G32柴油机技术介绍

Technology Review of G32 Diesel Engine

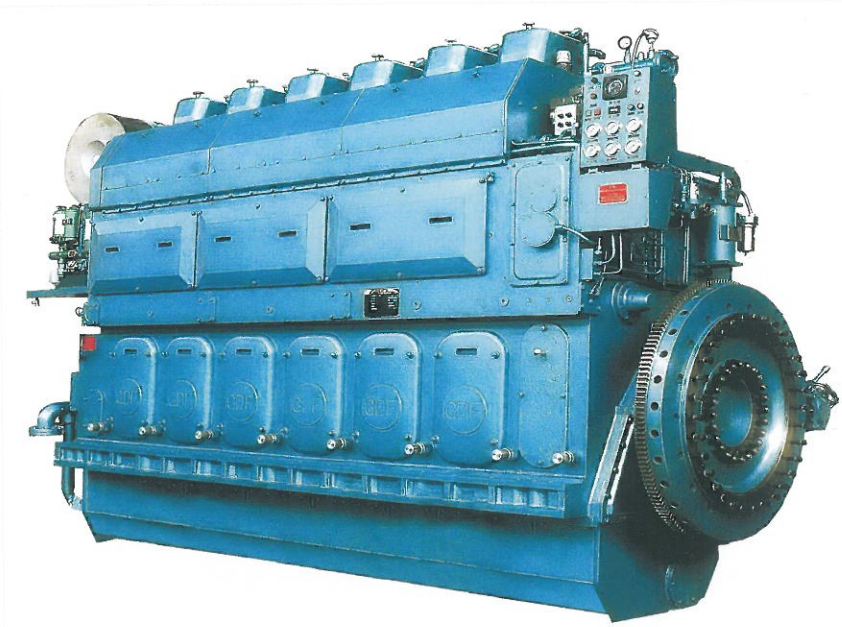
GDF®

广州柴油机厂股份有限公司

GUANG ZHOU DIESEL ENGINE FACTORY CO.,LTD

G32柴油机 G32 diesel engine

- **广州柴油机厂股份有限公司**(前身协同和机器厂)是中国柴油机制造业中历史最悠久的企业之一。G32系列船用中速柴油机是广州柴油机厂股份有限公司近年来研发的产品。
- G32系列柴油机结构、主要性能指标达到国际先进水平，获得**CCS、GL、BV、NK**等船级社颁发的工厂认可、产品认可等证书。
- 至2010年底，已有一百余台G32系列柴油机在集装箱船、油船、海洋工作船、散货船、海上浮吊船、挖泥船、海峡火车渡船等船舶上使用，总累积运行时间已超过600000小时。



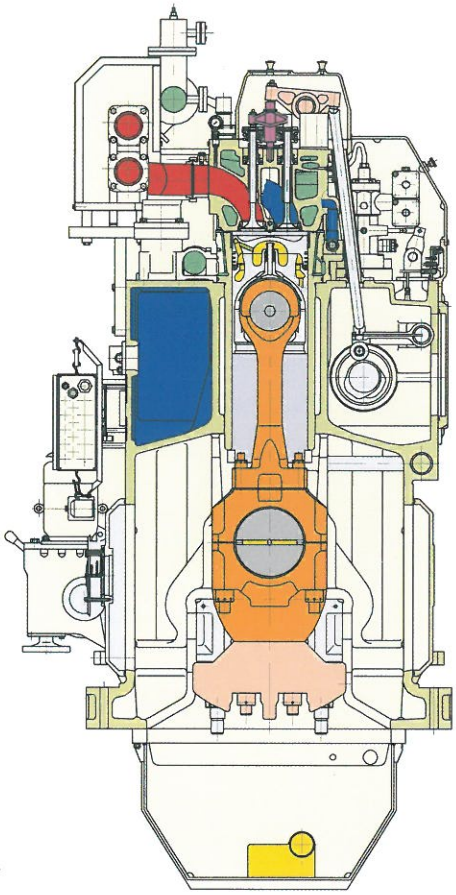
- **Guangzhou diesel engine factory Co.,Ltd** (formerly known as Hip Tung Wo Machinery factory) is one of the oldest diesel engine manufactures in China. The company has developed G32 series marine medium-speed diesel engine in recent years.
- G32 series diesel engine with its configuration and performance has reached international advance level, also obtained work approval certificates and product approval certificates issued by **CCS、GL、BV、NK** etc.
- By the end of 2010, it had about 100 sets of G32 diesel engine used in container ship, oil ship, marine working ship, bulk carrier, floating ship, dredger and train carrier etc., with the running time over 600000 hours.

目录 Technology Review

设计理念 Design Philosophy

G32柴油机在设计时就已经确立了高效、可靠、环保的原则。设计过程中，在采用了船用柴油机最新技术的同时，也考虑了制造工艺的适应性。在确保较长的维护保养周期的前提下，也使维护更加便捷。

The G32 diesel engine is based on the principle of high-efficiency, reliability, environmental protection . The most advanced marine diesel engine technology is adopted during designing. It is designed for flexible manufacturing methods and long maintenance-free operating periods and easy maintenance.

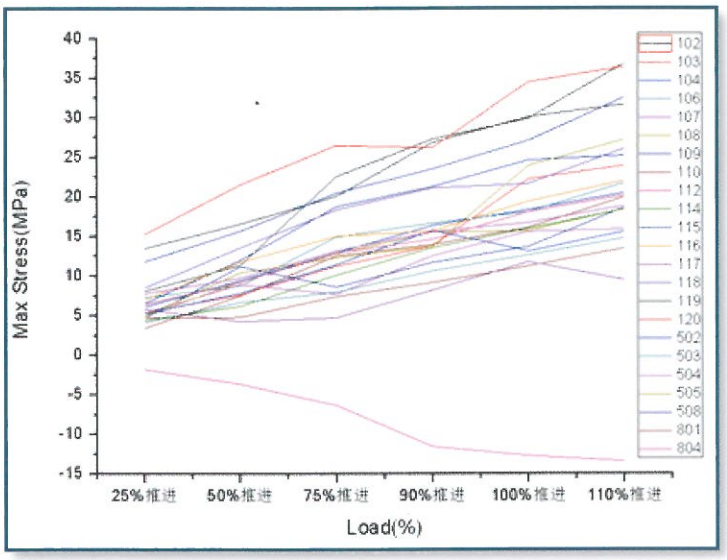


- 优化高效增压系统和燃油喷射系统使燃油消耗率大幅降低
  Optimum high effective turbocharging system and fuel injection system make specific fuel consumption greatly reduce.
- 优良的制造工艺进一步保证了零部件的使用寿命
  Excellent manufacturing process further ensures the service life of parts and components.
- 基于人体工程学的设计
  Design based on ergonomic engineering.
- 符合国际海事组织IMO-TierⅡ的排放要求
  Meet EIAPP IMO-TierⅡ emission requirements.
- 可以燃用380cSt /50℃重油
  Can use 380cSt /50℃ HFO.
- 更周密的监控系统保证柴油机的安全运行
  Closer monitoring and controlling system to ensure the safety operating of the engine.
- 提高结构件的刚性减少变形，确保可靠性
  Improving the stiffness of parts and reducing deforming to ensure the reliability.

机舱_8G32柴油机
8G32 in the Engine Room

G32系列柴油机获得中国船舶重工集团公司科学技术一等奖
G32 series diesel engine win First prize of Science and Technology issued by CSIC

机体 Engine Block



机体工作应力测试 Working stress test for engine block

机体为悬挂式主轴承结构，进气道和主润滑油道与机体的其他部分一齐铸造出来，通过纵、横拉杆螺栓将主轴承盖与机体码合为一体，加上采用了高强度的球墨铸铁材料，使机体结构简洁并具有极高的刚性。

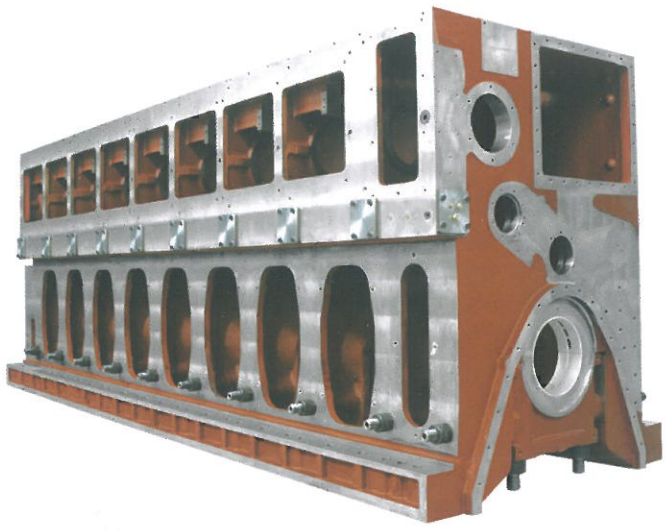
The engine block is of suspended main bearing structure. The inlet duct and main lubricated oil passage are cast together with other parts of the engine block, and the main bearing cover are clamped with engine block by the longitudinal/cross tie rod bolts, in addition, it is made of nodular cast iron, all these make the engine block structure simple with highest rigidity.

机体内无冷却水腔，避免了冷却水渗漏对润滑油污染的可能性。气缸套和气缸盖由安装在机体上方的水道供水冷却。

There is not cooling water chamber in engine block to avoid the possibility of pollution of lubricating oil due to the cooling water leakage. The cylinder liner and cylinder head are cooled by cooling water supplied by the water jacket on the top of the engine block.

机体采用无管道设计，其他润滑油道在机体上直接加工出来，既减少了零部件同时也极大地提高了柴油机的可靠性。

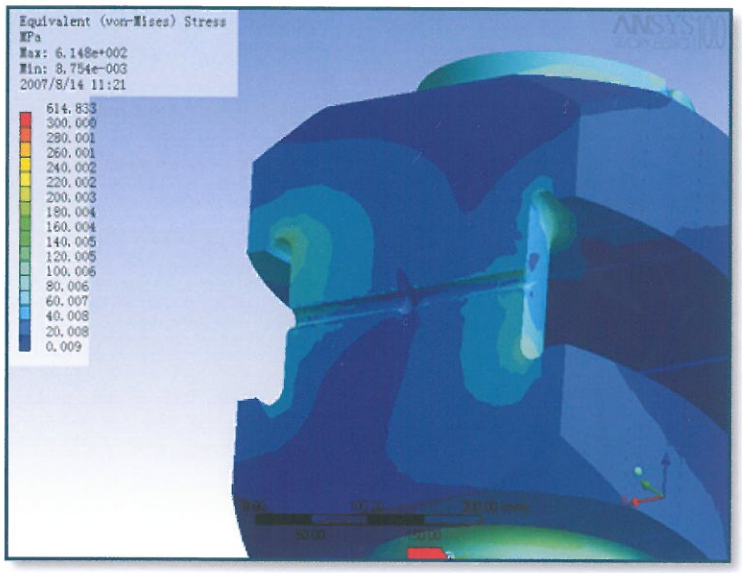
The design of engine block adopts no-duct design concept, other lubricating oil channels are directly machined in the engine block, such the number of engine parts is greatly reduced and the reliability of engine is improved.



曲轴 Crankshaft

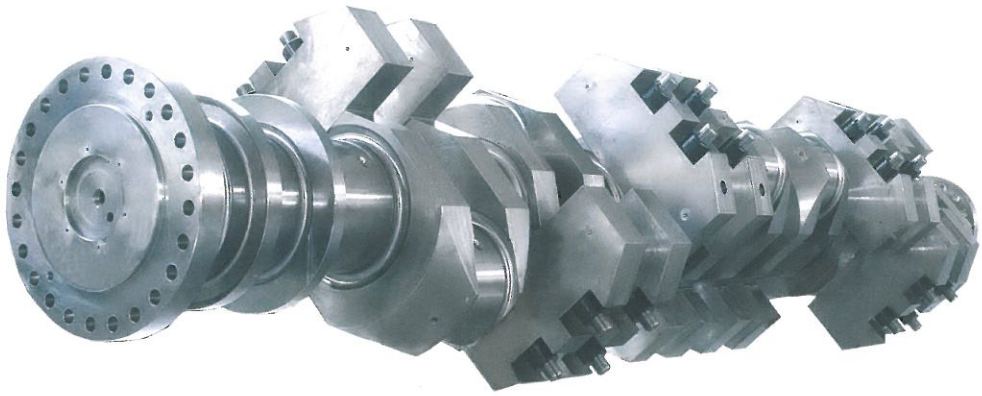
随着柴油机性能的不断提高，气缸内燃烧压力也在不断提高，为了保证曲轴在很高的负荷下安全运行，曲轴的结构设计，材料选择和制造工艺都非常关键。G32柴油机曲轴是采用特殊的优质合金钢以全纤维连续锻造而成。

As the performance of the diesel engine improves, combustion pressure becomes higher, so the construction design, choice of material and manufacturing technology for crankshaft are very crucial for ensuring that the crankshaft with heavy loads can safely operate. The G32 crankshaft is forged with continuous grain flow, material of which is special high-quality alloy steel.



而恰当的轴颈尺寸和精心设计的轴颈圆角也使曲轴在保证安全运行的前提下尺寸不至于过大。

The suitable journal dimension and carefully designed fillets make the crankshaft dimension be not too big on the premise of safety operating of crankshaft.



合理设计曲轴的平衡块使曲轴的工作应力和轴承负荷合理分布，大大提高了曲轴的可靠性。当然，轴瓦的设计和制造也是十分重要的。

The reasonable design of crankshaft counterbalance makes working stress of crankshaft and bearing load distribute evenly, which greatly improve the reliability of crankshaft. At the same time, the design and manufacture of bearing shells are important.

活塞及活塞环 Piston and Piston Ring

对于高性能燃用重油的柴油机而言，钢顶球墨铸铁裙的组合式活塞已成为无可替代的了，G32柴油机自然也采用了这种结构。活塞顶通过钻孔冷却和环槽硬化，使活塞在燃用重油的恶劣条件下寿命也得以大大延长。

在活塞环中，第一条气环的工作条件最为恶劣，因此它的形状和尺寸均经过多次测试才最后确定。同时，所有气环上还镀上了特殊的减磨材料。

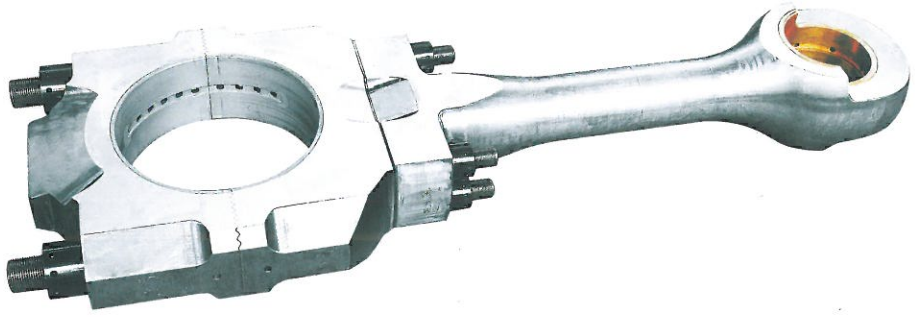
The G32 engine adopts the composite piston with a steel crown and nodular cast iron skirt, which is not replaced by any structure of piston for high performance engine operated on HFO. The service life of piston is extended under awfully condition by drilling hole in piston crown to cool the piston and harden the ring grooves .

The working condition of the first ring is worst in all piston rings, so its shape and dimension are determined throughout measuring and testing for several times. At the same time all the rings are provided with an special wear-resistant coating.

连杆 Connecting Rod

G32柴油机连杆采用船用式的三段结构，保证了大端孔有足够的尺寸和结构刚度。上下轴承盖之间用高精度的齿形啮合在一起。连杆外形全部经精确加工而成，有效地保证了曲轴的平稳运转。

The G32 connecting rod adopts marine three-piece structure, which ensure the big-end bearing hole has enough dimension and stiffness. The upper and lower bearing covers are meshed together by fine grinding teeth. Dimensions of connecting rod are formed by fine machining, which effectively ensure that the crankshaft can run smoothly.



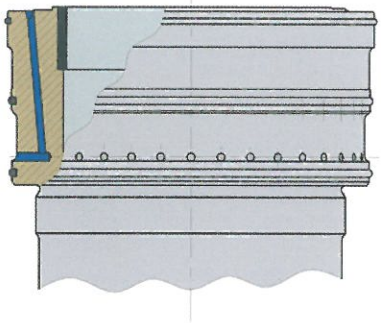
气缸套及减磨环 Cylinder Liner and Anti-polishing Ring

气缸套上部为又厚又高的凸缘，该凸缘的设计使气缸套在很高的预紧力和燃烧压力下不会产生任何变形。

气缸套采用钻孔冷却的方式来控制缸壁温度，使缸壁温度总是保持在合理的范围。

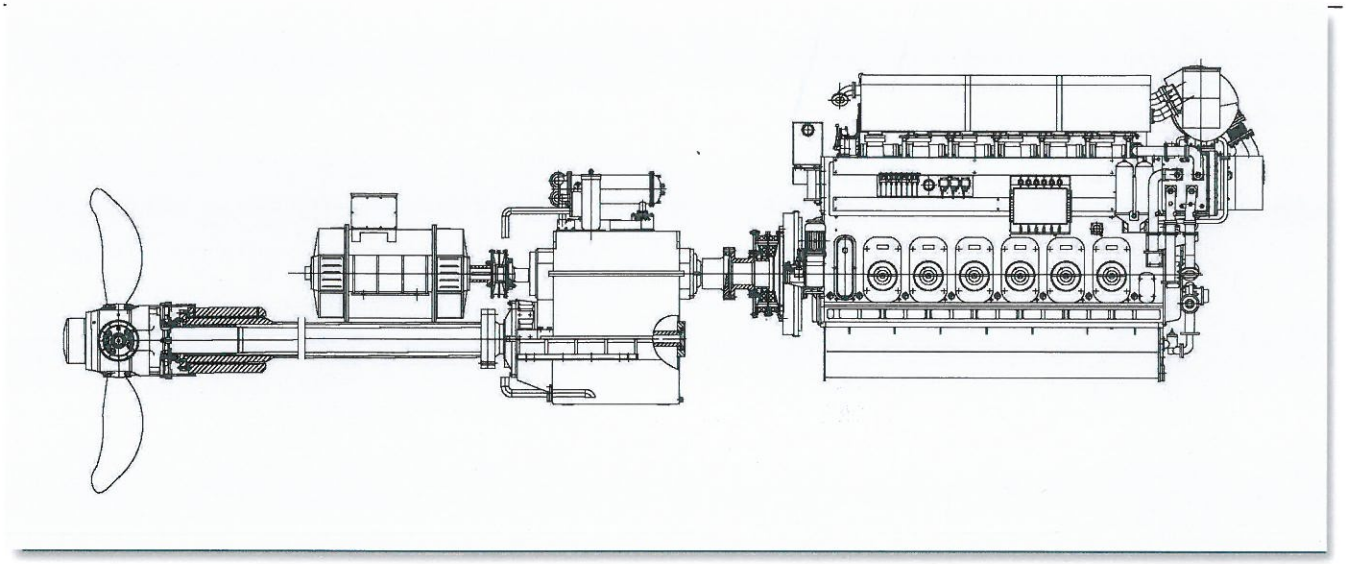
The cylinder liner upper part is thick and high flange, and this makes the cylinder liner not change under high pretightening loads and combustion pressure.

Its temperature is controlled by bore cooling of liner wall to keep the temperature of liner wall in reasonable range.



气缸套上部装有一减磨环，该减磨环能有效地控制活塞头部积碳的厚度，使积碳不会与缸壁接触，保证了油膜不被破坏，在减少缸套磨损的同时也降低了润滑油消耗。

In the upper end the liner is equipped with an anti-polishing ring to control the thickness of carbon deposits formed on the piston crown to prevent any contact between the liner wall and deposits at any piston position. When there is no contact between the liner and deposits, the oil film can not be destroyed. The other positive effect is that liner wear is reduced and lube oil consumption is lowed at the same time.

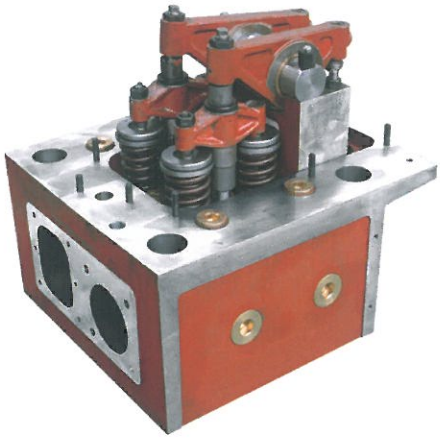


G32柴油机配可调桨推进系统实例 Propeller system example for G32 engine with CPP

气缸盖 Cylinder Head

气缸盖采用独特的四螺栓设计，其高度达400mm，由高性能球墨铸铁铸造而成。所有这些措施的目的都是为了加强气缸盖的刚性，一个高刚性的气缸盖是保证其在高爆压下不变形和气密封性能的基本条件。

The cylinder head design is based on the special four-screw concept. Its thickness is 400mm.It is cast with high performance nodular cast iron.The purpose of above designs is to reinforce the stiffness of cylinder head.The cylinder head with high stiffness is essential condition for ensuring both no deformation under high explosion pressure and seal performance.



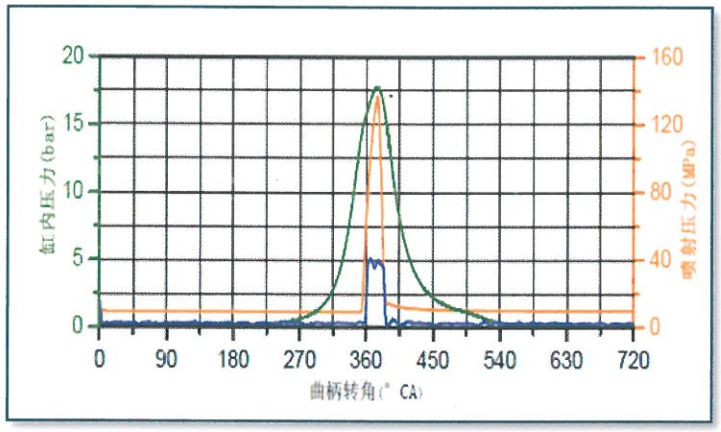
四螺栓的布局使气缸盖内部有足够的空间来布置进、排气道和冷却水道，使进、排气流动损失减至最低，也可获得良好的冷却效果。

A four-screw cylinder head design makes the inner of cylinder head have enough space to arrange the air inlet , exhaust channels and cooling water channel, such the flow loss of inlet air and exhaust air may be reduced to a minimum and the cooling effect is good.

长期燃用重油气缸盖底面情况
Undersurface state of cylinder head of engine longtime operated on HFO

气缸盖零件工作应力测量
Working stress test for cylinder head

燃油系统 Fuel System

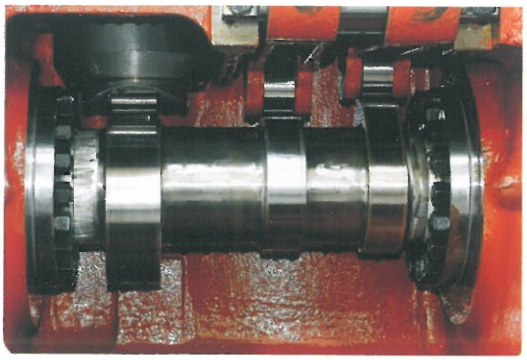


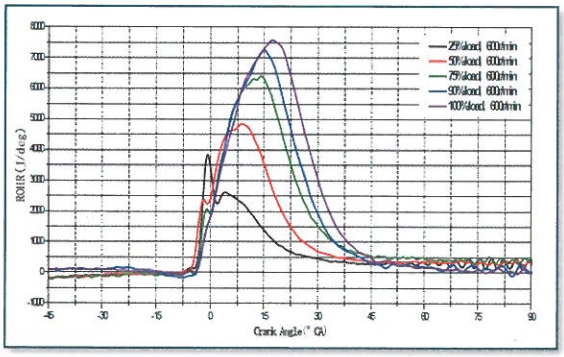
高性能的喷油泵和喷油器可令燃油喷射压力达到150MPa，高喷射压力使燃油的雾化效果更好，油粒的穿透力更强，从而显著地降低了燃油消耗率。

The high-performance fuel injection pump and injector make the injection pressure reach 150MPa, which makes the fuel atomization better and penetration force of oil particle stronger, thereby the specific fuel consumption is markedly decreased.

优化设计的供油规律以及燃油系统的良好匹配在提高了喷油速率的同时，通过采取缩短喷油持续角，选择适当的最高燃烧压力等措施，获得等压燃烧的效果，实现对NOx排放的控制。

The optimum design of fuel supply rate curve and perfect matching of fuel system make the speed rate of fuel injection increase, at the same time, some measures are taken, such as shortening the injection duration angle and choosing the reasonable max. combustion pressure, in order to get isobaric pressure combustion, thereby the emission NOx is controlled.





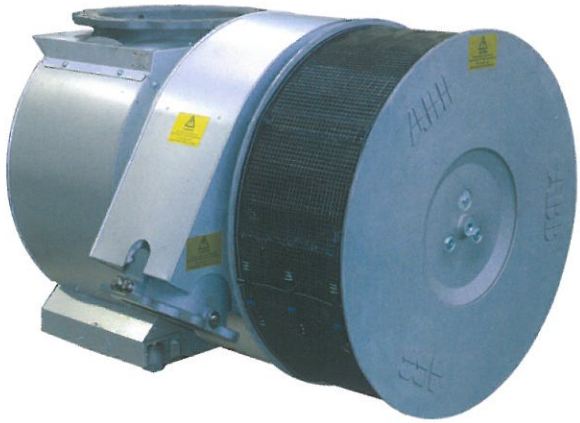
增压系统 Turbocharging System

G32柴油机采用了效率很高的增压器，柴油机在高负荷时，压比达到≥4.

采用Miller循环等技术，使其符合IMO-TierⅡ的排放要求，并获得中国船级社颁发的【柴油机国际防止空气污染证书】。

增压器是非水冷式的，其简洁的结构使维护保养十分方便，采用特殊的滑动轴承拥有比滚动轴承更长的使用寿命。润滑油由柴油机的润滑系统供应。

各型号柴油机采用不同的排气管系统，系统的成功匹配使该机型在任何工况下均无可见烟色。



The G32 engine adopts effective turbocharger which makes the compression ratio of the engine with high load reach ≥4.

Adopts Miller cycle etc. technique to make it meet IMO-TierⅡ emission requirements, and get 【Engine International Air Pollution Prevention Certificate】issued by CCS.

Turbocharger isn't cooled by water, simple structure of which make the maintenance easy. The service life of turbocharger with special plain bearings is longer than that with rolling bearings. The lube oil of turbocharger is supplied by the lubricating system of the engine.

The differnt model engine adopts different exhaust piping system according to engine model characteristic, which makes colour smoke unseen under all working condition because the system is matched successful .

国家科学技术进步奖

证 书

为表彰国家科学技术进步奖获得者，特颁发此证书。

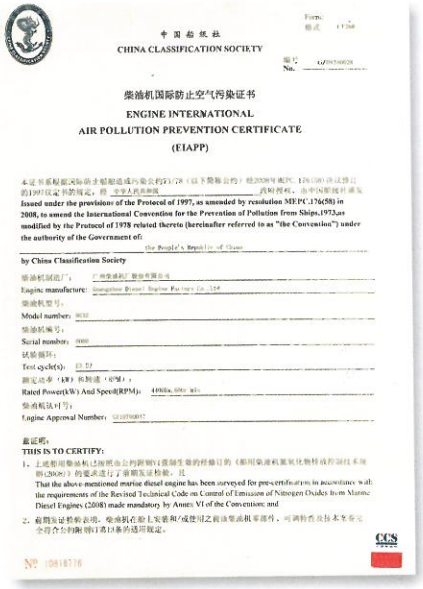
项目名称：混合式脉冲转换涡轮增压系统研发及在四冲程大功率柴油机上的应用

奖励等级：二等

获 奖 者：广州柴油机厂

2009 年 1 月 12 日

证书号：2009-J-217-2-05-004



中国船级社

CHINA CLASSIFICATION SOCIETY

柴油机国际防止空气污染证书

ENGINE INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

(EIAPP)

Issued under the provisions of the Protocol of 1997, as amended by resolution MEPC.176(58) in 2008, to amend the International Convention for the Prevention of Pollution from Ships,1973,as modified by the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

the People's Republic of China

by China Classification Society

Engine manufacturer:

Model number:

Serial number:

Test cycle(s):

Rated Power(kW) And Speed(RPM):

Engine Approval Number:

THIS IS TO CERTIFY:

That the above-mentioned marine diesel engine has been surveyed for pre-certification in accordance with the requirements of the Revised Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines (2008) made mandatory by Annex VI of the Convention; and

CCS

研发成果获得【国家科学技术进步奖】、获得【柴油机国际防止空气污染证书】等

Win 【Reward of National Science and Technology Progress】, and obtain 【Engine International Air Pollution Prevention Certificate】

冷却系统 Cooling System

冷却系统分为高温和低温两个冷却回路。

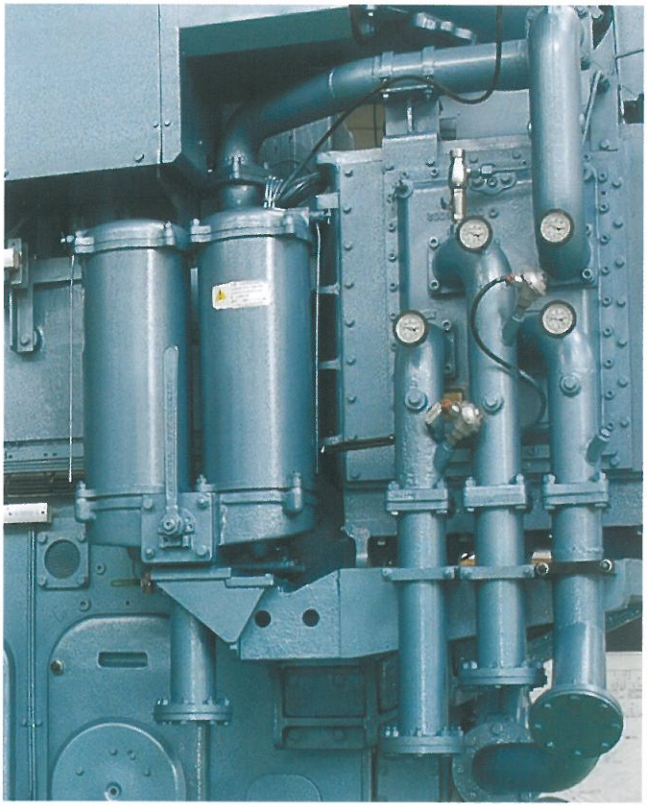
高温冷却回路使气缸盖和气缸套保持在较高温度的状态下工作，在低负荷时通过中冷器适当提高进气空气温度，改善低负荷时的燃烧条件和避免出现低温腐蚀现象。

低温冷却回路冷却滑油冷却器、中冷器，不经过气缸套和气缸盖，从而有效地减少了冷却水带走的热量，提高了柴油机的热效率。

The cooling system is split into two separate circuits, the high temperature and low temperature circuits.

The high temperature circuit keeps the temperatures of cylinder head and cylinder liner at a high level of normal range .The inlet air temperature is added by charging air cooler for improving the combustion condition and avoiding the corrosion in low temperature at low loads.

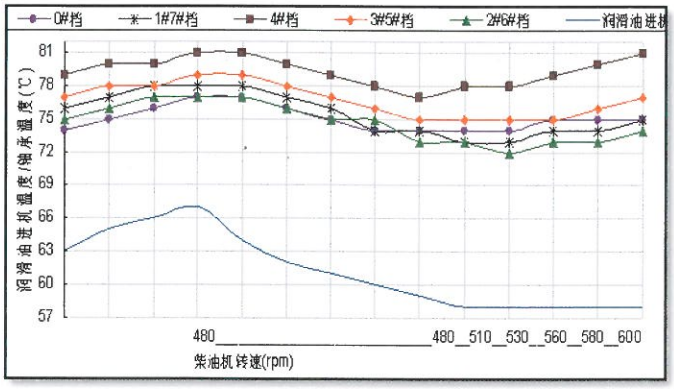
The low temperature circuit cools the cooler of lube oil, Charge air cooler, which doesn't pass the cylinder liner and cylinder head, thereby the heat taken away by cooling water is reduced effectively and the thermal efficiency of engine is increased.



润滑系统 Lubricating Oil System

G32柴油机的润滑系统包括由机带的主润滑油泵、机外布置的预润滑泵、润滑油冷却器和全流量的反冲式过滤器，及在柴油机进油口处的全流量过滤器。这样的系统配置最大限度地消除了润滑油中可能存在的杂质对柴油机的不利影响。

The lubricating oil system includes an engine-driven main lube oil pump, pre-lubricating pump, cooler, full flow back-flushing filter outside of the engine and full flow filter at the lube oil inlet of the engine. This system can eliminate the disadvantage influence of impurity in lube oil on the engine.



润滑系统参数分析
Parameter analysis of lubricating oil system

G32柴油机 G32 diesel engine

控制系统 Control System

G32柴油机采用了先进的计算机监控技术。配置了包括主轴承温度在内的近50个检测点，实时监测着柴油机的运行状态保证其可靠运行，通过与电控调速器配合，还能实现对柴油机的远程控制。

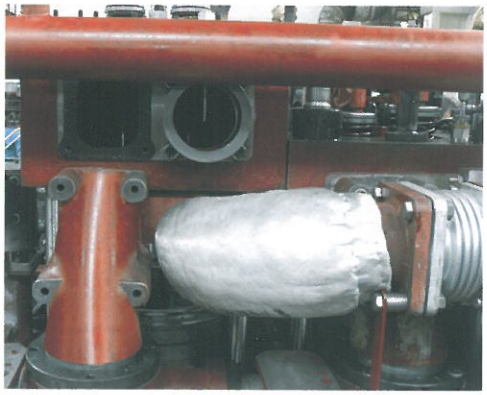
The G32 adopts advanced computer monitoring and controlling technology. The operating states of engine are monitored by 50 check points including main bearing temperatures in real time. If the control system is cooperation with electrical governor, the engine may be remote-controlled.

控制系统包括主控单元，接线箱和分布在机上的各个传感器和执行机构。主控单元安装在发动机外，可以实现对发动机运行数据的远程采集和显示。

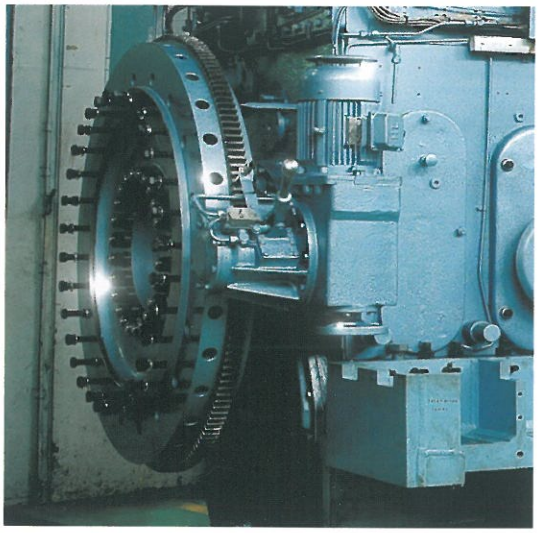
The control system includes main control unit, wiring box, various sensors and actuators distributed in the engine. The main control unit is installed outside of the engine, which may remotely collect and display the operating data of the engine.

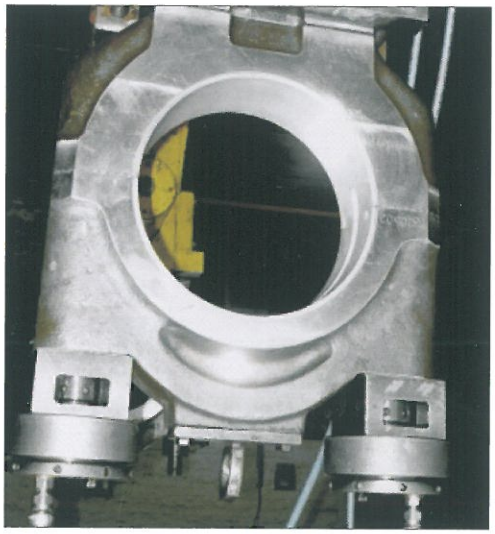
便捷的维护 Easy Maintenance

- 由于采用无管路设计以及基于人体工程学的设计理念，使得G32柴油机的维护更加便捷
- 无水式机体及水套的设计使得不需要拆下任何一条水管就能将气缸盖拆下来。
- 包括气缸盖螺栓，主轴承螺栓，连杆螺栓在内的强力螺栓均采用液压拉伸方法进行拆装。
- 三段式的连杆设计有效地降低了吊缸高度。
- 电动盘车机构，使检测工作轻松方便。



- The no-duct design and design philosophy based on ergonomic engineering make maintenance of G32 engine easy.
- The cylinder head is dismounted without dismounting any water pipe due to the water-free type engine block and water jacket designs.
- The strong force bolts including the bolts of cylinder head, main bearing and connecting rod are dismounted by hydraulic tension methods.
- The three-piece connecting rod design effectively lowers the height of lifting the piston.
- Electric turning mechanism let the checking work easy and convenient.





G32柴油机为各种船舶提供可靠动力
G32 engines supply the reliable power for various ships.

■ 琼州海峡‘粤海铁3号’、‘粤海铁4号’火车渡轮__分别使用8G32×2 主机

Qiongzhou Channel YueHai Railway No. 3 and No. 4 ferry__ 8G32×2 diesel engine respectively

■ '济海8005'海洋工作船__6G32A×2主机
'JiHai 8005' marine working ship __ 6G32A×2

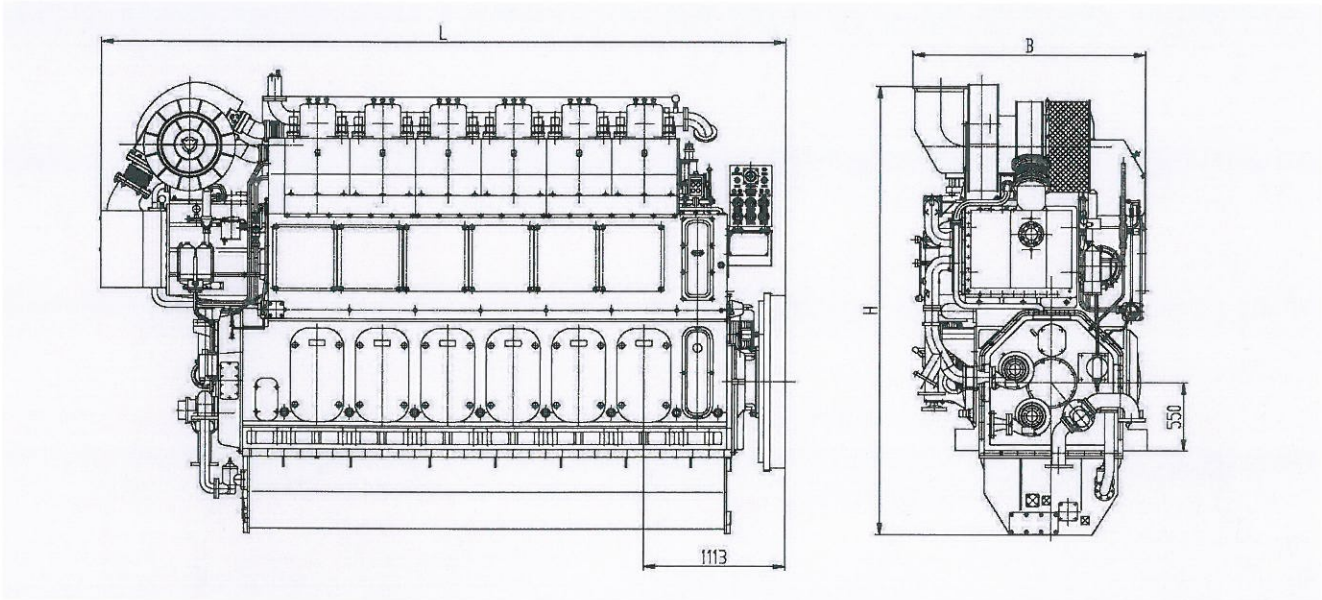
■ '江信 7'集装箱船__6G32A×1主机
'JiangXin7' container ship__ 6G32A×1

■ '华联盛1'挖泥船__ 9G32×1 + 6G32 ×2
'HuaLianSheng1'dredger __ 9G32×1 +6G32×2

■ 'SAAG'成品油船__6G32×1主机
'SAAG' product oil tanker__ 6G32×1

主要技术参数 Main Technical Data

项目Item / 型号Model		6G32	6G32A	8G32	8G32A	9G32
气缸数 No. of cylinders		6		8		9
气缸直径 Cylinder bore	mm	320				
活塞行程 Piston stroke	mm	480				
持续转速 Speed at MCR	r/min	600				
持续功率 MCR	kW/Ps	2665/3600	2930/4000	3552/4800	3906/5310	4400/6000
平均有效压力 Mean effective pressure	MPa	2.30	2.53	2.30	2.53	2.53
活塞平均速度 Mean piston speed	m/s	9.6				
燃油消耗率 Specific fuel oil consumption	g/kW.h	185/183（85%MCR）				
滑油消耗率 Specific lube oil consumption	g/kW.h	≤ 0.8				
主要尺寸 Main dimensions (L×B×H)	mm	5580×1924×3640		6727×1904×3605		7257×1910×3930
重量 Weight	kg	36500		46000		54000



注 Note:

燃油消耗率按ISO基准环境条件标定，允差5%，不带泵。

Specific fuel oil consumption is defined under ISO standard reference condition.
The allowable deviation for specific fuel oil consumption is +5 % without engine driven pumps.

产品技术参数如有调整，以随机技术文件为准。

The technical document with engine prevails if the technical data of product is adjusted.

广州柴油机厂股份有限公司（原广州柴油机厂）

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