport and store. In addition, the flexible preparation of operational anti-freeze solutions in light of ambient circumstances and working requirements is more economical and practical. Conversely, if the number of vehicles is few or dispersed, the direct-use type can be selected.

3) 选用优质的防冻液，不得使用劣质的防冻液。

Select a high-grade anti-freeze solution, and do not use a low-grade anti-freeze solution.

优质的防冻液一般是国家指定的检测站检测合格的品牌，从外观上看：清澈透明、无杂质、不浑浊、无刺激性气味，产品外包装上应有详细的生产单位名称，产品说明书以及明确的指标说明。使用劣质的防冻液不但不能防冻防沸，反而会加速冷却系统的腐蚀。

High-grade anti-freeze solution is generally a qualified brand approved by a national authentication center. It is transparent, clean and without irritating odor. Detailed producer information, product description and detailed directions for use are displayed on the external package. Low-grade anti-freeze solutions not only do not inhibit freezing and boiling, but also accelerate the corrosion of the cooling system.

4)选择与橡胶密封件(管)相匹配的防冻液。

防冻液应对橡胶密封件(管)无溶胀和侵蚀等副作用。

Select an anti-freeze solution compatible with rubber sealing components. Anti-freeze solution should not bring undesired side effects, such as swelling, erosion to rubber, etc.

2 如何正确使用防冻液。

How to use anti-freeze solution correctly.

1) 加注防冻液前一定要对冷却系统进行彻底清洗。

若未清洗干净便加注防冻液，会使防锈效果减弱。可按以下步骤清洗：(1)启动发动机，使冷却液达到节温器开启温度，停机，将冷却液放干净。(2)用 10%烧碱水溶液作冷却液使发动机高速运转 5min，浸泡 1h 后放尽。(3)加注软水，使发动机高速运转 10min，将水放尽。反复(3)几次，直到放出的水无污染为止。

Be sure to wash the cooling system completely before adding anti-freeze solution, otherwise its antirust effect may be weakened. The

washing sequence is as follows: (1) First, start and then stop the engine when the temperature of anti-freeze solution rises to the opening temperature of the thermostat. Then, drain the anti-freeze solution. (2) Make the engine operate at high speed for 5 minutes with a water solution of 10% caustic sodium as coolant, and then drain it after soaking for an hour. (3) Make the engine operate for 10 minutes after adding soft water, and then drain. Repeat (3) several times until the drained water is uncontaminated.

2)加注防冻液前一定要检查冷却系统有无渗漏现象,及时排除后才能加防冻液。乙二醇表面张力小,极易从缝隙中泄漏。因此,换用防冻液前,必须检查并紧固冷却系统各支管和接头,以防发生泄漏。

Be sure to check for leakage in the cooling system before adding anti-freeze solution. Add it only after stopping any leak. Glycol easily seeps through cracks due to its low surface tension. Therefore, it is necessary to check the whole cooling system, especially the pipe lines and connection joints to avoid leakage before replacing the anti-freeze solution.

3)防冻液膨胀率比水大,如果没有膨胀水箱,防冻液只能加到冷却系统容积的 95%。

The expansion coefficient of anti-freeze solution is greater than that of water. If there is no expansion tank, anti-freeze solution can only be added to 95% the volume of the cooling system.

4)禁止直接加注防冻液母液(浓缩型), 禁止用硬水调配防冻液。

Be sure not to add anti-freeze solution concentrate directly or mix the solution with hard water.

4) 防冻液使用中要定期检查。

Periodic checking of the operation of anti-freeze solution is necessary.

使用一般时间后, 防冻液会出现短少, 这时首先检查防冻液的密度。如果密度没有增加, 这是由于渗漏引起的, 应加入同牌号的防冻液; 如果密度下降, 应加入同牌号的防冻液浓缩液; 如果密度增加, 这是由于水蒸发引起的, 应加入蒸馏水或去离子水。加入蒸馏水或浓缩液后, 待搅拌均匀再检查防冻液的密度, 直到所需冰点对应的密度为止。切勿加入普通用水(如河水、湖水、池水、井水、自来水等), 因为这些水中有杂质, 会消耗一部分防腐剂。

Anti-freeze solution may decrease in quantity after being used for a period of time. Its density should be checked first. If its density has not increased and any decrease is the result of leakage, the same brand anti-freeze solution should be added. If density decreases, the same brand solution concentrate should be added. If density increases, or any decrease is caused by water evaporation, distilled-water or de-ionized water should be added. After adding distilled water or concentrated solution, check the density of anti-freeze solution after

mixing thoroughly until it reaches the density corresponding to desired freezing point. Do not use common water (such as river water, lake water, pool water, well water, tap water, etc), because these kinds of water contain impurities, which would decrease the anticorrosion performance of the solution.

6)不同牌号的防冻液不能混用,以免破坏各自的综合防腐能力。

Do not mix different brands of anti-freeze solution to avoid disabling the action of complex anti-corrosion agents.

7)长效防冻液使用年限一般为 1~2 年,到期后要更换。为了减少浪费,可在到年限后检查防冻液的 pH 值。如果 pH 值高于 5.5 可以继续使用;如果 pH 值低于 5.5,应及时更换,否则会加速冷却系的腐蚀。在 pH 低于 5 的冻液中加入延效剂,可使防冻液延长使用 1 年。

The service term for long life anti-freeze solution is generally one to two years. Replace it when it becomes due. If the PH value is higher than 5.5, it can continue to be used; if the PH value is lower than 5.5, it should be replaced, otherwise it would accelerate corrosion in cooling system. A validity extending agent can be added to anti-freeze solution whose PH value is lower than 5, which can prolong its use term up to one year.

8)乙二醇有毒,对肝脏有损害,切勿吸入口中,皮肤接触后,要用水清洗。亚硝酸钠为致癌物质,废液不要乱倒,以免污染环境。

Glycol is poisonous and harmful to the human liver. Do not ingest it.

Washing is necessary if it contacts skin. Sodium nitrite is a carcinogenic substance. Do not dump the exhausted solution to prevent pollution to the environment.

附录三 喷油器使用注意事项

尊敬的玉柴顾客：

由于喷油器已更改，使用前请您仔细阅读以下第 1 项和第 2 项的说明：

1. 请注意发动机生产日期：

● 2003 年 12 月 1 日前生产的发动机只能使用“二节圆”结构的油嘴偶件作维修配件；

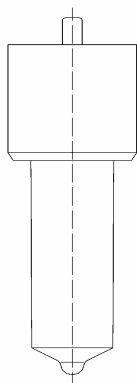
● 2003 年 12 月 1 日起生产的发动机只能使用“三节圆”结构的油嘴偶件作维修配件。

2. 请注意产品标识：

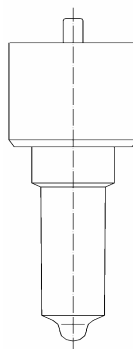
● 产品标识为“530-A”的气缸盖或“1530-A”的气缸盖只能使用“三节圆”结构的油嘴偶件作维修配件；

● 产品标识为“530”的气缸盖或“1530”的气缸盖只能使用“二节圆”结构的油嘴偶件作维修配件。

附油嘴偶件示意图：



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“二节圆”油嘴偶件

“三节圆”油嘴偶件