G系列柴油机（改进型）使用保养说明书

Operation and Maintenance Manual
G Series Diesel Engine (Improved Model)

S00017326+03

上海柴油机股份有限公司
SHANGHAI DIESEL ENGINE CO.,LTD.

G 系列柴油机（改进型）使用保养说明书

Operation and Maintenance Manual
G Series Diesel Engine (Improved Model)

上海柴油机股份有限公司

2016 年 11 月

Shanghai Diesel Engine Co., Ltd.

November of 2016

告诫

为降低人员受伤和财产损失的可能性，降低柴油机性能恶化及柴油机早期磨损或损坏的可能性，请务必认真遵守本手册中所给出的安全须知和操作规范，尤其是操作警告和注意事项。

本手册中给出的警告部分内容必须严格遵循，否则会引起烧伤、截肢、致残、窒息、其他人身伤害或死亡的可能；注意部分内容是提醒操作者必须按正确的方法操作，以避免柴油机零部件损坏或柴油机性能恶化。这些“警告”和“注意”并不周全，上海柴油机股份有限公司不可能，也不能给出违反这些安全须知和操作规范而产生的所有潜在的危险后果。

产品报修、技术咨询、投诉与建议

产品报修、技术咨询、投诉与建议，请与上柴“易+人”呼叫中心联系，365×24 小时为您提供快捷、专业、真情的服务。全国免费服务热线 400-820-5656。

产品报修，请务必提供如下信息：

柴油机型号

柴油机订货号

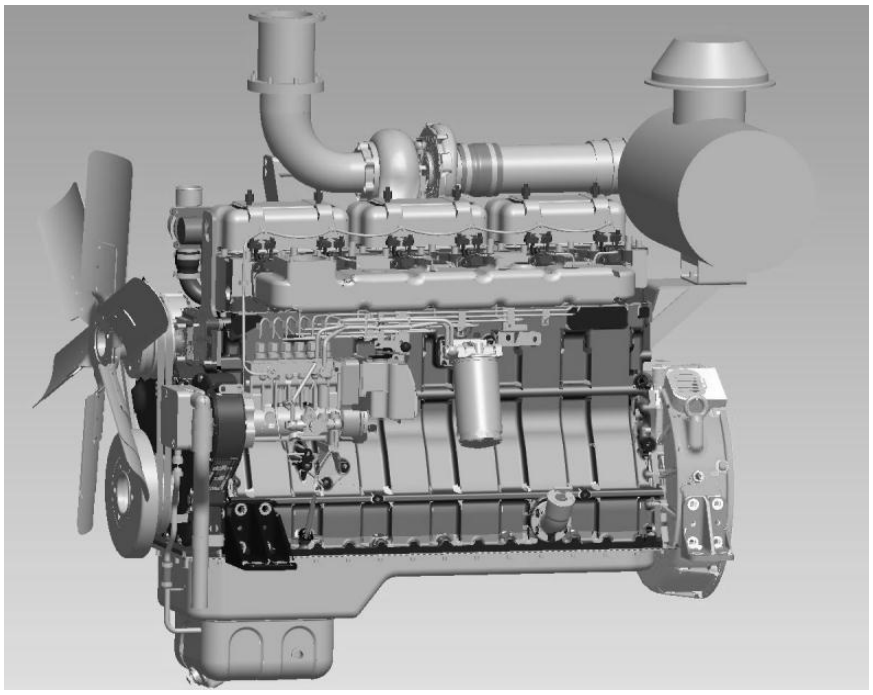
柴油机机号

设备采购日期

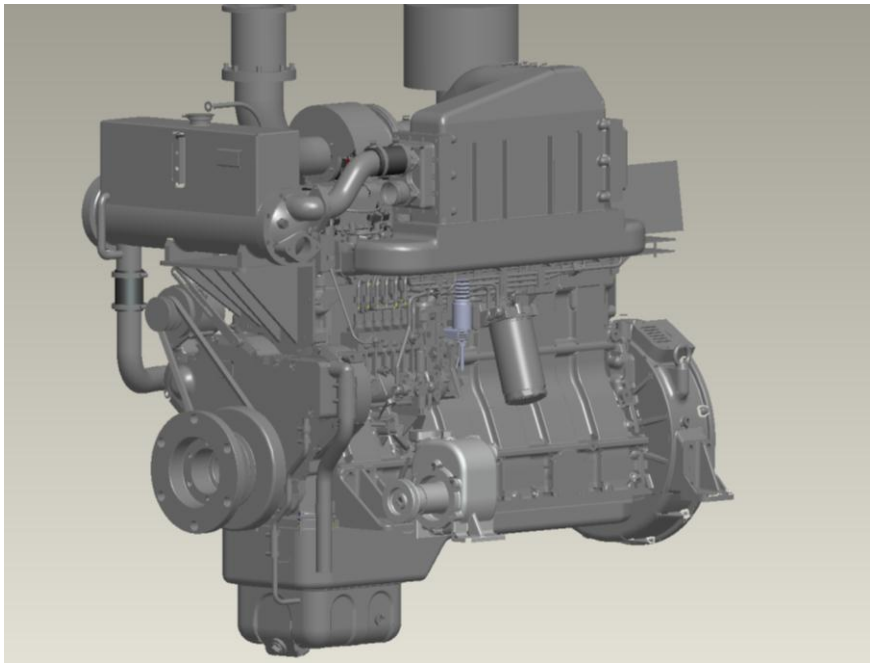
较详细的故障描述

联系人地址与电话

目录



电站用柴油机



船用柴油机

1 引言

1.1 致用户和操作者

感谢您选择使用上海柴油机股份有限公司的柴油机产品！

G 系列柴油机（改进型）是在原 G128 系列柴油机基础上优化设计及扩行程开发的直喷式中等功率柴油机，有 13 升和 15 升 2 种排列。G 系列柴油机（改进型）动力更强劲、燃油耗和排放更低、可靠性更高；外形尺寸与原 G128 柴油机基本相同，有较大的通用性和互换性，是船舶、电站的理想配套动力。

本手册主要叙述该系列柴油机基本型的技术规格、使用和保养注意事项，以帮助用户熟悉本产品并正确使用和保养本产品。用户在使用柴油机前应认真阅读本手册中的有关内容和要求。由于产品性能和结构在不断改进，本手册中所列技术规格和图例说明与您在使用中的实物可能略有不同，我公司在今后再版时会不断予以补充完善，不再专门通知用户，谨请注意。在本产品的使用保养中，如有任何疑问请随时联系上柴“易+人”呼叫中心（400-820-5656），以获得技术咨询或技术指导。

上海柴油机股份有限公司（上柴公司）的产品采用最新技术和高质量零部件。维修保养时，建议使用上柴公司品牌的服务备件。上柴公司授权的维修站遍布全国各地，提供维修服务和备件供应，维修人员经过专业培训。

如柴油机转让或出售，本说明书应跟随柴油机转交给新的用户。

1.2 使用范围

本手册适合配套船用和电站系列柴油机。

1.3 用户反映产品质量情况须知

为便于我公司了解和分析产品质量问题及其产生故障的原因，及时改进产品质量，更好地为用户服务，谨请用户在反映产品质量时说明下列事项：

1）发生故障的时间和地点；

2）柴油机出厂编号（机号）、型号、订货号、发货日期、收货者确切地址；

3）柴油机使用条件、工作累计时间（小时数）、工作状态（功率、转速）、使用的燃油和机油牌号；

4）被驱动设备的特性（型号、消耗功率、结构特点等）；

5）故障现象描述；

6）要求赔偿或检修的零件或部件，应随同损坏过程记录或说明寄到或带到本公司，以便进行分析。如用户发现问题较多或问题特别严重时，应保持现场，并及时告知，我公司派员共同分析之。

对柴油机质量问题的处理按照质量保修手册有关规定。

1.4 产品售后服务承诺

为做好产品售后的服务工作，减小因产品出现质量问题给用户造成损失，上柴公司建立了 24 小时报修处理制度。用户在全国范围内拨打 400-820-5656 电话，均可得到上柴公司及时、专业的咨询和售后服务。

1.5 重要的安全注意事项

在使用、定期维护保养发动机前，应仔细阅读和了解全部的安全注意事项和警告。

下面的安全注意事项和警告必须遵守，否则会造成人身伤害。

●保证操作四周安全，应随时想到潜在的危险。

●操作发动机时，应始终保持警惕，如感觉身体不适或精神不佳，应停止工作。

●操作发动机时，不得吸烟。

●加注燃油时，不得吸烟，燃油蒸汽容易燃烧。

●检查蓄电池电解液液面时，不得吸烟，因为电解液会释放易燃气体。

●在发动机或其驱动装置周围工作时不得穿着肥大的衣服并摘掉所有饰物。必要时，戴上防护眼镜，穿工作服，戴安全帽或其他保护用品。

●为了防止在运行中发生火灾，发电机组使用时，必须保持离开建筑物以及其他设备 1 m 以上的距离。

●发动机的废排气中含有一氧化碳等对人体有害的成分，在通风不良的场所运行时，有废排气中毒的危险。如发动机在室内运行，废气必须排出至室外，并确保排气管的连接部位等不能有废排气漏泄。

●排气系统零部件如安装保护装置或隔热罩，则不可将其拆除；暴露在外部的转动零部件如安装保护罩，也不可将其拆除，否则容易造成人员伤害。为防止人身事故，船用配套主机厂必须对排气尾管、排气消声器加装防护装置，对暴露在外的旋转零部件如传动胶带带轮、绞网机等建议加装保护装置。

●在发动机的周围不得放置燃油、润滑油、冷却液等可燃物，火药类等危险物品。有引发火灾或爆炸的危险。

●溢出外面的燃油、润滑油或冷却液应擦净。燃油、润滑油或冷却液着火后会引发火灾危险。将有油或冷却液的抹布存放在防火容器中，不得将其放在发动机上。

●要清除掉发动机上或周围的灰尘、泥土和异物等。这也是引起火灾或发动机过热的原因。

●起动发动机前，应确保发动机周围没人员，发动机上无工具或其他物品。起动开关等挂有“禁止起动”警示标牌时，绝对不能起动发动机。

●发现燃油、润滑油或排气漏泄时，应立即采取阻止漏泄的措施。 燃油、润滑油飞溅到发动机的高温部件上，或废排气接触到可燃物品时会引起火灾，引起人身事故或机损事故的危险。

●不得用手检查发动机三漏，高温高压燃油、润滑油和冷却液会伤害人体。在检查高压燃油管泄漏时应特别小心，因为燃油在高压下能注入皮肤并导致人身伤害或伤亡。应使用厚板检查是否有燃油泄漏，发现燃油漏泄时，应避免与喷出的燃油直接接触。

●检测燃油、润滑油、冷却水或蓄电池电解液时，如需用灯照明，必须使用防爆照明器具，以避免发生引火燃爆的危险。

●处理任何与燃油系统相关的组件或在其附近工作时，不得吸烟，也不得使用明火。燃油蒸汽可能会点燃，引起零部件损坏或人身事故的危险。

●发动机运行时，切勿对燃油系统中任何零件进行保养。

●柴油在超高压下通过高压油管从喷射泵流到喷油器。故在发动机运行期间，切勿松动任何高压油管，不遵守此项警告会造成严重烫伤事故。

●当发动机长期停用或需要维修时，应拆除发动机与蓄电池的连接导线，若是空气起动马达起动，应拆去空气连接管路，以防止发动机意外起动。同时必须在操作室或控制部位挂上“禁止运行”的标牌。拆除蓄电池端子时，一定要先从(–) 端子侧开始。安装时一定要先从(+) 端子侧开始。

●蓄电池的两端子之间不得用工具等金属物接触，不得将蓄电池正负极端短路，有燃爆的危险。

●蓄电池端子的连接应牢靠。端子松动时，因接触不良产生打火时，有引爆的危险。损伤的电缆、电线会引起火灾。在重新连接前应检查并作更换。

●在蓄电池附近不得使用明火，或进行电焊作业。蓄电池内会产生易燃性的氢气和氧气，在蓄电池的附近使用明火的话，有导致引火爆发的危险。在电解液处于最低液面线以下时，应停止使用蓄电池。电解液使用不当会引起失明或烫伤事故。

●如室内运行发动机，应常备灭火器，并使灭火器处于可用状态。应熟知灭火器的使用方法。急救箱要放置在规定的场所，万一需要的时候，要能够立即使用。应规定火灾和事故的处理措施，规定急救时的联系地点和联系方法。不得用四氯化碳类灭火器，这类灭火器不仅释放有毒气体，其液体还会损坏电线的绝缘性能。

●添加或更换冷却液、添加蓄电池专用液时，应避免冷却水或电解液接触到皮肤和眼睛。一旦接触皮肤，应尽快用肥皂和清水冲洗皮肤，如进入眼睛，应立即用大量清水冲洗眼睛 15 分钟，并且立即到医院就诊。

●加注冷却液时，应小心防止蒸汽伤人。应先冷却发动机，只有在冷却液温度低于 50℃时才可慢慢拧松散热器上的加液盖即压力盖，使冷却系统卸压，然后进行添加。刚停机时的冷却水的温度很高，端盖打开的话，蒸汽或热水喷出有烫伤的危险。检查冷却液液面、添加冷却液或更换冷却液后应注意拧紧加液盖。

●发动机运行时，进、排气系统温度高，不可用手触摸排气管、排气尾管、增压器、中冷却器进气管、膨胀水箱等高温零部件。发动机运行时，冷却水温度很高，不可打开散热器加液盖。如果打开散热器加液盖，蒸汽或热水喷出有烫伤的危险。

●风扇皮带断裂时，应立即停机，否则发动机会产生过热、膨胀水箱内的冷却液形成蒸汽喷出，有引起烫伤的危险。

●排出润滑油，或更换润滑油滤油器时，不得用手直接操作。高温的润滑油或部件会烫伤手上的皮肤。

●在拆卸或松开任何管路、固定接头、接口或有关零部件之前，应先释放这些零部件所属系统的压力，如空气系统、冷却系统、润滑系统或燃油系统中的压力。否则，高压燃油、润滑油和冷却液会伤害人体。

●发动机运行中，不得接近转动部位。在转动件的周围不得放置容易被卷入的物体。身体或工具等被转动件卷入后，会发生严重的人身事故。

●在调整发动机及其驱动装置之前务必停止发动机运行。卷入转动部件内会引起重大的事故。

●使用适当的发动机盘车方法，不得利用风扇部位盘动发动机曲轴，否则会造成严重的人身伤害或风扇叶片损坏。

●对发动机上手不能伸及的部位进行作业时，不得站在发动机上，或用脚撑在发动机侧面的部件上，应站在稳定可靠的作业台上进行，并注意不要打滑摔落；不得用零件箱或工具箱代用等作业台。不慎的作业方法不仅会损坏发动机的部件，还会引起人身事故。

●使用过的润滑油可能含有致癌成分，且能引起再生毒性。应避免吸入润滑油蒸汽或长时间与其接触。用适当安全可靠的方法处理废油。

●为防止窒息或冻伤，在拆除空调致冷剂（氟利昂）管路时，一定要穿戴防护衣并且必须在通风良好的环境中进行。为保护环境，致冷系统必须使用专门的设备进行倒空或灌装，以防止氟利昂扩散到大气中。应回收和循环使用致冷剂。

●为保护环境，更换润滑油和润滑油滤清器、燃油滤清器或冷却液时，排出的润滑油或冷却液、被更换的润滑油滤清器或燃油滤清器，不能随便废弃，应按相关环境保护法规处置。废弃的蓄电池也应按相关环境保护法规处置。

1.6 柴油机使用注意事项

在使用、定期维护保养发动机前，应仔细阅读和了解全部的发动机使用保养注意事项和警告。

下面的使用注意事项必须遵守，否则会造成发动机故障或损坏。

●认真阅读本手册，严格遵守本手册中规定的操作步骤及保养规程。

●应严格遵守本手册规定，进行日常维护和四级保养，并做好定期保养记录。

●应按本手册规定，使用恰当的燃油、润滑油和冷却液。

●发动机的冷却系统在任何气候下都应采用本手册规定的冷却液。

●加注润滑油时，不同规格的润滑油不得混用。

●起动发动机前，必须检查冷却液、润滑油、燃油是否足够。

●切记发动机必须空载起动。

●对新机或大修后的发动机，使用前须经 60 小时磨合运行。

●不允许在不带空气滤清器情况下运行发动机（船用除外），以免发动机发生早期磨损。

●如发动机在室内运行，应始终保持机房内的通风良好。发动机吸入空气量不足时，会引起发动机温度上升、输出功率不足和性能下降；如需要，必须配备机房通风设备。

●发动机运行时，应经常观察其运行状态和所有仪表的显示值。如发现异常情况或遇紧急情况应采取紧急停车措施，并排除故障，防止因缺水过热或润滑油压力过低而导致使发动机运动件咬合。

●当冷却液温度低于 60℃时，严禁发动机高速高负荷运行。

●严禁发动机超负荷运行。

●发动机出现过热必须停机时，不能在停机后立即注入冷却水，否则会损坏气缸盖等零部件。

●发动机发生异常停机后，不能立即再起动。在发出异常报警的同时停机时，必须查明故障的原因并排除故障后才能再次起动。如果不作故障处理继续运行的话，有可能引起更加重大的事故发生。

●当由于某种原因发动机的润滑油压力异常下降时，应立即停机，检查润滑油系统的各个部分，确认故障原因。在低油压状态下继续运行的话，会引起发动机轴承烧损等事故。

●起动刚修复的发动机时，应作好切断空气供给的准备。一旦在发动机起动后发生飞车现象时，应立即断气停止发动机。

●避免在装有电子设备的发动机或设备上进行焊接，如必须话，则焊接前，应切断设备电源，断开电子设备与线束连接。不可带电插拔线束。不允许随意对线束进行插拔；如需插拔，必须断电后进行，以免失效。

●检查胶带张力及其它驱动装置时，发动机应处于停车状态。

●不得用撬棒将传动胶带从带轮上拆下或安装到带轮上，因为这样做可能会破坏胶带内部的增强纤维。应手工拆卸和安

装。

●如果传动胶带被润滑油、燃油或其它有害液体沾染，则必须更换，并消除污染源。不得使用溶剂清洁胶带。

●传动胶带存放或搬运时，应确保其弯曲直径不小于25 mm，不得挂在挂钩上。

●传动胶带带轮各处表面必须光滑，以延长胶带寿命。因此在安装胶带之前，应确保带轮表面无粗糙表面或毛刺，且转动自如。

●蓄电池有一定的使用寿命，到一定的时期必须更换。

●如调温器失灵应及时更换，不得随意拆除不用。

●为了维持发动机的正常性能，在燃油控制连杆部分设有燃油喷油量的封印以及转速控制的封印。切断这些封印后使用发动机，如出现故障，则不予任何保修。 封印切断时，会发生以下的故障：喷油泵中的滑动和部位磨损增加, 发生烧融、损伤等故障，燃油消耗量、润滑油消耗量激剧增加，燃油喷射量和调速器的平衡失调，性能下降，引起超速等重大事故。

●不得用海水直接冷却发动机。

●对带电子调速器的喷油泵，不得用水直接喷淋进行清洗。

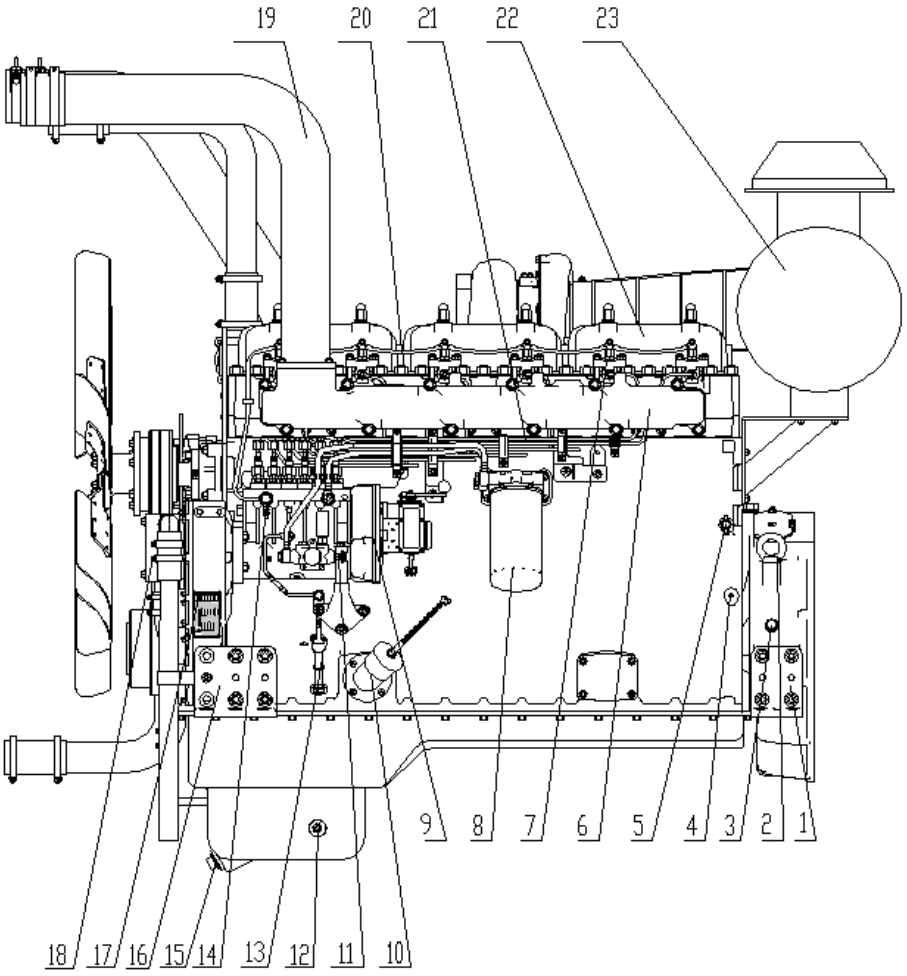
●注意不要让雨水等从排气管口或进气管口进入。不得在发动机运行中清洗发动机。清洗剂（ 水）有可能被吸入发动机的内部。发动机的燃烧室内进水的话，发动机起动时发动机受水压作用有可能导致内部的损坏，引起重大的事故。

●不得随意更改发动机的用途及使用范围，否则容易导致发动机或/和设备损坏，还有引起人身事故的危险。对擅自改造发动机，即使在质保期内，也不给予保修任何。

2 柴油机概况

2.1 柴油机外形图

2.1.1 电站用柴油机外形图



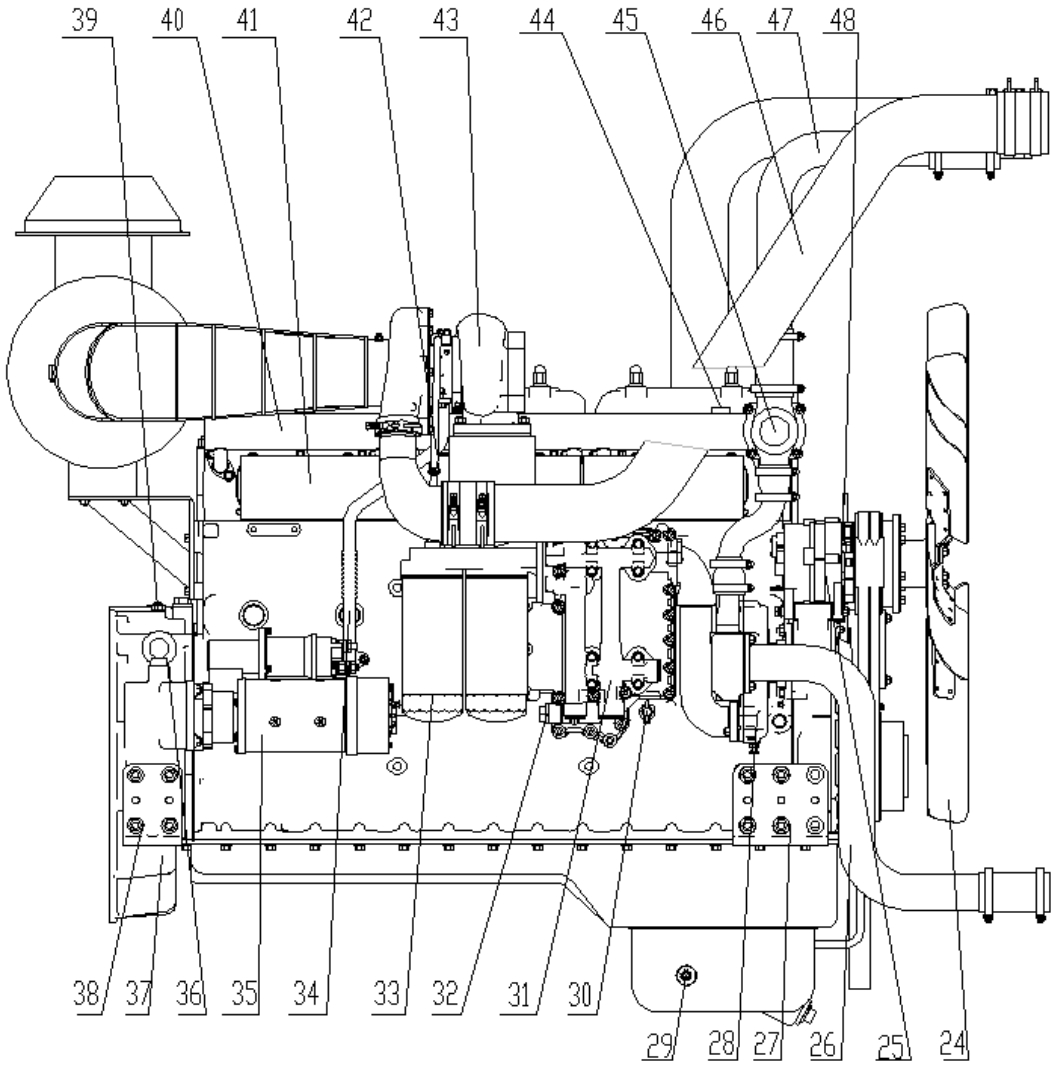
柴油机进气侧

1：后支架 2：后吊环 3：转速表接头 4：油压表接头 5：放水螺塞 6：进气管 7：喷油器

8：燃油精滤器 9：喷油泵总成 10：加油口 11：输油泵进油接头 12：油温传感器接头

13：油尺 14：油泵回油接头 15：放油螺塞 16：前支架 17：铭牌 18：油气分离器

19：中冷器出气管 20：喷油器回油管 21：高压油管 22：气缸盖罩壳 23：空气滤清器



柴油机排气侧

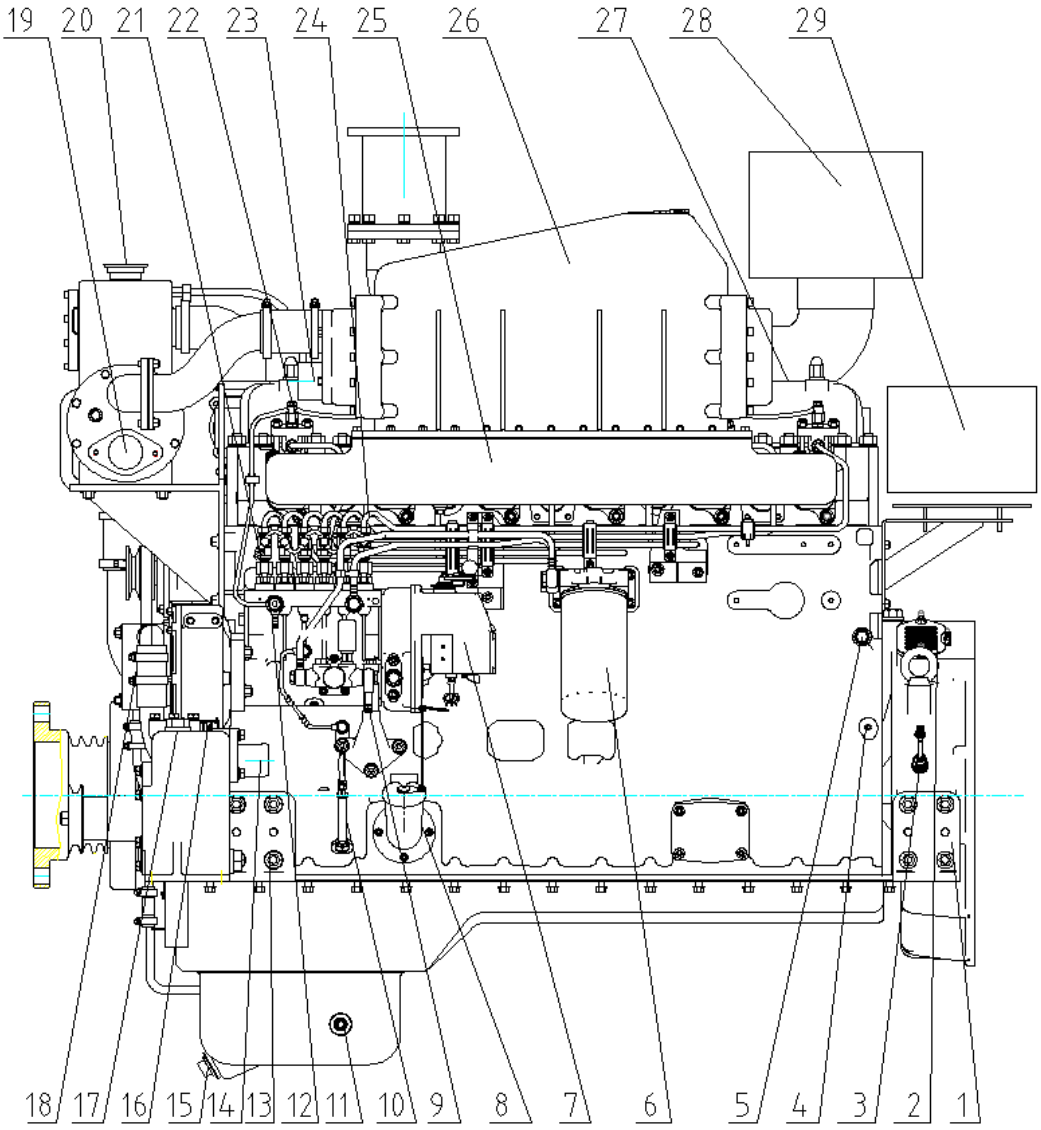
24：风扇 25：发电机 26：水泵进水管 27：前支架 28：水泵 29：油温表接头 30：放水螺塞

31：机冷器部件 32：主油道调压阀 33：机油滤清器 34：增压器回油管 35：起动电机 36：后吊环

37：飞轮壳 38：后支架 39：转速传感器接头 40：出水总管 41：排气管 42：增压器进油管

43：增压器 44：水温传感器接头 45：调温器 46：中冷器进气管 47：水箱进水管 48：前吊环

2.1.2 船用柴油机外形图



进气侧

1：后支架 2：后吊环 3：转速传感器接头 4：机油压力传感器接头 5：放水螺塞

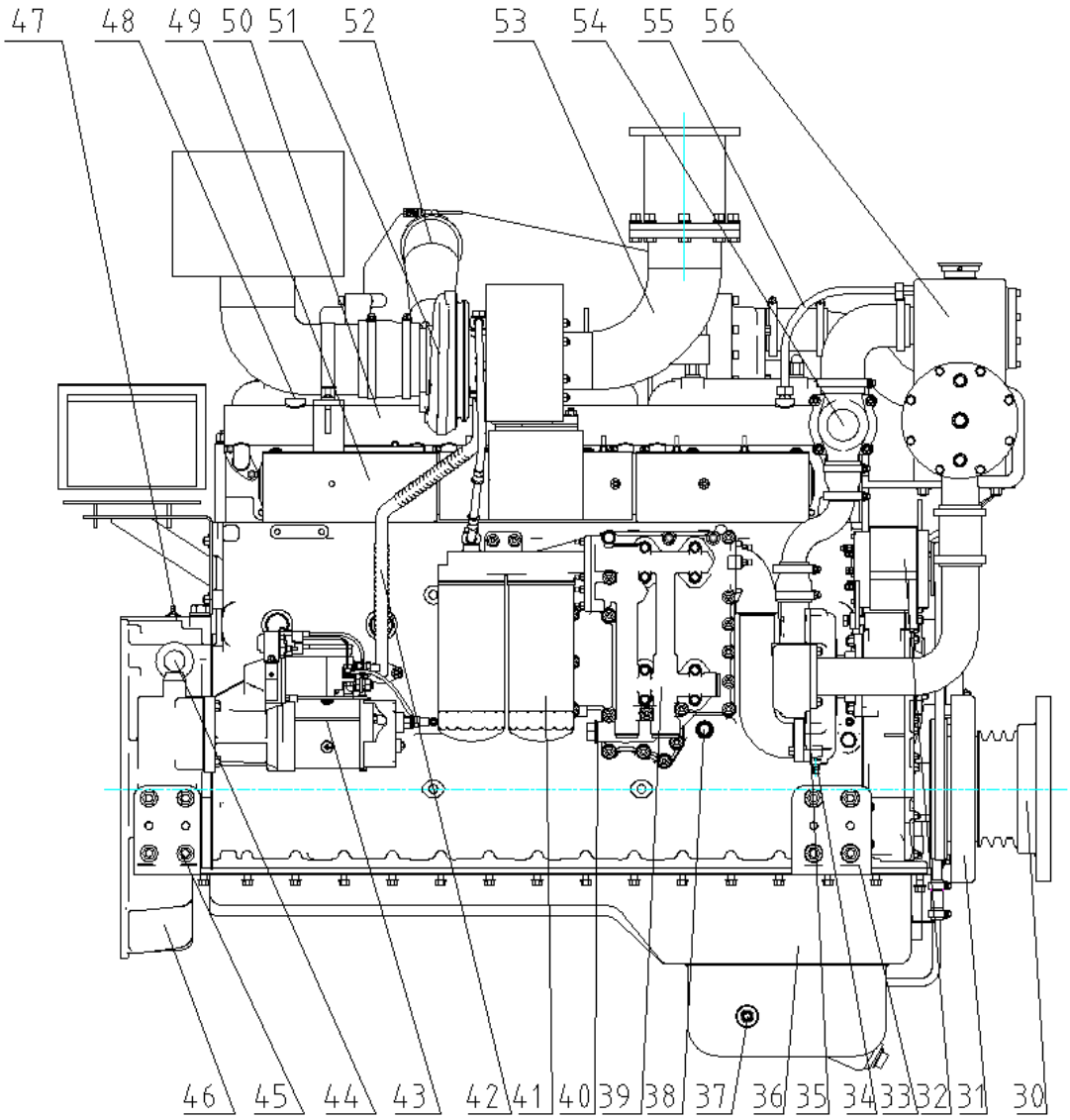
6：燃油精滤器 7：喷油泵总成 8：加油口 9：输油泵进油接头 10：油尺

11：机油温度传感器接头 12：燃油回油接头 13：前支架 14：海水泵进水口 15：放油螺塞

16：铭牌 17：海水泵出水口 18：油气分离器 19：热交换器海水进水口 20：淡水加水口

21：前吊环 22：喷油器 23：中冷器海水进水口 24：高压油管 25：进气管

26：中冷器 27：气缸盖罩 28：空气滤清器 29：仪表箱



排气侧

30：用户皮带盘 31：减振器 32：发电机 33：前支架 34：淡水泵放水阀 35：淡水泵

36：油底壳 37：机油温度传感器接头 38：放水螺塞 39：机油冷却器 40：机油压力调节阀

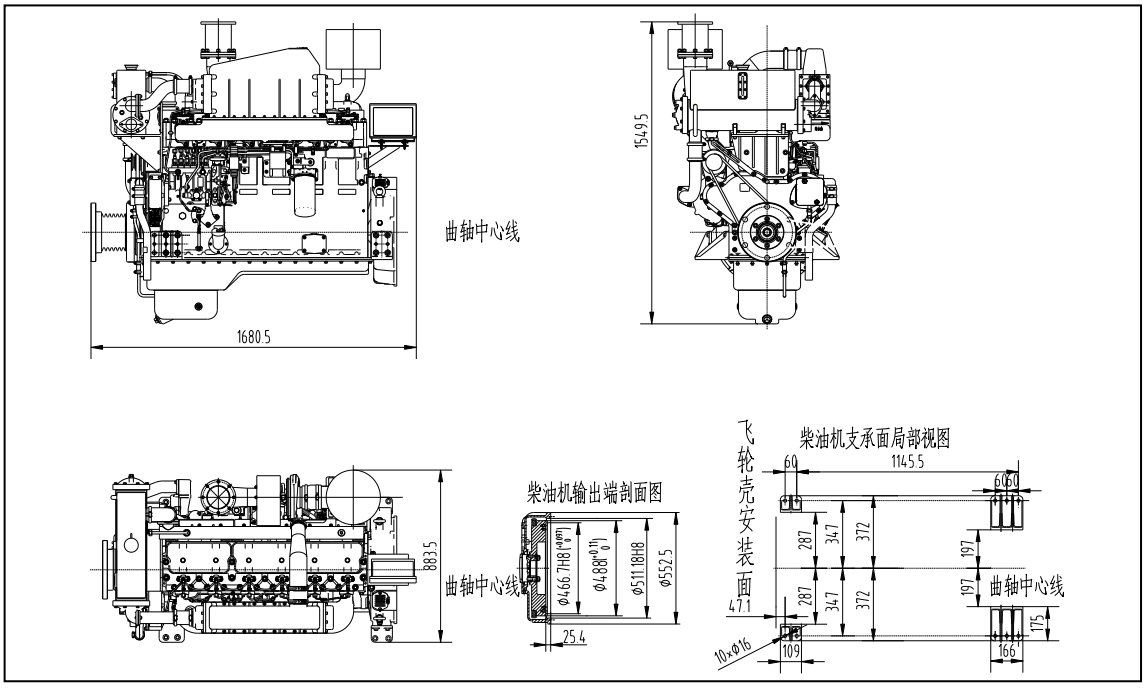
41：机油精滤器 42：增压器回油管 43：起动电机 44：后吊环 45：后支架 46：飞轮壳

47：转速传感器接头 48：出水温度传感器接头 49：排气管及隔热装置 50：淡水出水总管

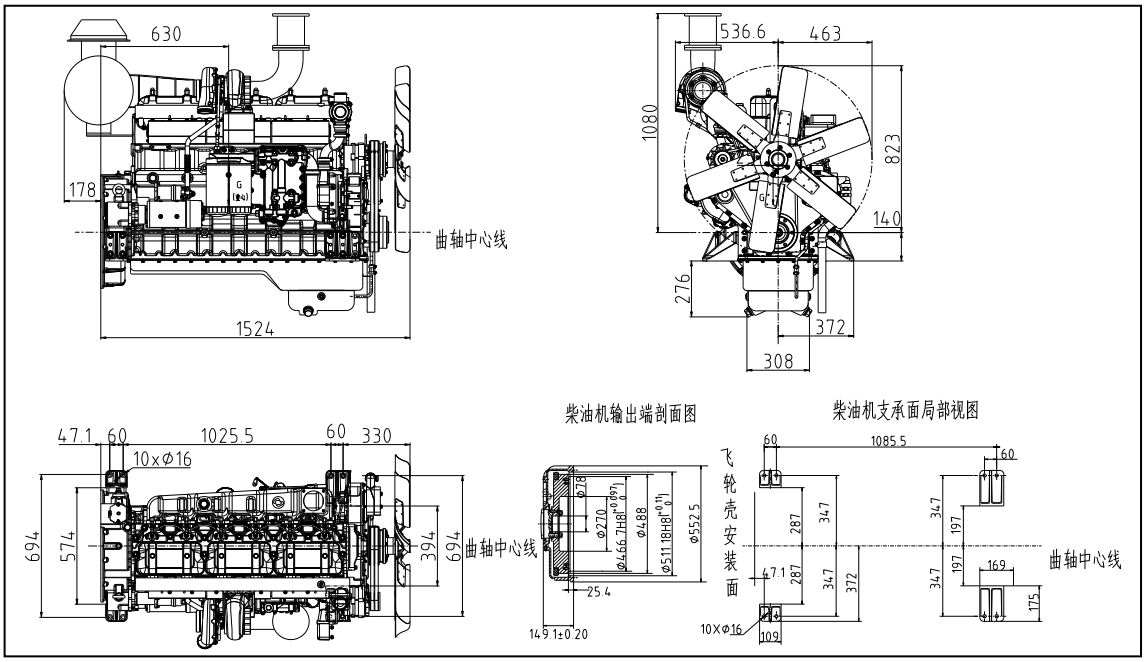
51：增压器及隔热装置 52：中冷器进气管 53：排气接管 54：调温器 55：除气管

56：热交换器

2.1.3 柴油机外形安装图



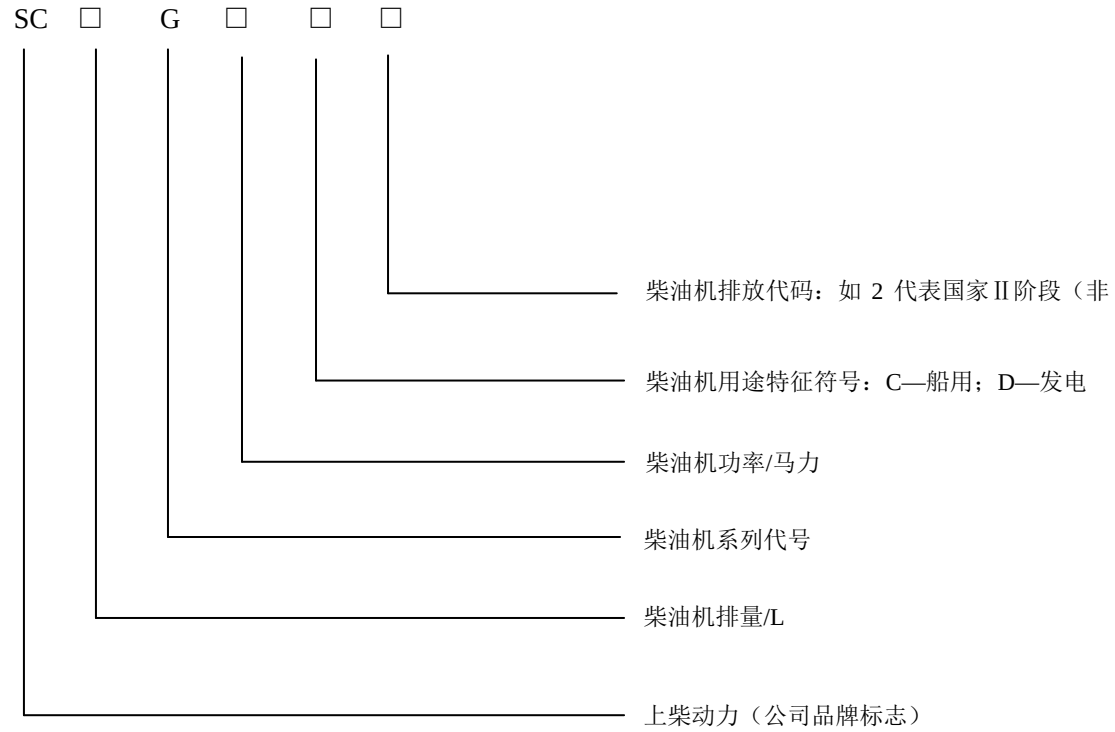
船用柴油机外形安装图



电站用柴油机外形安装图

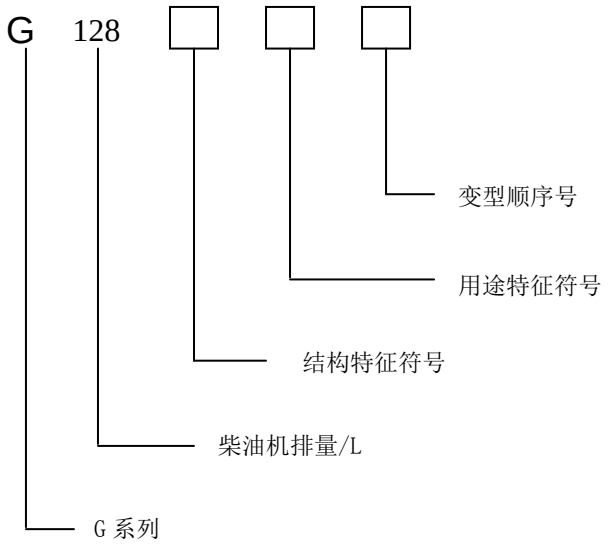
2.2 柴油机的型号识别

2.2.1 G 系列柴油机型号表示方法一：



例：SC15G500D2 代表上柴动力 G 系列 15 升 500 马力符合国家Ⅱ阶段（非道路）排放标准电站用柴油机
SC13G420D2 代表上柴动力 G 系列 13 升 420 马力符合国家Ⅱ阶段（非道路）排放标准电站用柴油机
SC15G500CA2 代表上柴动力 G 系列 15 升 500 马力符合国家Ⅱ阶段（非道路）排放标准船用柴油机

2.2.2 G 系列柴油机型号表示方法二：

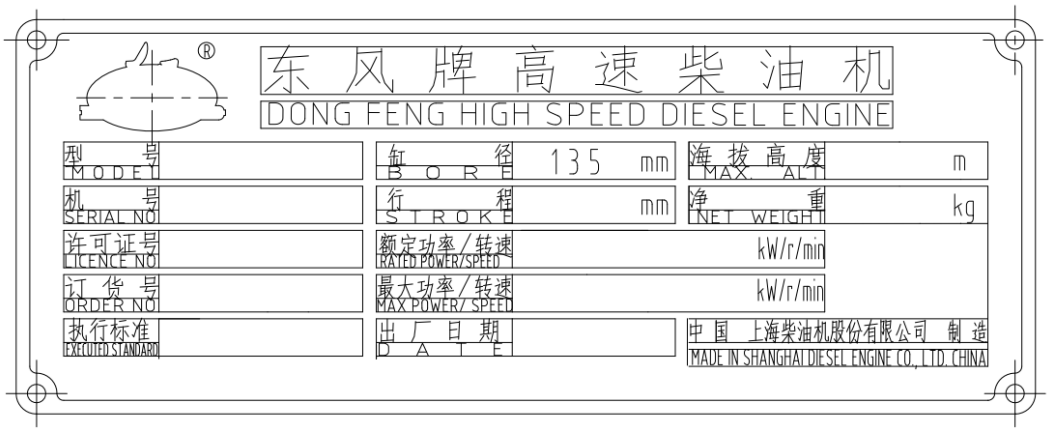


例：G128ZLCa 代表 G 系列气缸排量为 12.8 升增压中冷船用主机柴油机基本型
G128ZLCa1 代表 G 系列气缸排量为 12.8 升增压中冷船用主机柴油机第一种变型

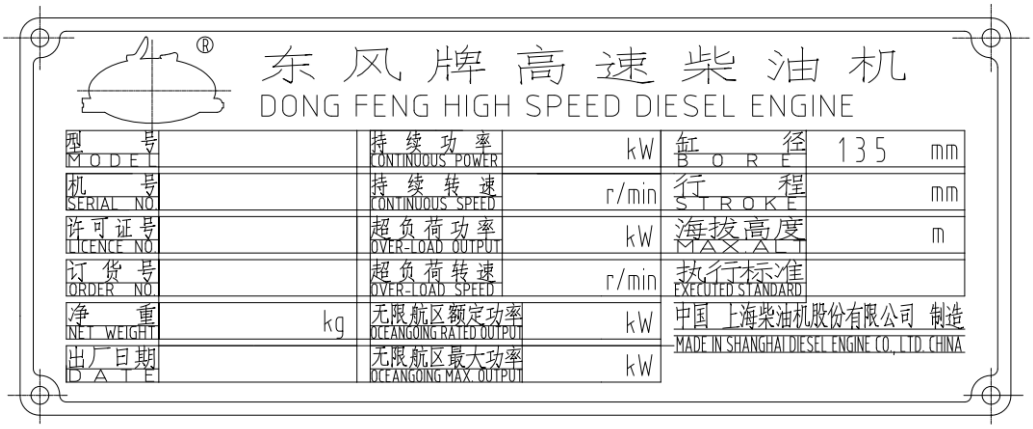
2.3 柴油机铭牌

柴油机铭牌标明了您所购买的柴油机主要技术数据和信息：型号、订货号、机号、出厂日期、功率、标定转速，是用户购买维修零件和我公司进行售后技术服务的主要依据。希望用户将这些信息和数据记录到您的柴油机或所配设备的工作日志中。在日后联系维修和反映质量问题时，及时提供这些信息，有助于正确解决您所要反映的问题。请保护好铭牌不受损坏。铭牌位于柴油机前齿轮室侧面。

电站名牌



船用铭牌



△注意：未经我公司许可，用户不得随意更换柴油机铭牌！

2.4 柴油机技术规格

2.4.1 主要技术规格和性能参数

机型		SC15G500D2	SC15G500CA2	SC13G420D2	G128ZLCa5
型式		六缸、 直列、水冷、四冲程、直喷			
吸气方式		废气涡轮增压+空空中冷	废气涡轮增压+水空中冷	废气涡轮增压+空空中冷	废气涡轮增压+水空中冷
缸径/mm		135	135	135	135
冲程/mm		165	165	150	150
排量/L		14.16	14.16	12.88	12.88
起动温度/℃		≥-10	≥-10	≥-10	≥-10
曲轴转向（面向输出端）		逆时针	逆时针	逆时针	逆时针
发火次序		1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
标定工况	功率/kW	330	330	280	267
	转速/r/min	1500	1500	1500	1500
超负荷工况	功率/kW	363	363	308	294
	转速(r/min)	1500	1545	1500	1545
排放		国Ⅱ（非道路）	国Ⅱ（非道路）	国Ⅱ（非道路）	国Ⅱ（非道路）
起动方式		电起动	电起动	电起动	电起动
允许海拔/m		2 000	2 000	2 000	2 000
净重/kg		1 265±50（不包括散热器）	1 320±50（不包括海水泵）	1 265±50（不包括散热器）	1 320±50（不包括海水泵）
柴油机外形尺寸	长/mm	1 702	1 620	1 702	1 620
	宽/mm	1 000	884	1000	884
	高/mm	1 550	1 550	1 550	1 550

注：1）表格中的性能参数系标准环境状况下柴油机运行时的性能参数，标准环境状况是指：环境温度 25℃、相对湿度 30%，大气压力 100 kPa。

2） 柴油机在超过规定的高原（2 000 米）上运行，输出功率将变小，性能将变差，必须降低功率运行。不建议在 4 000 m 以上使用。

2.4.2 主要技术参数

机型		SC15G500D2	SC15G500CA2	SC13G420D2	G128ZLCa5
排气温度(涡轮前)/℃		≤680	≤680	≤680	≤680
油底壳机油温度/℃	最高允许	115	115	115	115
	适宜范围	90～110	90～110	90～110	90-110
主油道机油压力/MPa	标定转速	0.4～0.60	0.4～0.60	0.4～0.60	0.4～0.60
	怠速	≥0.15（机油温度≥75℃时）	≥0.15（机油温度≥75℃时）	≥0.15（机油温度≥75℃时）	≥0.15（机油温度≥75℃时）
油底壳机油容量（高-低油位）/L		30-22	30-22	30-22	30-22
润滑系统总容量/L		32.5	32.5	32.5	32.5
进水最低温度/℃		60	60	60	60
出水最高温度/℃		100	100	100	100
适宜工作水温/℃		75～95	75～95	75～95	75～95
调速器的调速性能	最低空载稳定转速/(r/min)	900（电子）	650（机械）	900（电子）	650（机械）
	最低空载稳定转速时转速波动/(r/min)	±20（电子）	±25（机械）	±20（电子）	±25（机械）
	最高空载稳定转速/(r/min)	1 545（电子）	1650（机械）	1 545 电子）	1650（机械）
	瞬时调速率/%	≤10（电子）	≤15（机械）	≤10（电子）	≤15（机械）
	稳定调速率/%	≤3（电子）	≤10（机械）	≤3（电子）	≤10（机械）
蓄电池	最小推荐的蓄电池容量/Ah*	180	180	180	180
	－18℃ 蓄电池冷起动电流/CCA	750	750	750	750
	电压/V	2×12	2×12	2×12	2×12
起动电机	电压/V	24	24	24	24
	功率/kW	8.5	8.5	8.5	8.5
发电机	电压/V	28	28	28	28
	电流/A	40	36	40	36
	额度功率/kW	1	1	1	1

*对起动要求较高的应用，应适当加大蓄电池的容量。

2.4.3 配套技术要求

因环境状况对空-空中冷的增压柴油机的运行影响较大，下表根据环境温度对柴油机运行的最大总功率及其运行参数进行规定。用户需按此表要求匹配合适的空-空中冷器、散热器、消声器及其连接管路，及时保养空滤器，并按表中要求控制柴油机的负荷，以防止柴油机超负荷运行导致柴油机故障。

环境温度 ℃	转速 r/min	允许最大总功率比例	中冷器出口温度 ℃	中冷器压降 kPa	柴油机出水温度 ℃	油底壳机油温度 ℃	进气阻力 kPa	排气背压 kPa
≤30	1 500	100%	≤50	≤6	＜100	≤115	≤3	≤6
40	1 500	96%	≤60	≤6	＜100	≤115	≤3	≤6
50	1 500	88%	≤70	≤6	＜100	≤115	≤3	≤6

3 柴油机安装和连接

3.1 柴油机安装

在柴油机齿轮室和飞轮壳两侧有 4 个安装支架。

每台柴油机上有用于起吊的吊环和吊板，能承受柴油机的全部重量。吊装时用链条滑车或其他吊装工具，但必须注意：勿使受力链条压向薄壁零件或仪表零件（并尽可能不使吊环承受弯矩）；起吊要平稳，使柴油机基本保持在水平位置；搬运吊装中，柴油机应搁置在专用的底座上或稳妥的垫块上，防止油底壳直接承受柴油机的重量。

3.2 柴油机连接

3.2.1 进气管的外接

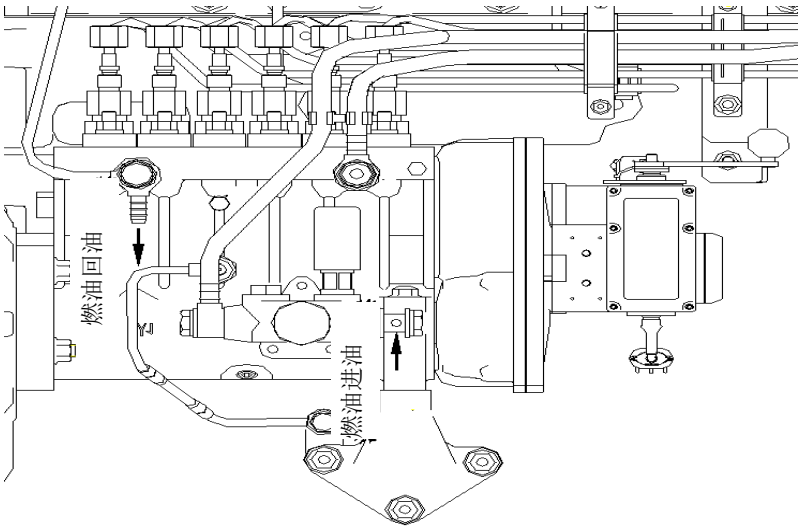
△注意：当采用加长的进气管路时，则必须有足够的进气截面。推荐中冷器前、后管路内径为 100 mm，且不宜过长或急转弯，否则会增大进气阻力，从而影响柴油机的工作性能。另外，必须注意进气管路的密封性，否则将导致柴油机早期磨损。

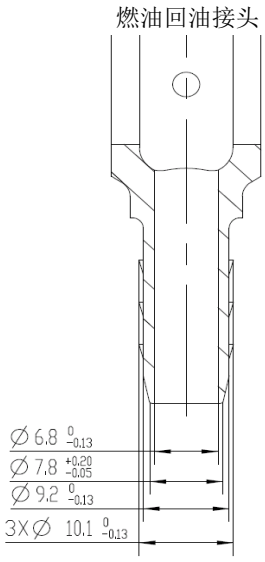
3.2.2 水管路的外接

G 系列改进型柴油机冷却系统为闭式循环，用户不必另设水池或散热水塔等装置。水泵进水管内径推荐 61 mm，调温器出水管内径推荐 54 mm。

3.2.3 燃油管路的外接

柴油机燃油箱进油口及燃油回到油箱的接头位置如图所示。燃油进油接头铰接螺栓为 M14×1.5 mm，燃油进油管内径推荐为 9 mm，燃油回油管内径推荐为 8 mm，燃油回油接头尺寸如图所示。





燃油箱容量要求能存放柴油机工作 8 小时以上的燃油。燃油箱应保证供油的最低油位不低于输油泵中心 1 m，进油管吸油口必须高于燃油箱底面 50 mm 以上；建议在吸油口处再接一粗滤网，防止将沉淀物吸入而堵塞油路。为便于清洗，建议在燃油箱底部设有泄放阀门。燃油箱不应靠近热源（如排气管）和电器设备。

3.2.4 柴油机的功率输出

柴油机由飞轮端输出功率驱动设备工作。当采用联轴器连接被驱动设备时，设备中心线和曲轴中心线应在同一直线上。如采用弹性联轴器，其同轴度应不大于 ϕ0.30 mm；如采用刚性联轴器，其同轴度应不大于 ϕ0.10 mm。

△注意：柴油机不允许带载起动，因此在柴油机与本身不能空载运转的负载装置之间应设有离合装置。

柴油机曲轴前端可以输出部分功率，但直接利用前轴胶带盘横向拖动的输出功率不得大于 11 kW。

禁止在飞轮上直接安装皮带盘横向拖动被驱动设备，这样容易损坏曲轴及主轴承。如需用作横向拖动时，应选用适合横向拖动的变型柴油机或另采用适应横向拖动的动力传动过渡装置，不要使柴油机曲轴和主轴承直接承受横向力。

4 柴油机使用

正确使用柴油机，不仅能保持柴油机工作正常、性能良好，而且会延长柴油机的寿命、降低使用成本。按本章节的要求采用正确的燃油、机油和冷却液，采用正确的操作步骤。

4.1 柴油

本系列柴油机使用的柴油规格应符合国标 **GB 252-2011** 普通柴油规定。根据环境温度选择燃油的牌号。在冬季气温低的环境下，应使用低凝固点的柴油，夏季则反之。燃油牌号选择可按 GB **252-2011** 标准推荐，用户也可按下表的推荐来选用：例如，环境温度为-27℃时，应选用-35 号柴油。

柴油牌号与适用最低气温的关系

柴油牌号	0 号	-10 号	-20 号	-35 号
十六烷值	≥45	≥45	≥45	≥45
凝点/℃	≤0	≤-10	-20	-35
适用最低气温（柴油机工作环境温度/℃）	4℃以上	-5℃以上	-14℃以上	-29℃以上

△注意：柴油必须保持高度的清洁，不被灰尘杂质或水污染。

4.2 机油

为确保柴油机的正常运行和长寿命、改善柴油机的排放，请使用 CF-4 级及以上等级的润滑油。在一般环境温度下选用 CF-4 l5W-40 机油，当环境温度保持在-5℃以下时，应选用较轻质的 CF-4 5W-30 机油有利于起动，但持续使用低粘性机油会增加柴油机磨损。本柴油机使用的机油规格应符合国标 **GB 11122-2006** 规定。

机油规格（**GB 11122-2006**）

规格 / 黏度等级	运动粘度（100/℃）mm^2/s 不低于	闪点（开口）℃ 不低于	倾点 ℃ 不高于	机械杂质（质量分数）/% 不大于	水 分 % 不大于
5W-30	9.3 ~ <12.5	200	-35	0.01	痕迹
15W-40	12.5 ~ <16.3	215	-25	0.01	痕迹

△注意：机油必须保持清洁，不被灰尘杂质或水所污染。不同牌号机油不能混合使用。

4.3 冷却液

为确保柴油机的正常运行和长寿命，请在任何气候条件下都使用上柴公司专用的有机型（防冻）冷却液。该冷却液具有防冻、防腐、导热性好、稳定性好、环保等特点。

名称	件号	冰点/℃	沸点/℃
上柴有机型（防冻）冷却液	F/LQY-45	-45	108

△注意：柴油机用作船用主辅动力时，绝对不允许采用海水作为冷却液直接冷却柴油机。

4.4 柴油机与工作机械功率的匹配

用户选用柴油机时不仅应考虑与之配套的工作机械所需功率的大小，还必须考虑工作机械的负荷率，比如是间歇使用，还是连续使用。同时要考虑工作机械的运行经济性，即负载的工作特性和柴油机的特性必须合理匹配。因此柴油机功率的正确标定和柴油机与工作机械特性的合理匹配乃是保证柴油机运行可靠、经济及使用寿命长的前提，否则将可能使柴油机超负荷运行和产生不必要的故障，或负载功率过小，柴油机功率不能得到充分运用，这样既不经济并且易产生窜机油等弊病。

4.5 柴油机起动

在使用柴油机之前，应根据具体的使用环境和条件，选用适当规格的机油、燃油和冷却液。起动前应做好如下工作：

（1）对柴油机及起动系统作一次环视检查，发现问题，及时解决。

（2）检查机油压力表、机油温度表、冷却液温度表、警示灯、以及其他仪表是否处于正常状态。

（3）检查空气滤清器保养指示器是否出现红色柱塞。

△注意：绝不允许不带空气滤清器起动柴油机（船用柴油机除外），以防柴油机早期磨损。

（4）检查机油**液**面高度是否在规定的范围内。

（5）检查冷却液液面高度是否在规定的范围内。

（6）检查电解液液面高度是否在规定的范围内。

（7）柴油机刚开始投入使用、或停止工作多日、或者刚更换燃油滤清器，燃油系统内会有空气，需要对燃油系统泵油排气，具体操作见 5.3 章节中燃油系统泵油排气。

（8）检查电起动线路是否处于正常状态。

（9）检查电起动系统电路接线是否正确。

（10）所有安全防护装置必须安装到位。

（11）检查油门操作杆是否灵活。

（12）对新机或停放 5 天以上未用的柴油机，起动前应用盘车工具先转动曲轴 3～5 转。

4.5.1 常规起动步骤

G 系列柴油机（改进型）可以在环境温度不低于-10℃情况下顺利起动，方法如下：

•使柴油机与传动装置脱离。

•机械操纵装置等处于运转位置。

•将喷油泵调速器操纵手柄推到空载。

•插入电钥匙，将开关从 OFF 位置转到 START 位置，起动柴油机。如果在 10 秒内未能起动，应立即将开关从 START 位置转到 OFF 位置。过 2 分钟后再作第 2 次起动，如连续 3 次不能起动，应停止起动。参照第 6 章故障排除指南找出原因并排除故障后再进行起动。每次起动时间一般为 2 至 3 秒。

△注意：柴油机必须空载起动。

•起动成功后，开关自动从 START 位置回到 ON 位置。起动后 15 秒内柴油机机油压力表必须显示读数，并且读数应大于 0.15 MPa。如果 15 秒内没有指示机油压力，应立即停车，以防损坏柴油机。按第 6 章故障排除指南查明原因并排除故障。

•热态柴油机起动后，应在怠速运转 1～3 分钟，然后逐步加速加载运行。

•冷态柴油机起动后，应先在怠速运转 3～5 分钟，然后逐步增加转速到 1 000～1 200 r/min，进入部分负荷运行。待柴油机的出水温度高于 75℃、机油温度高于 50℃、机油压力高 0.40 MPa 时，才允许进入全负荷运行。

△注意：特别是在低温起动后，转速的增加应尽可能缓慢，以确保各轴承得到足够的润滑，并使油压稳定。

•柴油机在怠速工况下运转时，检查所有仪表工作是否正常。

△注意：严禁柴油机起动后立即加速加载运转。

△注意：柴油机怠速运转时间不许太长，否则会损坏柴油机。因为怠速运转时燃烧室温度低，燃油不能完全燃烧，造成缸内结碳，引起喷油器喷孔堵塞、使活塞环和气门卡滞，导致柴油机性能下降。

△注意：当使用一个跨接电缆起动柴油机时，一定要将电缆并联：正极连正极，负极连负极。当使用外部电源起动柴油机时，将断路开关转到“OFF”位置。连接跨接电缆之前，为了防止意外起动，将钥匙拔出。

4.5.2 低温起动

低温起动是指在低于-10℃环境温度下的起动。起动时，用户应根据实际使用的环境温度采用相应的低温起动辅助措施。然后按常规起动步骤起动柴油机。一般采取的低温起动辅助措施有如下几种。

•将柴油机的机油和冷却液预热至 40～50℃。

•在进气管内安置预热进气的装置或在进气管口采用简单的点火加热进气的方法（采用此法须注意安全）。

•提高机房的环境温度。

•选用适应低温需要的柴油、机油和冷却液。

•对蓄电池采取保温措施或采用加大容量的或高倍放电率的蓄电池（特殊的低温蓄电池）。

4.5.3 长时间停车或更换机油后的起动

每当更换机油后或停车时间大于 30 天起动柴油机时，必须先使润滑系统充满机油。采用盘车法，使机油进入各摩擦副，待柴油机盘车手感顺利轻松后方可起动柴油机。并做好下列起动准备，然后按常规起动程序或低温起动程序起动柴油机：

（1）检查机油液面。

（2）检查蓄电池电压是否正常。

（3）给燃油系统泵油排气，具体操作见 5.3 章节。

对于平时停放作为应急用的柴油机，为便于在急用时能迅速起动运行，在停放期内，每隔 3～5 天应起动运行一次，至冷却液温度、机油温度达到 60℃以上为止。

4.6 柴油机运行

柴油机运行时注意事项：

●经常关注机油压力和冷却液温度是否正常，若见异常，应该停车检查。

机油压力：怠速时（允许最低）150 kPa；标定转速时（允许最低）400 kPa；标定转速时（允许最高）600 kPa

冷却液温度：柴油机正常工作时为 75~95℃。

●若柴油机温度出现过热时（水温报警器报警），应降低转速或负荷或二者同时进行，直到柴油机冷却液温度恢复到正常工作范围；否则应参考第 6 章“故障排除指南”进行检修。

●在运行过程中，特别是突减负荷时，应注意防止因喷油泵调速器失灵使柴油机转速突然升高超过规定值（俗称飞车）。一旦出现此类情况应先迅速采取紧急停车措施，然后再查明原因。

△注意：柴油机超速运行会导致其严重损坏。

大多数柴油机故障出现前有明显的征兆，通过听柴油机声音变化、看柴油机性能变化和外观变化可以预先知道柴油机需要保养或维修，应及时进行保养或维修，否则会酿成严重故障。必要时，应及时联系上柴“易+人”呼叫中心，以获得技术指导或专业的维修服务。

柴油机故障前典型征兆

柴油机熄火　　柴油机异常振动　　柴油机声音不正常　　柴油机冷却液温度、机油压力突然发生变化

柴油机冒黑烟　　功率不足　　机油耗增加　　燃油耗增加　　三漏（机油、燃油、冷却液泄漏）

4.7 柴油机停车

4.7.1 正常停车

柴油机长时间高速高负载运转后，停机前应逐步卸去负荷、降低转速，并在怠速运行 5 分钟，使发动机均匀冷却，使增压器转速大幅下降，然后再停机，以保护柴油机和增压器。停车后关闭燃油箱，船用柴油机还需要关闭海水进水阀。

柴油机如需停用一段时间，需要做好保存工作，具体见第 7 章柴油机停运后保存。

4.7.2 紧急停车

在紧急或特殊情况下，为避免柴油机发生严重故障可采取紧急停车。此时用手拨动紧急停车手柄，即可达到目的。

4.8 新柴油机或大修后柴油机的磨合

新的或大修后的柴油机，在正式使用前须经 60 h 磨合并更换机油后方可投入全负荷使用，以改善柴油机各运动部件的工作状况，提高柴油机的运行可靠性和使用寿命。磨合应视柴油机用途和拖载方式的不同，考虑具体磨合方案。原则上随着磨合时间的增加分阶段逐步提高柴油机的转速和负载。在整个磨合期内负荷应是标定功率的 50%～80%，转速应不大于标定转速的 80%。电站恒速柴油机允许在标定转速磨合，但磨合开始阶段的空载运行时间或过小负荷情况下的运转时间不宜太长。

柴油机在磨合期及磨合后的正常工作期，均不宜长时间怠速运行或低负荷运行。柴油机怠速连续运行时间不得超过 10 分钟，以避免因积碳而引发早期磨损或影响柴油机性能。

每当更换缸套、活塞、活塞环、连杆轴瓦、主轴瓦或/和曲轴后亦应按上述磨合工况适当进行短期磨合。

5 柴油机保养

5.1 柴油机保养计划

下表给出了本系列柴油机保养周期及保养内容。用户应根据本表规定进行定期保养。若柴油机经常在环境温度低于-18℃或高于 38℃情况下运行，或者在多尘环境下运行，须适当缩短保养周期。

保养内容	首次保养 60 小时	日常 维护	每 250 小时 或 每 3 个月	每 500 小时 或 每 6 个月	1 000-1 500 小时 或 每 12 个月	每 2 000 小时 或 每 2 年
检查柴油机外围	●	●	●	●	●	●
检查燃油箱	●	●	●	●	●	●
检查空滤器保养指示器	●	●	●	●	●	●
检查机油油面	●	●	●	●	●	●
检查冷却液液面	●	●	●	●	●	●
检查电解液液面	●	●	●	●	●	●
检查传动胶带 *	●	●	●	●	●	●
检查冷却风扇	●	●	●	●	●	●
检查进气系统			●	●	●	●
加注润滑脂			●	●	●	●
检查传动胶带张紧情况	●		●	●	●	●
更换机油和机油滤清器	●		●	●	●	●
更换燃油滤清器				●	●	●
燃油系统泵油排气				●	●	●
检查和调整气门间隙	●			●	●	●
检查中冷器及其管路					●	●
检查风扇轴承						●
检查增压器						●
检查减振器						●
更换冷却液、清洗冷却系统						●
	* 当胶带表面出现裂痕或其他影响使用的缺陷时，必须更换。 注意：船用柴油机空滤器无保养指示器，每当更换机油和机油滤清器时，按 5.3.22 规定清洗空滤器滤芯。					

注：本表中以小时或年月为单位规定保养间隔的，以先到为准。

5.2 柴油机保养记录

用户应做好定期保养记录。用户可参考下面提供的“保养记录”格式，编制自己的保养记录本。

保养记录

柴油机机号_____ 柴油机型号/订货号_____

用户名称_____ 设备名称/编号_____

日　期	小时或 时间间隔	保养内容	保养者	备　注

5. 3 柴油机保养内容及方法

5.3.1 检查柴油机外围

每天在柴油机起动前进行柴油机外围检查。检查内容如下：

（1）检查柴油机及散热器上有无揩布、废电线、管夹、螺钉等杂物堆积，保持柴油机清洁、整齐。

（2）检查燃油系统、冷却系统、润滑系统各接头、接合面有无泄漏。

（3）检查风扇连接和安全护罩是否安全可靠。

（4）检查附件紧固情况。

（5）检查电气线路接头是否松动，导线是否完好。

（6）检查传动胶带是否完好。

5.3.2 检查燃油箱

每天检查燃油箱油面。

5.3.3 检查空气滤清器保养指示器

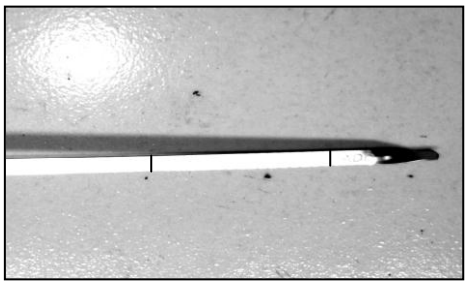
每天检查空气滤清器上的保养指示器。如果检视窗口显示红色，表示空气滤清器的进气阻力超过规定值，需要更换滤芯。滤芯更换要求和步骤见 5.3.21。滤更换芯后，必须按下保养指示器顶部上的按钮，使其复位。

△注意：绝不允许不带空气滤清器的情况下运行柴油机（除船用柴油机外）。否则极易造成柴油机早期磨损。

5.3.4 检查机油油面

每天在柴油机起动前或停车状态时（停车后至少 10 分钟，以使机油有充分的时间流回油底壳）检查机油油面。机油油面高度应在油尺上的高油位刻线（上刻线）和低油位刻线（下刻线）之间。如果机油量不足，应添加机油至近高油位刻线。

△注意：决不能在机油液面低于低油位情况下运行柴油机。否则会导致柴油机性能变差，甚至损坏柴油机。但机油液面不得超过高油位刻线。



5.3.5 检查冷却液液面

▲警告：柴油机工作时，其冷却液温度较高且有压力，容易引起烫伤。待柴油机停车并且冷却液温度下降至 50℃以下，才能进行冷却液液面检查或添加。

▲警告：冷却液中防锈剂含碱，应避免皮肤和眼睛与其接触，以防伤害。

每天在柴油机起动前或停车状态时检查柴油机冷却液液面。

（1）在柴油机起动前或停车后冷却液温度下降至 50℃以下后，慢慢旋开散热器或膨胀水箱上的压力盖（加液盖）以释

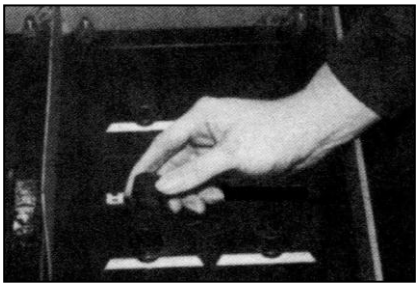
放冷却系统压力。

（2）卸下压力盖，从加液口或液面检查口检查冷却液液面高度，应在上下刻线内或满足设备制造商的规定。

（3）必要时添加。添加至接近上刻线或满足设备制造商的规定。

△注意：添加冷却液时应需慢慢注入，以防产生气阻。

5.3.6 检查电解液液面



有些蓄电池是非免维护型，需要注意蓄电池使用寿命，具体参见蓄电池上的说明。寿命到期，必须及时更换。

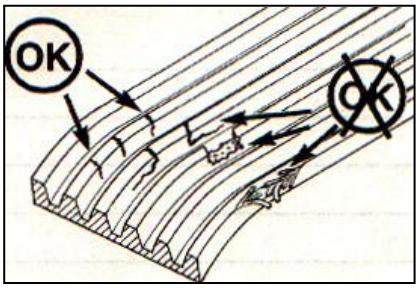
有些蓄电池有些需要补充专用补液或蒸馏水，故需要检查电解液液面。

（1）每天卸下加液盖，查看电解液液面。电解液液面应在加注口底部。如果液面不足，应按要求补充。

（2）装上加液盖。

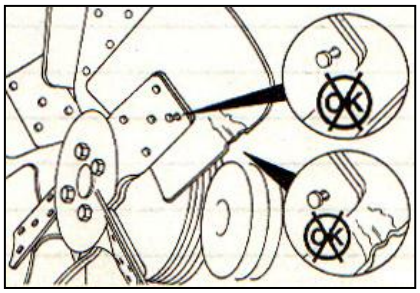
△注意：切忌用饮用纯净水代替。因为纯净水中含有多种微量元素，对蓄电池会造成不良影响。

5.3.7 检查传动胶带



每天目视检查传动胶带。检查胶带是否有纵横交叉的裂纹。沿胶带宽度方向的横向裂纹是允许的，但不允许出现纵向（沿胶带长度方向）和横向贯穿的裂纹。若胶带磨损或出现材料剥落也应予更换。

5.3.8 检查冷却风扇



每天目视检查风扇有无裂纹、铆钉松动、叶片松动和弯曲等毛病。应确保风扇安装可靠。必要时应拧紧风扇紧固螺栓，或更换损坏的风扇。

▲警告：风扇叶片损坏会造成伤人的严重事故。绝不允许拖拉和撬动风扇，更不能借风扇转动柴油机曲轴。

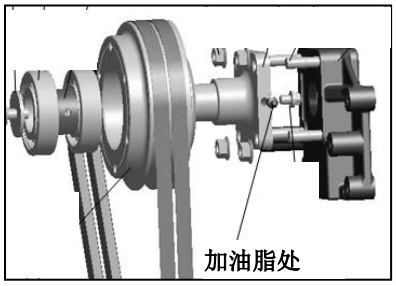
5.3.9 检查进气系统

检查进气胶管是否有裂缝或穿孔，夹箍有否松动。如有发现进气胶管失效应予以更换，发现夹箍松动应拧紧夹箍螺

钉，确保进气系统不漏气。

5.3.10 加注润滑脂

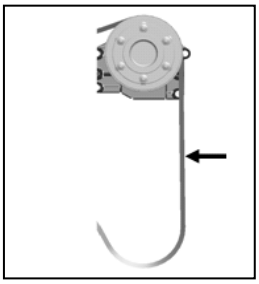
定期在加油脂的小孔处加上适量的钠基润滑油脂。



5.3.11 检查传动胶带张紧情况

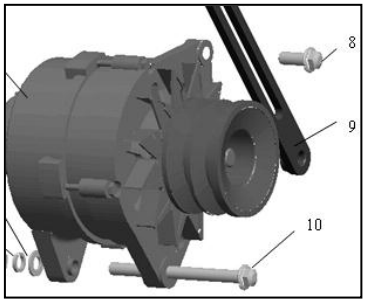
检查

在胶带两带轮之中央位置，以手指用力下压或上拉（施以 98 N 左右力量），观察下压或上拉距离。满足胶带张紧力要求的距离应是 8～12 mm。如超过此范围，需要进行调整。



调整

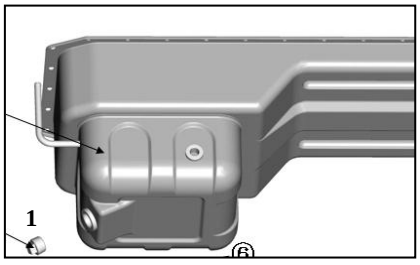
（1）拧松发电机和发电机调节撑条 9 上的所有螺栓和螺母，改变发电机及调节撑条的位置，调整胶带张紧力。
（2）将螺栓、螺母拧紧至40～50 N·m。



5.3.12 更换机油和机油滤清器

▲警告：在更换机油和机油滤清器时要注意安全，与热机油和柴油机表面接触会引起皮肤烫伤。

（1）待柴油机运转至冷却液温度达到 60℃ 时停车，拆下放油螺塞 1，放尽机油。

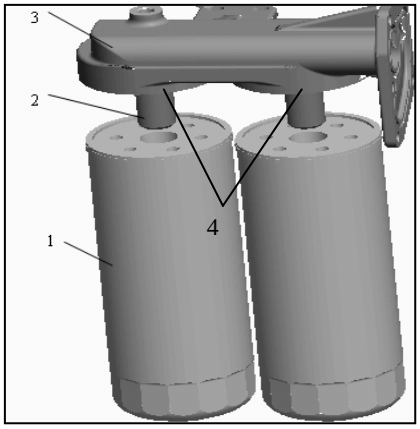


△注意：不要在柴油机冷态时放机油。因为冷态时，悬浮在机油中的杂质颗粒已沉积到油底壳底部并粘附在油底壳内部表面上，不能随机油一起排出。机油温热时杂质颗粒悬浮在机油中，此时放机油，杂质颗粒易排出。

（2）清洁放油螺塞安装面，然后装上放油螺塞，在螺纹上涂可赛新 1567F 密封胶，拧紧扭矩 60～70 N m。

（3）清洁机油滤清器外表面，用工具拆下机油滤清器并报废。

（4）清洗滤清器座密封面，不得有旧的 O 形密封圈残留。



（5）安装新的机油滤清器前，应从滤清器周边 8 个小孔注入清洁机油，注满滤清器内腔，油面离螺纹孔下端 3～15 mm。在 0 形密封圈密封表面上涂一薄层凡士林或清洁机油，以形成润滑膜。

△注意：不得从滤清器中心孔注入机油。

（6）手旋滤清器直至密封圈接触到滤清器座安装面，然后用工具再拧紧 45 ± 5 N·m 或 3/4 圈至 1 圈。

（7）打开加油口盖，用清洁的机油注入柴油机至接近油尺上高油位刻线。柴油机润滑系统机油容量为 32.5 L

（8）起动柴油机并怠速运转，检查机油滤清器和放油螺塞有否漏油。

（9）停车，约等 10 分钟让机油有充分的时间流回油底壳，然后检查机油液面高度。如需要，则添加至接近油尺上高油位刻线。

（10）安装加油口盖，手感拧紧即可。

5.3.13 更换燃油滤清器

（1）清洁燃油滤清器外表面，用工具拆下燃油滤清器并报废。

（2）清洁燃油滤清器座周围及滤清器座的密封面。不得有旧的 O 形密封圈残留。

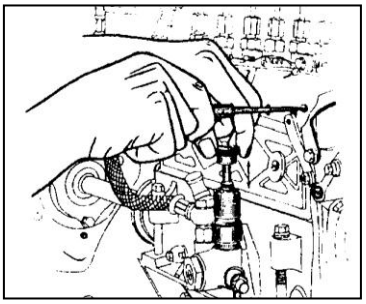
（3）安装新的燃油滤清器前，应从滤清器周边 8 个小孔注入清洁燃油，注满滤清器内腔，油面离螺纹孔下端 3～15 mm。并在 0 形密封圈密封表面上涂一薄层凡士林或清洁机油，以形成润滑膜。

△注意：不得从滤清器中心孔注入燃油。

（4）手旋滤清器直到密封圈接触到滤清器安装面，然后用工具再拧紧 45 ± 5 N·m 或 3/4 圈至 1 圈。

5.3.14 燃油系统泵油排气

柴油机已有多日停止工作或更换燃油滤清器后，空气会进入燃油系统，需要按以下步骤进行泵油排气：



（1）旋松喷油泵上的放气螺钉。

（2）按动手揿泵进行手动泵油排气，直至放气螺钉处溢出的燃油中无气泡。

（3）拧紧放气螺钉。

△注意：没有及时加燃油，导致空气进入燃油系统，或者其它因素导致燃油系统有空气，均需要排除空气。

5.3.15 检查和调整气门间隙

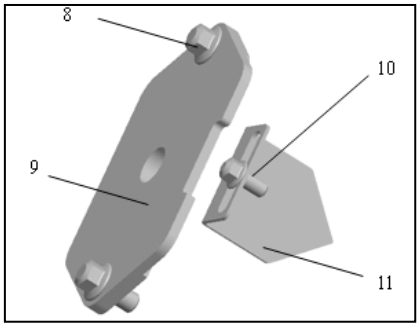
新柴油机和大修后投入使用的柴油机，在首保时，进行第一次气门间隙检查，以便及时调整和纠正气门间隙的初期变化。在其后的正常运转期间，按保养计划检查和调整。

气门间隙检查在柴油机停止运转并且冷却液冷温度降至 60℃以下后进行。

（1）拆下气缸盖罩壳带帽螺母，拆下罩壳，报废罩壳密封圈和垫片。

（2)逆时针盘车使柴油机第 1 缸或第 6 缸活塞处于压缩上止点。

注：通过飞轮壳盖板 9 上监视窗口观察指针 11 位置。如指针对准飞轮上的 “0”线刻时即为第 1 缸或第 6 缸活塞上止点。



（3）转动第 1 缸进、排气门推杆，如果推杆能转动，说明第 1 缸的活塞处于压缩上止点；如不能，则第 6 缸的活塞处于压缩上止点。

（4）当第 1 缸活塞在压缩上止点时，用千分尺（厚簿规）检查第 1、2、4 缸进气门间隙，第 1、3、5 缸排气门间隙；当第 6 缸活塞在压缩上止点时，用千分尺（厚簿规）检查第 3、5、6 缸进气门间隙，第 2、4、6 缸排气门间隙。

注：用间隙塞片检查间隙时，塞片在气门杆顶面与摇臂之间移动时手感有点阻力，即为正确的气门间隙。

（5）如间隙不符合要求，拧松该摇臂上的气门间隙调节螺钉的锁紧螺母，调整气门间隙至规定值，然后拧紧锁紧螺母至 50~60 N·m。复查该气门间隙，间隙数值不应有变化。

气门间隙：

进气门……0.30～0.35 mm

排气门……0.35～0.40 mm

（6）在减振器做上标志，然后旋转曲轴一周（360°），以同样的步骤调整其余的进、排气门间隙。

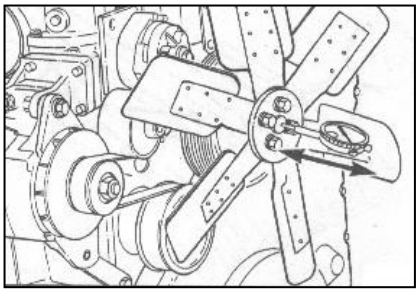
（7）安装气缸盖罩壳，采用新的罩壳密封圈和垫片，安装并拧紧气缸盖罩壳带帽螺母，拧紧力矩 10～15 N m。

5.3.16 检查中冷器及其管路

目视检查中冷器进出气室是否有裂缝、穿孔或其他损坏，检查进出气管是否有裂缝、脱焊及其他损坏。如有，应予以更换。检查中冷器进出气管、进出水管（水空中冷）的连接软管有否裂缝或穿孔、夹箍有否松动。如有，应更换软管、拧紧夹箍。

5.3.17 检查风扇轴承

拆下传动胶带，用手转动风扇胶带轮，检查转动轴轴承是否有异常。转动风扇时不得有振动和过大的轴向窜动现象。如必要，更换风扇轴承座。



5.3.18 检查增压器

目视检查增压器涡轮叶片和压缩机叶片是否损坏或有裂纹，手指轻压叶片，叶片是否与涡轮壳或压气机壳接触，检查增压器转轴转动是否有卡滞现象。如发现上述问题，需要更换增压器。

5.3.19 检查减振器

检查减振器有否减振液（硅油）泄漏、减振器表面是否塌陷；检查减振器厚度以确定减振器是否变形。如发生上述问题，需要更换减振器。

5.3.20 更换冷却液、清洗冷却系统

为确保柴油机冷却液的冷却和防蚀效果，必须每 2 000 小时或 2 年（先到为准）更换冷却液、清洗冷却系统。

▲警告：在工作温度下，柴油机冷却液温度较高且有压力，蒸汽能引起人身伤害。只有在柴油机停止工作后，待冷却液温度降至 50℃以下，才可慢慢拧开散热器上压力盖（加液盖）释放冷却系统压力。

▲警告：冷却液内防锈剂含碱，应避免皮肤和眼睛与其接触，以防人身伤害。

（1）待柴油机停车且冷却液温度降至 50℃后，慢慢旋松散热器上压力盖以释放冷却系统压力，然后卸下压力盖。旋开散热器的放水阀，放尽散热器中的冷却液。

（2）拆下柴油机上 2 个放水螺塞（一个在进气侧、靠近飞轮壳，一个在排气侧、机油冷却器下方），旋松水泵上的放水阀，放尽柴油机冷却系统中的冷却液。

（3）按下列步骤清洗冷却系统。

（a）装上并拧紧所有放水阀和放水螺塞，从散热器加液口将碳酸钠水溶液（或在市场上能买到的碳酸钠与水的混合物）加入冷却系统。

△注意：每 23 L 水用 0.5 kg 碳酸钠混合。不得用含腐蚀剂的清洗剂，否则会损坏铝制零件。

△注意：在灌注清洗液过程中必须将冷却水腔中空气排出，且慢慢注入，防止产生气阻。清洗液需加至散热器加液口底面，等待 3～5 分钟，让空气充分排出。

（b）起动柴油机，等清洗液温度升至 80℃以上后运转 5 分钟，然后停车放尽冷却系统中的清洗液。

△注意：整个冷却系统清洗过程中，不安装压力盖，并在不加盖的情况下运行柴油机。

（c）将清水注入冷却系统。

△注意：灌注清水时，须慢慢注入，防止产生气阻。清水需加至散热器加液口底面，等待 3～5 分钟，让空气充分

排出。

（d）起动柴油机，等水温升至 80℃以上后运转 5 分钟，然后停车放尽冷却系统中的清水。

△注意：若排出水仍是脏的，必须按上述步骤再次清洗冷却系统，直到流出的水是干净为止。

（4）清洗完毕后，拧紧散热器上的放水阀和柴油机水泵上的放水阀，拧紧柴油机上 2 个放水螺塞，拧紧扭矩 60～80 N m。安装柴油机上放水螺塞前，在螺塞螺纹上涂抹可赛新 1567F 密封胶。

（5）加注冷却液，15 升柴油机本体冷却液总量：25.5 L ；13 升柴油机本体冷却液总量：23 L

△注意：上面的冷却液总量是指柴油机冷却系统的总量。整个冷却系统的添加量应以设备制造商的数据为准。

△注意：加注冷却液时，须慢慢注入，防止产生气阻。冷却液需加至散热器加液口底面或符合设备制造商的要求，等待 3～5 分钟，让空气充分排出。

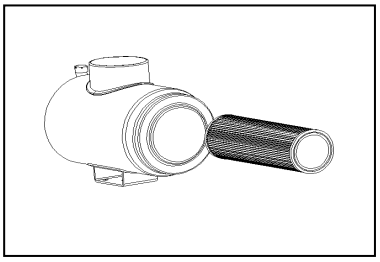
（6）安装压力盖，起动柴油机，直至冷却液温度达到 80℃，然后停车检查冷却系统有否泄漏。

（7）停车后待冷却液温度降至 50℃以下，打开压力盖，复查冷却液液面，如有必要，再补注适量冷却液。

5.3.21 更换空气滤清器滤芯（纸质滤芯）

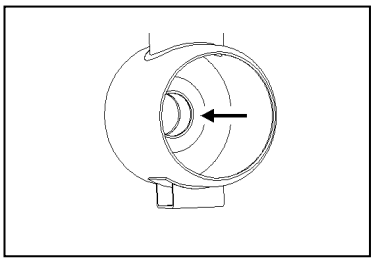
（1）用压缩空气将吹净附在壳体上的灰尘。

（2）拆下空气滤清器罩盖和滤芯，报废滤芯。



（3）用清洁覆盖物盖住空滤器壳体内通向压气器进口，防止灰尘进入进气系统。

（4）用压缩空气将吹净空滤器壳体内部。



（5）检查新的滤芯是否完好无损，取下压气机进口处覆盖物。

（6）安装新的滤芯，并确保空滤器两端密封可靠；安装空滤器罩盖。

△注意：更换空气滤清器滤芯后，确保空气滤清器两端面可靠密封，不得漏气。

5.3.22 清洗空气滤清器滤芯（非纸质滤芯）

（1）用压缩空气将吹净附在壳体上的灰尘。

（2）拆下空滤器罩盖，拆下滤芯。

（3）将滤芯浸泡在温的中性清洁溶液中清洗，去掉油污，严禁用刷子刷洗。清洗后需要吹干。如采用非中性清洁溶液，需要用清水冲洗掉清洁溶液。

（4）清洁后需检查滤芯是否破损。

（5）安装滤芯并确保空滤器两端密封可靠，安装空滤器罩盖。

△注意：保养空气滤清器滤芯后，确保空气滤清器两端面可靠密封，不得漏气。

6 柴油机故障排除指南

6.1 概述

如柴油机出现故障时，操作人员应沉着仔细，及时分析故障的特征，判断其产生的原因。一般按下列原则进行：

1） 当柴油机运转中有不正常的现象时，可以用“看、听、摸、嗅”综合判断是哪个部位或哪个系统产生故障。

“看”：观察各仪表的读数、排气烟色以及冷却液温度和机油压力的变化情况；

“听”：用细长的金属棒或木柄起子作为“听诊器”触及柴油机外表相应部位，“听诊”运动发出的声音及其变化情况；

“摸”：凭手指感觉检查配气机构等零件的工作情况和柴油机振动情况；

“嗅”：凭感官的嗅觉，嗅出柴油机有否出现异常气味的地方。

2）当柴油机突然发生故障或已判断出故障的原因，而且故障将影响柴油机正常工作时，应及时停车检查。对不能立即查明原因的故障，可以先将柴油机低速空载运转，再观察分析原因，以避免发生更大的事故。

3）当判断是较大故障或柴油机突然自行停车时，即应及时拆检和维修。

4）应将每次出现的故障、特别是大的故障原因和排除方法记录在案，供下次检修时参考。

本章所列的柴油机常见故障和排除方法，仅供操作人员参考。在实际工作中，应根据当时当地的具体条件和实践经验灵活掌握，找出产生故障的内、外原因，“对症下药”，及时排除。

6.2 柴油机故障排除

下表列出了柴油机使用中一些典型故障模式，后面故障表列出故障特征、可能的原因和排除方法。用户可自行排除简单的故障，复杂的故障，如需要，可联系上柴“易+人”呼叫中心（400-820-5656）寻求帮助，以获得技术指导或专业的维修服务。

序号	柴油机故障模式	序号	柴油机故障模式
1	柴油机不能起动	6	机油温度过高、机油耗量太大
2	柴油机功率不足	7	机油内有冷却液
3	柴油机运转时有不正常的杂声、振动过大	8	柴油机出水温度过高
4	排气烟色不正常	9	柴油机出水温度过低
5	机油压力不正常	10	冷却液中有机油

序号	系统和零部件常见故障	序号	系统和零部件常见故障
11	电气系统常见故障	14	输油泵常见故障
12	喷油泵常见故障	15	喷油器常见故障
13	调速器常见故障	16	废气涡轮增压器常见故障

1）柴油机不能起动

故障特征	可能原因	排除方法
柴油机被起动电机带动后不发火，回油管无回油	燃油系统故障： (1)燃油系统中有空气 (2)燃油“浊点”高于环境温度，影响正常流动性（所谓“浊点”就是燃油开始析蜡的温度） (3)燃油管路阻塞 (4)燃油滤清器阻塞 (5)输油泵不供油或断续供油 (6)喷油泵调速器操纵手柄位置不对 (7)喷油泵静态供油定时不正确 (8)喷油很少，喷不出油或喷油不雾化	 排除燃油系统中的空气，方法参见 5.3 节 放出油箱和燃油滤清器中所有燃油，按 4.1 要求选用正确的燃油品质和牌号，然后注入油箱；用手掀泵和放气螺钉将燃油系统内空气排尽 检查管路是否畅通 清洗滤网、更换燃油滤清器 检查进油管是否漏油，进油管接头上的滤网是否堵塞。如排除后仍不供油，应检查进油管和输油泵 起动时应将手柄位置推到空载 检查或调整喷油泵静态供油提前角 将喷油器拆出，检查并在喷油器试验台上调整喷油压力至规定范围，必要时更换喷油器偶件
起动开关接通时，柴油机不转动	(1)电路接线错误或接触不良 (2)蓄电池电力不足 (3)起动电机电刷与换向器没有接触或接触不良 (4)柴油机内部机械故障阻碍了曲轴转动	检查接线是否正确和牢固 给蓄电池充电或用电力充足的蓄电池或增加蓄电池并联使用 修整或调换碳刷，用木砂纸清理换向器表面，并吹净，或调整刷簧的压力 如果将所驱动的设备断开后，曲轴仍不能转动，就应人工盘转曲轴，检查是否因曲轴或连杆轴承咬死、活塞卡住、或凸轮轴定时齿轮安装错误造成
喷油正常但不发火，排气管内有燃油	气缸内压缩压力不足： (1)活塞环或缸套过度磨损 (2)气门漏气	 更换活塞环，视磨损情况更换缸套 检查气门间隙、气门弹簧、气门导管及气门座的密封性，密封不好应修理和研磨
起动时间长且不发火	环境温度过低	根据实际环境温度，采取相应的低温起动辅助措施

2）柴油机功率不足

故障特征	可能原因	排除方法
加大油门后功率或转速仍提不高	燃油系统故障： (1)燃油管路破裂、管接头泄漏、燃油滤清器阻塞、燃油系统有空气 (2)油箱内燃油不足或油箱中有水和杂质 (3)喷油泵静态供油定时不正确 (4)喷油泵供油不足 (5)喷油器雾化不良或喷油压力低	更换破裂的油管、拧紧管接头、清洗滤网、更换燃油滤清器、给燃油系统充油排气 确保燃油箱内有充足清洁燃油，通过泄油阀排除油箱中的水和沉淀物。如果原有的燃油不清洁，应换注清洁燃油 检查并调整喷油泵静态供油提前角 检查修理，必要时更换喷油泵 检查喷雾或调整喷油压力，并检查喷油嘴偶件，必要时更换
正常情况下排温较高、烟色较差	进、排气系统故障： (1)空气滤清器阻塞 (2)进气系统漏气 (3)排气管阻塞或接管过长、转弯半径太小、弯头太多 (4)气门间隙不正确 (5)喷油泵静态供油定时不正确	清除纸质滤芯上的灰尘，必要时更换滤芯 检查增压器压气机出口至气缸盖进气口之间有无漏气，必要时排除泄漏源 清除排气管内积碳，重装排气接管，弯头不能多于 3 个，并有足够大的排气截面 检查并调整气门间隙 检查并调整喷油泵静态供油提前角
各档转速下性能变差	喷油泵供油提前角或进、排气相位变动	检查并调整喷油泵静态供油提前角，必要时检查凸轮轴齿轮定时
柴油机过热	(1)环境温度过高 (2)机油和冷却液温度很高，排温也大大增高	环境温度过高应改善通风，临时加强冷却措施 检修机油冷却器和散热器，清除水垢；检查有关管路管径是否过小
柴油机功率不足，性能下降，而且有漏气、进气管冒黑烟，有不正常的敲击声等现象	气缸盖组件故障： (1)气缸盖与机体结合面漏气，变速时有一股气流从气缸盖垫片处冲出，使气缸盖大螺母松动或垫片损坏 (2)进、排气门漏气 (3)气门弹簧损坏 (4)气门间隙不正确 (5)喷油器孔漏气或其铜垫圈损坏 (6)活塞环卡住、气门杆咬住引起气缸压缩压力不足	按规定扭矩拧紧气缸盖螺母或更换气缸盖衬垫，必要时修刮接合面 拆检进、排气门，修磨气门与气门座密封面 更换已损坏的气门弹簧 检查和调整气门间隙至规定值 拆下检修，并更换已损坏的零件 检查活塞环、活塞、缸套、气门，必要时更换这些零件
柴油机声音不正常，并有机油压力下降等现象	连杆轴瓦与曲轴连杆轴颈表面咬合	检查连杆大头的侧向间隙，查看连杆大头是否能前后移动，如不能移动则表示咬毛，应修磨轴颈和更换连杆轴瓦
转速下降，进气压力降低，漏气或不正常的声音等	涡轮增压器故障： (1)增压器轴承磨损，转子有碰擦现象 (2) 压气机进气道沾污、阻塞或漏气	让专业维修人员检修，如需要，更换增压器 请增压器专业维人员检修清洗压气机壳体、揩净叶轮。清洁进气管路；拧紧接合面螺母、夹箍等

3）柴油机运转时有不正常的杂声、振动过大

故障特征	可能原因	排除方法
气缸内发出有节奏的清脆金属敲击声	喷油泵静态供油正时过早	调整喷油泵静态供油提前角
气缸内发出低沉不清晰的敲击声	喷油泵静态供油正时过迟	调整喷油泵静态供油提前角
运转时有轻微而尖锐的响声，在怠速运转时尤其清晰	活塞销与连杆小头衬套孔配合过大	检查连杆衬套内孔是否磨损，如有，更换连杆
运转时在气缸体外壁听到撞击声，随柴油机温度升高而减小	活塞与气缸套间隙过大	更换活塞或视磨损情况更换气缸套
运转时，曲轴箱内发出撞击声，当柴油机从 1 000 r/min 突然降低转速时听到沉重而有力的撞击声	连杆轴瓦磨损使配合间隙过大	拆检轴瓦，必要时更换轴瓦
柴油机怠转时，听到曲轴前后窜动的碰撞声	曲轴推力轴承磨损，轴向间隙过大，导致曲轴前后窜动	检查轴向间隙和推力轴承的磨损程度，必要时更换推力轴承
气缸盖处发出有节奏的轻微敲击声	气门弹簧折断，或挺杆弯曲，或推杆套筒磨损或气门损坏	更换已损坏的零件，并调整气门间隙
柴油机运转中气缸盖处发出沉重而均匀、有节奏的敲击声，用手指轻轻捏住气缸盖罩壳的螺帽有碰撞感觉	气门碰活塞	拆下气缸盖罩壳，检查相碰原因，调整气门间隙。必要时检查活塞型号是否正确
在前盖板处发出不正常声音，突然降速时可听到撞击声	传动齿轮磨损、齿隙过大	检查齿隙，视磨损情况更换齿轮
在气缸盖处听到干摩擦发出的“吱吱”响声	摇臂调节螺钉与推杆的球面座之间无机油	拆下气缸盖罩壳，检查断油的原因
在气缸盖处听到有节奏的较大响声	进、排气门间隙过大	检查和调整气门间隙
涡轮运转时有不正常的碰擦声	油路堵塞，润滑不良，导致轴承磨损，从而导致叶轮叶片弯曲	让专业维修人员检查轴承磨损情况，叶轮叶片弯曲情况，必要时更换增压器。清洗增压器进出油管路，确保润滑油道畅通
燃烧噪声太大	(1)燃油质量差 (2)喷油泵故障	将油箱里的燃油排掉，更换燃油滤清器。在油箱内注入质量优良的清洁燃油 使柴油机在燃烧噪声最大的工况下运转，然后逐个拧松喷油泵上每个气缸的油管螺帽（每次一个）。如果该油管螺帽拧松后，燃烧噪声消失，则检验该气缸喷油泵柱塞副，必要时换上新零件
柴油机严重振动	一缸或多缸的喷油器或喷油泵柱塞不工作	检修或更换喷油器、喷油泵柱塞或喷油泵
	柴油机与机座固定螺栓松动	拧紧柴油机与机座的紧固螺母
	柴油机与螺旋桨轴中心偏移（船用柴油机）	对准二者的中心线

4）排气烟色不正常

故障特征	可能原因	排除方法
排气冒黑烟	(1)柴油机负荷超过规定 (2)各缸供油量不均匀 (3)气门间隙不正确、气门密封不良，导致气门漏气，燃烧恶化 (4)喷油泵静态供油定时过迟使部分燃油在排气管中燃烧 (5)喷油器雾化不良 (6)空气滤清器或进气管阻塞，涡轮增压器压气机壳过脏等导致进气量不足 (7)涡轮增压器弹力封气环烧损或磨损，涡轮各接合面漏气等 (8)活塞环磨损严重	降低负荷使之在规定范围内 调整喷油泵 调整气门间隙，检查密封锥面，并消除缺陷 检查和调整喷油泵静态供油提前角 检查喷油器雾化情况 清洗和清除尘埃污物，必要时更换空气滤清器滤芯 让专业维修人员检查弹力封气环，必要时更换。拧紧接合面螺钉 更换新环
排气冒白烟	(1)喷油器喷油雾化不良，有滴油现象，喷油压力过低 (2)柴油机刚起动时，个别气缸不燃烧(尤其是冬天) (3)油中含水太多 (4)气缸盖裂缝，导致冷却液进入气缸	检查喷油嘴偶件，进行修磨或更换。 调整喷油压力至规定范围 适当提高转速及负荷，多运转一些时间 排除燃油管路中的水分 检查排气中是否有水分凝结现象，必要时更换气缸盖
排气冒蓝烟	(1)空气滤清器阻塞，进气不畅 (2)活塞环卡住或磨损过多，弹性不足；安装时活塞环倒角方向装反，使机油进入燃烧室 (3)长期低负荷(标定功率的 40%以下)运转，活塞与缸套之间间隙较大，使机油易窜入燃烧室 (4)油底壳内机油加入过多 (5)涡轮增压器油封损坏，机油进入进气管，从而进入气缸	拆检和清洗空气滤清器滤芯 拆检活塞环，必要时更换活塞环 适当提高负荷；配套时选用功率要适当 按油尺刻线加注机油，不能超过高油位刻线 检查进气管有无机油，必要时检查或更换涡轮增压器

5）机油压力不正常

故障特征	可能原因	排除方法
机油压力下降，调压阀调整后仍不正常，同时压力表读数波动	(1)机油管路漏油 (2)机油泵进空气，油底壳中机油不足 (3)机油冷却器或机油滤清器阻塞，或冷却器芯子破裂 (4)曲轴轴承处、曲轴前后油封处、凸轮轴轴承处、连杆轴瓦处、或/和摇臂轴和摇臂处泄油严重 (5)机油内有柴油 (6)机体内漏装活塞冷却喷嘴 (7)机油稀释	检修、拧紧螺母 加注机油至规定高度 清洁机油冷却器，必要时更换机油滤清器，机油冷却器芯子 检查各轴承磨损情况，磨损值超过规定范围时更换相应零件 找出柴油进入机油的地方，根据需要进行修理。更换机油和机油滤清器 装上活塞冷却喷嘴 检查原因，更换机油
无机油压力，压力表指针不动	(1)机油压力表损坏 (2)油道阻塞 (3)机油泵严重损坏或装配不当卡住 (4)机油压力调压阀失灵，其弹簧损坏	更换 检修清理后吹净 重新按装机油泵，必要时更换 更换调压阀

6）机油温度过高、机油耗量太大

故障特征	可能原因	排除方法
油温表读数超过规定值，加强冷却后仍较高，同时排气冒黑烟	(1)柴油机负荷过大 (2)温度表指示不准确 (3)机油油面过低或过高 (4)冷却液容量或风扇风量不足 (5)机油冷却器阻塞	降低负荷 校验温度表，必要时更换 调整机油至规定要求 注意使冷却液畅通，调整胶带张紧力，使水泵和风扇达到规定转速 清洗冷却器，必要时更换
油底壳中机油液面下降较快，油色较黑，通气管、加油口冒白烟，排气管冒蓝烟	(1)长期处于低负荷运行 (2)使用的机油牌号不当 (3)涡轮增压器弹力密封装置失效 (4)活塞上油环回油孔被积碳阻塞 (5)活塞环被粘住或磨损过甚，气缸套磨损过甚使机油窜入燃烧室，燃气进入曲轴箱 (6)气门导管磨损	适当提高负荷 选择本手册规定的牌号机油 让专业维修人员拆检弹力封气环是否烧坏、弹性失效，必要时更换弹力密封装置 清理积碳，必要时更换油环 更换活塞环，必要时更换气缸套 修理气缸盖、更换导管

7）机油内有冷却水

故障特征	可能原因	排除方法
机油中漂浮黄色泡沫，通气管滤芯表面有水蒸汽凝结	气缸套封水圈损坏导致冷却液泄漏	更换封水圈
	气缸套与机体接合面泄漏冷却液	检查气缸套肩胛与机体之间的接合面是否平整，缸套调整垫片是否损坏，必要时更换相关零件
	气缸套因穴蚀穿孔导致冷却液泄漏	更换气缸套
	气缸盖垫片损坏导致冷却液泄漏	更换气缸盖垫片
	机油冷却器芯子损坏，使冷却液和机油相混	拆检机油冷却器芯子，必要时更换冷却器芯子
	水泵中的冷却液漏入油底壳： (1)水泵轴与密封圈处泄漏冷却液 (2)水泵封水圈损坏	 检查并更换封水圈，必要时更换水泵 更换水泵
	机体水腔壁穴蚀导致冷却液泄漏(特别是靠推杆侧气缸壁)	更换机体

8）冷却液温度过高

故障特征	可能原因	排除方法
柴油机起动后出水管不出冷却液或冷却液量很少，冷却液温度不断上升	冷气系统中有空气	松开出水管上的出气管，放尽空气，直至冷却液流出畅通为止，拧紧水管路中各接头
在高负荷下，冷却液温度过高，机油温度也升高	(1)水泵或风扇转速达不到要求 (2)冷却系统内的冷却液不充足 (3)散热器压力盖故障 (4)水管路阻塞 (5)散热器表面积垢太多，导致散热水管路阻塞 (6)水温表不正确 (7)调温器失灵 (8)水泵叶轮与壳体的间隙过大 (9)水泵叶轮损坏	调整传动胶带张紧力至规定要求 补充冷却液至规定要求 检查压力盖的工作情况，必要时更换压力盖 清理管路，清除水道中的积垢 清除积垢，清洗散热器 检查水温表，必要时更换 检查调温器开启与关闭温度、开启升程是否符合要求，必要时更换调温器 更换水泵 更换水泵
散热器内冷却液有翻泡现象	气缸套肩胛处有裂纹	更换气缸套

9）柴油机出水温度过低

故障特征	可能原因	排除方法
	环境温度低，使用负荷低	适当提高负荷
	水温表指示不正确	校验水温表，必要时更换
	调温器开闭不灵活或损坏	更换调温器

10）冷却水中有机油

故障特征	可能原因	排除方法
	机油冷却器芯子损坏	更换机油冷却器芯子
	气缸盖垫片故障	更换气缸盖垫片

11）电气系统常见故障

故障特征	可能原因	排除方法
起动电机不转动	(1)连接导线接触不良 (2)电磁开关触点接触不良 (3)电刷接触不良 (4)起动电机本身短路 (5)蓄电池充电不足或容量太小	清洁和旋紧接线头 检查开关触点并用砂皮磨光 清洁换向器表面或更换电刷 找出短路部位后修理，必要时更换起动电机 给蓄电池充电或增加蓄电池并联使用，必要时更换蓄电池
起动电机空转无起动力	(1)电刷、接线头接触不良或脱焊 (2)轴承套磨损 (3)磁场绕组或电枢绕组局部短路 (4)电磁开关触点烧毛，接触不良 (5)蓄电池充电不足或容量太小，以及起动电机的线路压降太大	清洁表面，重新焊接或更换 换新 找出短路部位修理 检查开关触点，并用砂皮磨光 给蓄电池充电、必要时更换蓄电池，增大导线截面或缩短导线长度
起动电机齿轮与飞轮齿圈顶齿或起动电机齿轮退不出	(1)起动机与飞轮齿圈中心不平行 (2)电磁开关触点烧在一起	重新安装起动机，消除不平行现象 检查开关触点、锉平并砂光烧毛不平处
起动按钮脱开,起动电机继续运转	(1)起动电钥匙或按钮不复位 (2)电磁开关触头与连接螺钉烧牢 (3)起动继电器烧牢	重新调整 检修 重新调整
交流发电机不能充电	(1)交流发电机传动胶带松弛 (2)充电电路，接地回路或蓄电池接头接触不良 (3)转子（磁场线圈）发生故障	调整传动胶带至合适张紧力 检查全部导线和接头，将全部接头擦拭干净并拧紧。必要时更换导线和接头 更换转子
充电发电机电压太低或者充电不正常	(1)传动胶带松弛 (2)充电电路，接地回路或蓄电池接头接触不良 (3)交流发电机电压调节器损坏 (4)转子（磁场线圈）发生故障 (5)整流二极管烧坏	调整传动胶带至合适张紧力 检查全部导线和接头，将全部接头擦拭干净并拧紧。必要时更换导线和接头 更换电压调节器 更换转子 更换整流二极管
充电发电机电压太高	(1)交流发电机或发电机电压调节器上的接头接触不良 (2)交流发电机电压调节器有故障	拧紧交流发电机或电压调节器上的全部接头 更换电压调节器
发电机有不正常声音	(1)传动胶带磨损或损坏 (2)传动胶带松动 (3)传动胶带与胶带轮没有相互对准 (4)发电机轴承磨损 (5)电枢或转子轴弯曲 (6)发电机整流元件短路	更换传动胶带 调整传动胶带至合适张紧力 调整使传动胶带中心与胶带轮中心对准 更换发电机 更换发电机 更换发电机

12）喷油泵常见故障

故障特征	可能原因	排除方法
喷油泵不供油	(1)燃油箱中无柴油 (2)燃油系统中进入空气 (3)燃油滤清器或油管阻塞 (4)输油泵故障，不供油 (5)柱塞偶件咬死 (6)出油阀座与柱塞套接合面密封不良	及时添加柴油 用燃油手掀泵排除空气 清洗滤网、更换燃油滤清器，对管路清洗后要吹净 按输油泵故障排除方法检修 让专业维修人员拆出柱塞偶件进行修磨，必要时更换 让专业维修人员拆卸维修，必要时更换
供油不均匀	(1)燃油管路中有空气，断续供油 (2)出油阀弹簧断裂 (3)出油阀座面磨损 (4)杂质使柱塞阻滞 (5)进油压力太小	用燃油手掀泵排除空气 更换喷油泵 让专业维修人员更换出油阀偶件 让专业维修人员清洗， 检查输油泵进油接头滤网和燃油滤清器是否堵塞，必要时更换。按期进行清洗保养
出油量不足	(1)出油阀偶件漏油 (2)输油泵进油接头滤网或燃油滤清器阻塞 (3)柱塞偶件磨损	检查出油阀偶件，必要时更换 清洗滤网，换燃油滤清器 更换柱塞偶件

13）调速器常见故障

故障特征	可能原因	排除方法
转速不稳定(游车)	(1)各缸供油不均匀	重新调整各缸供油量
	(2)喷油嘴孔结碳或和滴油	让专业维修人员进行清洗、维修，或更换喷油器
	(3)齿杆连接销松动	让专业维修人员维修或更换喷油泵
	(4)喷油泵凸轮轴轴向间隙太大	让专业维修人员维修或更换喷油泵
	(5)飞铁销孔磨损松动	让专业维修人员维修或更换喷油泵
	(6)调节齿杆与调节齿轮配合间隙太大或之间有毛刺	让专业维修人员维修或更换喷油泵
	(7)调节齿杆或油门拉杆移动不灵活	让专业维修人员维修或更换喷油泵
	(8)燃油系统中有空气	用燃油手揿泵排除空气
	(9)飞铁张开或飞铁座张开不灵活	让专业维修人员维修或更换喷油泵
	(10)低转速调整不当	让专业维修人员重新调整
达不到标定转速	(1)调速弹簧永久变形	让专业维修人员维修或更换喷油泵
	(2)喷油泵供油量不足	按喷油泵故障排除方法处理
	(3)操纵手柄不在最高转速位置	检查并调整操纵手柄机构
达不到最低怠速	(1)操纵手柄未放到底	让专业维修人员调整或更换喷油泵
	(2)调节齿杆与调节齿圈有轻微卡滞	让专业维修人员维修或更换喷油泵
	(3)低速稳定器调整不当	让专业维修人员调整
调速器突然失灵,使转速超过标定转速 110%以上（俗称飞车）	(1)转速过高	应立即紧急停车，用断开燃油停止进油或切断进气等措施使柴油机停车并让专业维修人员检查维修或更换喷油泵
	(2)调节齿杆或油门拉杆卡死	让专业维修人员维修或更换喷油泵
	(3)调节齿杆和油门拉杆连接销脱落	让专业维修人员维修或更换喷油泵
	(4)油门拉杆螺钉脱落	让专业维修人员维修或更换喷油泵
	(5)调速弹簧断裂或弹簧挂耳脱落	让专业维修人员维修或更换喷油泵

14）输油泵常见故障

故障特征	可能原因	排除方法
输油量不足	(1)止回阀磨损或断裂	修磨或更换输油泵
	(2)活塞磨损	更换输油泵
	(3)进油紧帽泄漏	重新拧紧或修理
	(4)输油泵进口滤网堵塞	清洗滤网
	(5)活塞卡死断油	更换输油泵
	(6)输油泵漏油	检查输油泵，必要时更换

15）喷油器常见故障

故障特征	可能原因	排除方法
喷油很少或喷不出油	(1)燃油系统油路有空气 (2)喷油嘴偶件咬死 (3)喷油泵供油不正常 (4)燃油系统漏油严重 (5)喷油嘴偶件磨损	排除低压或高压油管中的空气 让专业维修人员检查或更换喷油嘴 按喷油泵故障排除方法找出原因处理 检查、修理或更换相应零件 让专业维修人员检查更换喷嘴偶件
喷油压力低	(1)喷油器调压螺钉松动 (2)喷油器调压弹簧变形、断裂 (3)喷油嘴针阀粘滞	让专业维修人员重新调整至规定压力，并拧紧锁紧螺母 让专业维修人员更换喷油器弹簧 让专业维修人员更换喷油嘴偶件
喷油压力太高	(1)喷油器调压弹簧弹力过高 (2)喷油嘴针阀粘滞 (3)喷孔积碳或堵塞	让专业维修人员重新调整至规定压力 让专业维修人员更换喷油嘴偶件 让专业维修人员清理喷孔或更换喷油器
喷油器漏油	(1)喷油器调压弹簧断裂 (2)喷油嘴针阀体研磨面损坏 (3)喷油嘴针阀咬死 (4)喷油器紧帽变形 (5)喷油嘴与喷油器体密封平面接触不良导致泄漏	让专业维修人员更换喷油器弹簧 让专业维修人员更换喷油嘴偶件 让专业维修人员更换喷嘴偶件 让专业维修人员更换紧帽 让专业维修人员维修或更换喷油嘴偶件，必要时更换喷油器
喷油雾化不良	(1)调压弹簧弹力衰减或弹簧断裂 (2)喷油嘴座面磨损 (3)喷油嘴偶件配合面有垃圾 (4)喷油嘴偶件变形或磨损 (5)喷油嘴针阀咬死	让专业维修人员更换喷油器弹簧 让专业维修人员维修或更换喷油嘴偶件 让专业维修人员清洗 让专业维修人员更换喷油嘴偶件 让专业维修人员更换喷油嘴偶件
喷油成线或油滴	(1)喷孔结碳、堵塞 (2)喷油嘴针阀体座面过度磨损 (3)喷油嘴针阀咬死	让专业维修人员清洁喷孔，必要时更换喷油器 让专业维修人员更换喷油嘴偶件 让专业维修人员更换喷油嘴偶件
针阀表面烧坏或呈蓝黑色	柴油机过热	检查冷却系统，柴油机不要长时期超负荷运行；让专业维修人员检查喷油嘴偶件，必要时更换

16）废气涡轮增压器的常见故障

故障特征	可能原因	排除方法
柴油机达不到规定功率	(1)轴承磨损 (2)压气机叶轮及其涡壳流道沾污 (3)涡轮、压气机叶轮背部及密封环处积碳过多	让专业维修人员更换轴承 让专业维修人员清洗 让专业维修人员清洗
柴油机排气烟色不正常，排气管冒黑烟(空气进气量不足)	(1)压气机部分流道沾污 (2)压气机漏气	清洗 检查密封情况，消除漏气
排气冒蓝烟	(1)弹力密封环失去弹性或过度磨损 (2)中间壳回油通道阻塞或管道变形	让专业维修人员更换弹力密封环 清洗并修复变形处
异常声响及振动	(1)压气机喘振，增压器振动时有较大振幅（压气机通道，进气管及涡轮出口通道有严重的沾污是产生喘振的原因之一） (2)装配不当（涡轮、压气机转子失去动平衡或旋转件与固定件碰擦） (3)涡轮叶轮或压气机叶轮的叶片被进入的异物损坏 (4)涡轮壳变形产生碰擦 (5)无叶涡壳通道中存有异物，在柴油机怠转时就能听到异常声音	让专业维修人员清洗， 让专业维修人员拆卸检查和维修 让专业维修人员检查和维修，必要时更换增压器 让专业维修人员查明产生变形的原因，并予以排除，必要时更换增压器 让专业维修人员拆卸检查通道截面，同时检查柴油机进、排气系统
涡轮压气机转子转不动或不灵活	涡轮、压气机背部及弹力密封环座处严重积碳	让专业维修人员进行清洗，同时检查柴油机燃烧不良及漏油现象
轴承烧损及转子碰擦	(1)润滑油过脏及油压太低或油路堵塞 (2)进油温度过高 (3)涡轮、压气机转子动平衡破坏或组装不当 (4)排气温度过高及增压器转速过高 (5)涡轮壳变形	检查润滑系统并清洗滤清器 查明原因使油温降低 让专业维修人员拆卸、检查并复校平衡，必要时更换增压器 检查柴油机及排气管有否严重漏气、变形、阻塞等现象，修复并清洗 查明产生变形原因，并予以排除，必要时更换增压器
转速下降、进气压力降低、漏气或不正常的声音等	(1) 增压器轴承磨损，转子有碰擦现象 (2)压气机进气管路沾污、阻塞或漏气	让专业维修人员检修，必要时更换增压器 清洗压气机壳体、揩净叶轮、清洁进气管路；拧紧接合面螺母、夹箍等

7 油机停运后保存

7.1 短期停运保存

柴油机如需停用一段时间（1 至 3 个月），需要做好清洁工作和必要的油封措施，防止生锈。

7.1.1 封存前

（1）清理干净柴油机表面，检查无可见的脏物、油污、锈迹、水迹等，然后用压缩空气吹干；用毛刷将防锈油均匀涂在所有柴油机金属表面机加工表面（即未喷漆的机加工表面）上；注意橡胶件、塑料件及纤维织物类零件表面禁止涂防锈油或与防锈油接触。

△注意：附件驱动带轮表面需采取一定防锈措施。

发动机外部封存推荐使用 FD615 脱水防锈油或满足下面性能要求的防锈油。

项目		质量指标
外观		均匀棕色
水分		无
滴点		≥55
耐寒性		合格
油基稳定性（ml）		≤2
盐雾试验	钢片	≥14
	铸铁片	≥7
湿热试验	钢片	≥30
	铸铁片	≥14
叠片试验（7 天）	钢片	合格
腐蚀试验（14 天）	钢片	合格
	铸铁片	合格

（2）断开蓄电池连接线，清洁端子，涂上一层薄油脂，给蓄电池充电。

（3）使传动胶带松弛。

（4）将所有外露气管、水管或油管管口用防潮纸或气相防锈纸或聚乙烯塑料薄膜胶带进行封口或包扎，整个空气滤清器也应由防潮纸封口或包扎。

（5）用塑料罩或类似的覆盖物覆盖柴油机，将柴油机置于通风良好的干燥室内。

7.1.2 保存期间

每月进行蓄电池充电。检查蓄电池液面，需要时，添加，然后进行充电。每月用盘车工具盘动曲轴 3-4 圈。

7.1.3 拆封后使用

启用时，拆下燃油喷射泵，送上柴公司指定的服务站进行调整；卸下覆盖物和包扎物，连接管路；安装燃油喷射泵，给燃油系统泵油排气；连接蓄电池连线，张紧驱动皮带；检查润滑油和冷却液的液位，在增压器进油口添加适量清洁机油；用盘车工具先转动曲轴 3～5 转。参照 4.5 节柴油机起动，采用正确的方法起动柴油机。

7.2 长期停运保存

柴油机停用时间超过 3 个月以上，需要进行封存处理。

7.2.1 封存前

（1）在最后一次柴油机使用后，在热态下放尽柴油机润滑油，包括机油滤清器中的机油。因冷却液具有防锈功能，不需要排放。向曲轴箱内加入合格的规定容量的封存油，起动柴油机至怠速，运转 1～1.5 min 即行停车，然后从油底壳中放出封存油。发动机内部封存油为经脱水的 CF 15W-40 润滑油。

（2）柴油机外表面清理防锈及其他封存要求参见 7.1.1 节第 1、2、3、4、5 条，并在柴油机挂上标签，标签上写明该柴油机没有机油，不要使用。

7.2.2 保存期间

参见 7.1.2。

7.2.3 拆封后使用

启用时，拆下燃油喷射泵，送上柴公司指定的服务站进行调整；拿掉柴油机覆盖物和包扎物,连接管路；安装燃油喷射泵，给燃油系统泵油排气；连接蓄电池连线，张紧驱动皮带；添加清洁机油，在增压器进油口添加适量清洁机油；检查机油液面和冷却液液面；用盘车工具先转动曲轴 3～5 转。参照 4.5 节柴油机起动，采用正确的方法起动柴油机。如果保存期超过 2 年，必须更换冷却液，清洗冷却系统。

Caution

Be sure to read this instruction manual carefully, and strictly observe the safety and operation instructions herein, especially the warnings and cautions, so as to reduce the possibilities of personnel injury, property loss, engine performance deterioration, premature wear or damage.

Warnings in this manual must be observed strictly. Failure to do so can cause burn, amputation, mutilation, asphyxiation, other personal injury or death. Cautions are provided for you to operate the engine in a proper way, so as to avoid damage to engine parts and engine performance deterioration. Warnings and cautions in this manual are not complete because Shanghai Diesel Engine Co., Ltd. (SDEC) has no possibility and is not able to foresee all potential risks resulting from the failures to follow the safety cautions and operation instructions.

Repair, Technical Consultation, Complaint and Suggestion

For engine repair, technical consultation, complaints or suggestions, please contact SDEC's after-sale service center: spare@sdecie.com.

Please provide the following information when you make feedback about your engine quality or request for repair:

The model of the diesel engine

The order number of the diesel engine

The serial number of the diesel engine

The date of the equipment procurement

The detailed description of the fault(s)

The address and phone number of contact person

Table of Contents

1 Introduction

1.1 To User and Operator

Thank you for purchasing a product of Shanghai Diesel Engine Co., Ltd!

The G series diesel engine (improved model), available in 13 liters and 15 liters, is a medium power engine developed based on G128 series diesel engine by optimizing design and extending cylinder stroke. The G series diesel engine (improved model) produces more power, less fuel consumption and emissions, and is more reliable than its base engine. It is compatible and exchangeable with the G128 series diesel engine (the base engine) in terms of dimensions and installation. The G series diesel engine (improved model) is a perfect power for marine applications and generator sets.

This manual mainly covers technical specifications, operation and maintenance instruction, with an aim to familiarize you with the engine, as well as the proper operation and maintenance thereof. Before using the engine, read carefully the relevant contents and requirements in this manual. Due to the continuous improvement of performance and structure of the engine, the technical specifications and illustrations of the engine in this manual may be slightly different from those of the engine you have, please note that we will provide the supplement and perfection in the later editions without notice. In case of any question during your engine operation and maintenance, please never hesitate to contact SDEC's after-sale service center spare@sdecie.com for technical advice or guidance.

SDEC has adopted the latest technology and high-quality parts for the engine. The genuine SDEC service parts are recommended to be used for repair and maintenance. Please contact SDEC's after-sale service center spare@sdecie.com for service parts.

Since this manual ensures proper engine operation and maintenance, it should be given to the new owner when the engine is traded or sold.

1.2 Scope

This manual is for the operation and maintenance of marine engine and power station engine series diesel engine.

1.3 Notices for Engine Quality Feedback

To better our service, please provide following information when you make feedback about quality issue(s), whereby, we can understand and analyze the quality issue(s) and the root cause(s) thereof, and make the improvement in time:

1) When and where fault occurred;

2) Engine serial number, model, order number, delivery date and the detailed address of consignee;

3) Service conditions, cumulative operation time (in hours), operating conditions (power, speed) and the specifications of the fuel and lubricating oil that were used;

4) The characteristics of the driven equipment (model, power consumption and structural feature, etc.);

5) The description of fault(s);

6）Part(s) or component(s) claimed for compensation or repair should be mailed or sent in person to SDEC headquarter with the damage process record or description for facilitating analysis. If there are several problems or a very serious problem, please leave the site as it was and inform us promptly, and then SDEC will send staff for a joint analysis.

Quality issue(s) should be settled based on the relevant provisions in the quality warranty manual.

1.4 Safety Instructions

Read and understand all safety notes and warnings before use and maintenance of the engine.

Following safety notes and warnings should be obeyed to avoid any personal injures.

●Be sure to work in a safe place, and be prepared for potential danger at any time.

●When working on the engine, remain alert at all times. Never work on the engine when physically or mentally fatigued.

●Do not smoke when working on the engine.

●Smoking is not allowed during fuel refilling, otherwise, fuel steam can cause fire easily.

●Smoking is not allowed when checking battery electrolyte level because electrolyte releases flammable gases.

●Do not wear a loose garment or any jewelry when working around the engine or its driven equipment. If necessary, wear safety goggles, work clothes, safety helmet or other protective items.

●Gen-sets must be kept 1 meter away from building or other equipment during operation to avoid fire.

The engine exhaust fumes contain carbon monoxide and other harmful stuff which can be DEADLY. If the engine runs indoors, exhaust gas must be piped safely away from any building or enclosure that houses the engine.

●Do not remove guards and protective devices with which the engine is equipped for its exhaust system parts and exposed rotating parts when required, or personal injure can be likely triggered. To prevent personal injury, marine engine exhaust parts like the exhaust tailpipe, muffler should be provided by OEM with protective devices; the engine exposed rotating parts like the belt pulley, net winding machine are better equipped with guards or protective devices.

●Do not put flammable stuff like fuel, lubricating oil, coolant, or danger stuff like explosive around the engine. They may cause fire or explosion.

●Wipe up any fuel, oil or coolant spills. They may cause fire when being lighted. Put rags with fuel, oil or coolant into a fire-protection container, and do not leave it on the engine.

●Remove dust, mud or other odds and ends on the engine. They can be a cause of fire or engine overheating.

●Before starting the engine, make sure there are no persons around, nor tools or other things on the engine. Do not start the engine when a tag of Do Not Start is on the starting switch.

●When fuel, oil, or exhaust gas leak is found, take measures to eliminate the leakage source immediately. Splashed fuel or oil on high temperature parts or exhaust gas contacting flammable stuff can cause fire, personal injure or engine damage.

●Do not check fuel, oil and coolant leaks with hand. High pressure and high temperature fuel, oil or coolant can cause personal injure. Be very careful w hen checking fuel leak, because high pressure fuel can inject into skin and cause personal injure or even death. Use a thick plate to check for fuel leak and avoid contacting injected fuel when finding fuel leak.

●Use an explosion-proof light to check fuel, oil, coolant or electrolyte if light is needed to prevent fire explosion.

●Do not smoke, and do not use fire when handling or working near fuel system components, for fuel steam may be lighted and cause damage to components or personal injure.

●Do not make any maintenance to fuel system parts when the engine is in operation.

●Fuel flows from the injection pump to the injectors through the high pressure fuel pipes under very high pressure. Do not loosen the high pressure fuel pipes when the engine is in operation. This will result in serious scald.

●If the engine will not be used for a long time or for repair, always disconnect the battery cables or the air line of an air starter motor if used to prevent accidental startup. Meanwhile, place a tag of Do Not Operate in the operation room or on the starting switch. Disconnect the cable from the post indicated by a NEGATIVE, NEG, or (–) first, then remove the POSITIVE, POS, or (+) cable. When reconnecting the cables, connect the POSITIVE cable first, the NEGATIVE cable last.

●Do not use a metal tool to contact the two battery posts, and do not make the two posts short circuit, or explosion may happen.

●The connection of the battery cable posts must be secured. Explosion may happen due to poor connection. Damaged wires or cables will cause fire. Check and replace them before reconnecting the wires and cables.

●Do not use fire, nor make welding near the battery(s) because battery can produce flammable hydrogen and oxygen.

Do not use the battery(s) when its electrolyte is lower than the minimum level. Improper use of electrolyte can cause blind or scald.

●If the engine runs indoors, keep a fire extinguisher near the engine at all times. Keep the extinguisher properly charged and be familiar with its use. Keep an emergency medical box in a specified place where is accessible. Make sure there are measures available for dealing with fire or accidents. Do not use any carbon fire extinguishers of tetrachloride type. These fire extinguishers emit toxic fumes and the liquid can damage wiring insulation.

●Keep skin or eyes free from coolant or electrolyte when refilling and changing. In case of skin contact, please flush the contacted part with soap and clean water; in case of eye(s) contact, flush your eye(s) for 15 minutes with clean water and seek for medical treatment immediately.

●Cool down the engine first when refilling coolant to avoid being hurt by coolant steam. Open the pressure cap or filler cap only when the coolant temperature is lower than 50℃, and then slowly loosen the cap to release the pressure of coolant. The coolant is very hot when the engine has just stopped, and coolant steam or hot coolant can inject and cause scald if the cap is opened. The cap must be tightened after checking, refilling or changing coolant.

●Do not touch by hand the intake and exhaust system components like the exhaust manifold, exhaust tailpipe, turbocharger, intercooler air inlet pipe and expand tank when the engine is in operation because they are very hot. The coolant is very hot when the engine is in operation, and steam or hot coolant will inject and cause scald if the cap is opened.

●Stop the engine when the fan drive belt breaks, or the engine will go overheat, and coolant steam in the expansion tank will inject and can cause scald.

●Do not handle discharged oil or replaced oil filter with bare hand, for high temperature oil or lubricating system part are very hot and can cause scald.

●Release the pressure in the air, lubricating, cooling or fuel system prior to dismantling or loosening any of its pipelines, permanent joints, connectors or relevant parts of the system. Otherwise high pressure fuel, lubricating oil and coolant can cause personal injury.

●Do not get near to the exposed rotating parts when the engine is in operation and keep away things that may be easily caught by the rotating parts from around the engine, or serious personal injure can happen.

●Make sure to shutdown the engine before any adjustment is performed to it and its driven equipment. Anything that is caught in rotating parts can cause a serious accident.

●Use a barring tool to rotate the engine. Do not rotate the engine with the fan, otherwise severe personal injury or damage to fan blades can be caused.

●Do not stand on the engine or on the side of the engine to work on parts high on the engine. Use a stable step and be careful when working on the step to avoid falling down. Do not use a parts box or tools box as a step. Careless operation can cause damage to the engine and personal injure.

●Used lubricating oil may contain carcinogenic substance which can result in reproductive toxicity, therefore, inhalation of or longtime exposure to oil steam should be avoided. Waste oil should be disposed in proper, safe and reliable manner.

●To prevent choke or cold injury, removal of air-conditioning refrigerant (Freon) pipeline should be conducted in well ventilated environment with protective clothing on. For environment protection, the refrigerating system should be emptied or filled using dedicated equipment so as to prevent diffusion of Freon into atmosphere. Refrigerant should be recovered and recycled.

●For environment protection, used oil, fuel, coolant, oil filter or fuel filter must be properly disposed according to relevant environment protection regulations when changing oil, oil filter, fuel filter or coolant. And discarded battery(s) must be also properly disposed.

1.5 Engine Operation Instructions

Read and understand all notes and warnings before use and maintenance of the engine.

Following notes and warnings must be followed to prevent the engine from fault or damage.

●Read this manual carefully, and be in strict accordance with operation instructions and maintenance procedures specified in this manual.

●Conduct daily and 4-level maintenances as specified in this manual, and keep the records of scheduled maintenances.

●Use the proper fuel, lubricating oil and coolant specified in this manual.

●The coolant specified in the manual should be adopted for the engine in any climate.

●When refilling lubricating oil, it is not allowed to use the mixture of oil of different specifications.

●Check if fuel, oil and coolant are enough before starting the engine.

●Be sure to remember that the engine must be started with no load.

●60 hours' running-in must be conducted for a new or overhauled engine.

●Do not run the engine without air filter (marine application is exceptional), otherwise, early engine wear can happen.

●If the engine runs indoors, always keep the engine room in good ventilation. Insufficient air sucked by engine will cause high coolant temperature, low power output and poor performance. Ventilation equipment is provided for the engine room if necessary.

●Observe the engine operation and all the instrument readings. In case of abnormal condition or critical situation, an emergency stop should be performed and faults must be removed to prevent the seizure of moving parts caused by low oil pressure or engine overheating due to lack of coolant.

●Do not run the engine at high load and high speed when the coolant temperature is blow 60℃.

●Do not run the engine at overloaded condition.

●Stop the engine when it is overheating. Do not add coolant right after the engine has stopped, which leads to damage to cylinder head parts.

●Stop the engine when its warming device goes alarm. Find and remove the root cause before starting the engine again. Let the engine having problems continue to run will lead to greater ones.

●Stop the engine when its oil pressure goes down in abnormal due to some reason. Find and remove the root cause. Let the engine continue to run at low pressure oil will lead to engine bearings burning.

●Before starting the engine after being repaired, make sure to be ready to cut air supply. In case of any abnormal, cut air supply to stop the engine immediately.

●Welding on the engine or equipment is not recommended. When welding on the engine or equipment is necessary, cut equipment power supply before welding, disconnect electronic components from their harnesses. It is not allowed to connect and disconnect harnesses when power is on. Do not plug a harness in and out without necessary. If necessary, plug it in and out when power is off to avoid its malfunction.

●The belt tension and the other drive devices can only be inspected when the engine is in stop.

●Do not pry the drive belt in the pulleys with a crowbar, or this can cause damage to the reinforced fibers inside the belts. Remove and install the belts only by hand.

●If the belt has been contaminated by oil, fuel, or other harmful liquid, make sure to replace it. Do not try to clean it. Find out and remove the source of pollution.

●When storing and carrying the drive belt, make sure its bent diameter is not less than 25 mm. Do not hang it on a hook.

●The surfaces of the drive belt pulleys must be smooth to prolong the belt service life. Therefore, before installing the belt, make sure the pulley surfaces are free from roughness or burr, and the pulleys can rotate smoothly.

●The battery(s) must be replaced when its lifetime is due.

●Malfunction thermostat should be replaced in time but the use of thermostat cannot be omitted.

●Do not cut the seal on the fuel injection pump. The seal prevents the fuel control part from being moved. The engine warranty will not be given if the seal is cut. If the seal is cut, the wear of moving and rotating parts of the fuel injection pump will increase and be damaged, fuel and oil consumptions will increase dramatically, fuel will be injected improperly, governor performance will go degenerated, and the engine will over-speed.

●Do not use raw water to cool the engine directly.

●Do not clean the fuel injection pump with electronic governor by watering it directly.

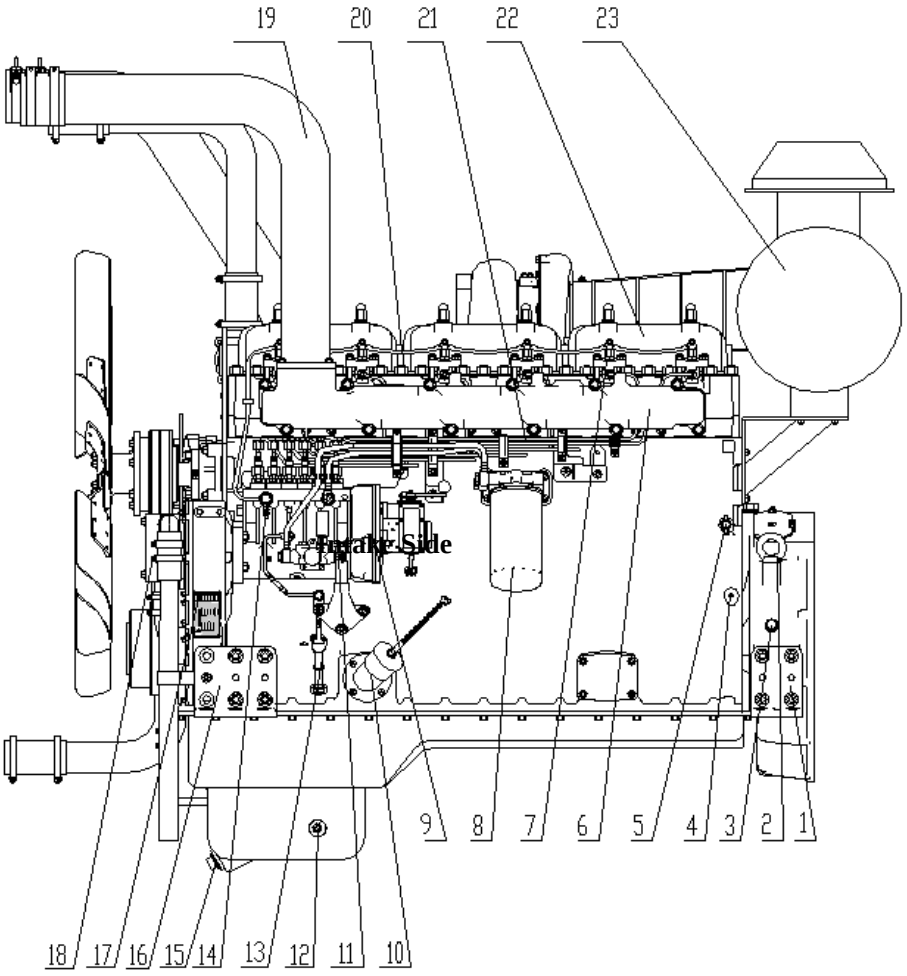
●Do not let rain enter the engine from the exhaust and intake ports. Do not clean the engine when it is in operation. Detergent or water may be introduced into the inside of the engine. When the engine is started, detergent or water inside the engine combustion chamber can cause damage to the parts inside by its hydraulic pressure, which leads to a serious accident.

●Do not change the application and scope of the engine without permission, or it can cause damage to the engine, and/or equipment, and personal injure. The changed engine will not get any warranty even though it is in the warranty period.

2 About the Engine

2.1 Engine Outline Diagrams

2.1.1 Outline Diagram of engine for generator sets



Intake Side

1：Rear engine support 2：Rear lifting ring 3：Tachometer connector 4：Oil manometer connector

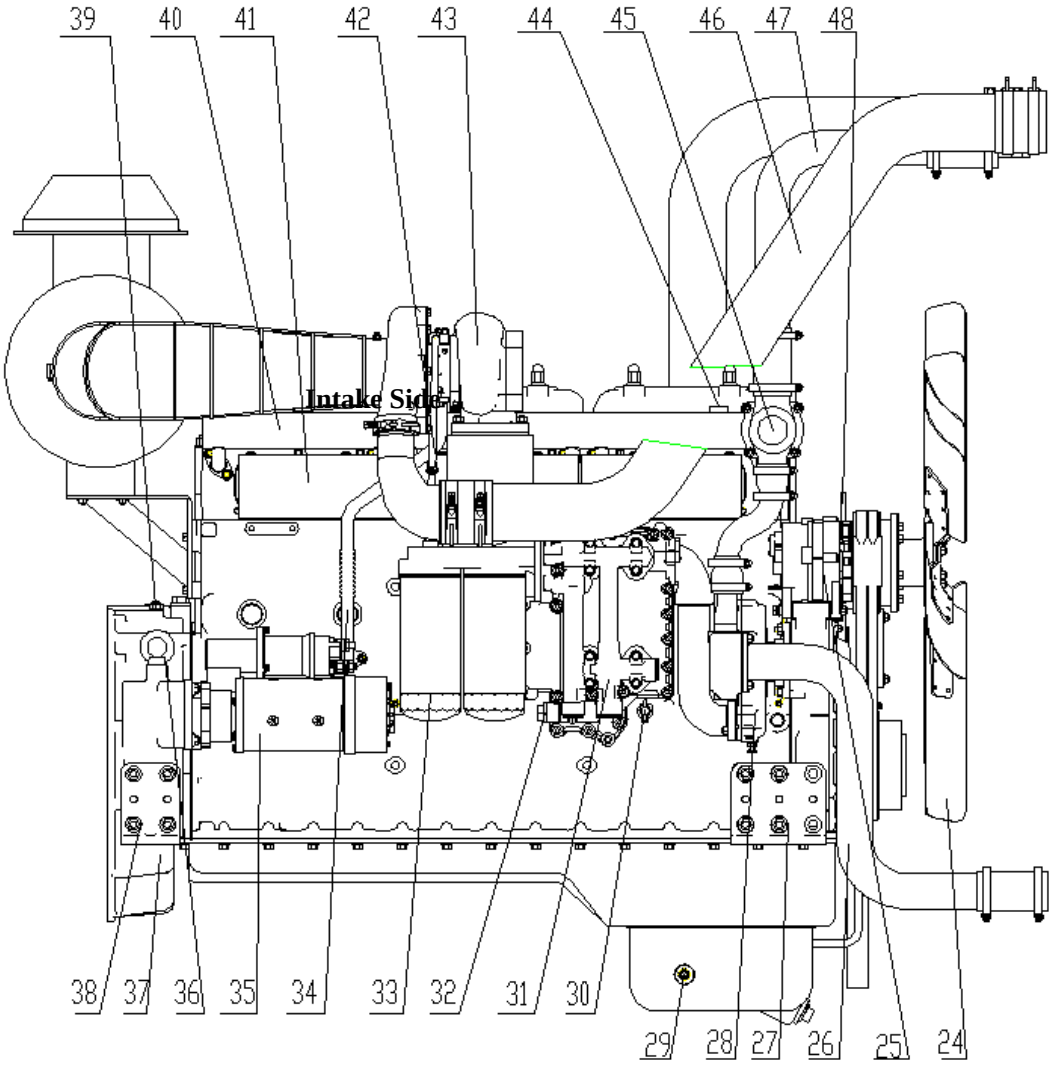
5：Water drain plug 6：Intake manifold 7：Fuel injector 8：Fuel filter 9：Fuel injection pump

10：Oil filler 11：Fuel transfer pump inlet joint 12：Oil temperature sensor joint

13：Oil dipstick 14：Fuel injection pump fuel return joint 15：Oil drain plug 16：Front engine support

17：Engine nameplate 18：Oil separator 19：Intercooler air outlet pipe

20：Injector fuel return pipe 21：High-pressure fuel pipe 22：Valve cover 23：Air filter



Exhaust Side

24：Fan 25：Alternator 26：Water pump inlet pipe 27：Front engine support 28：Water pump

29：Oil thermometer connector 30：Water drain plug 31：Oil filler 32：Oil pressure regulating valve

33：Oil filter 34：Turbocharger oil return pipe 35：Starting motor 36：Lifting ring

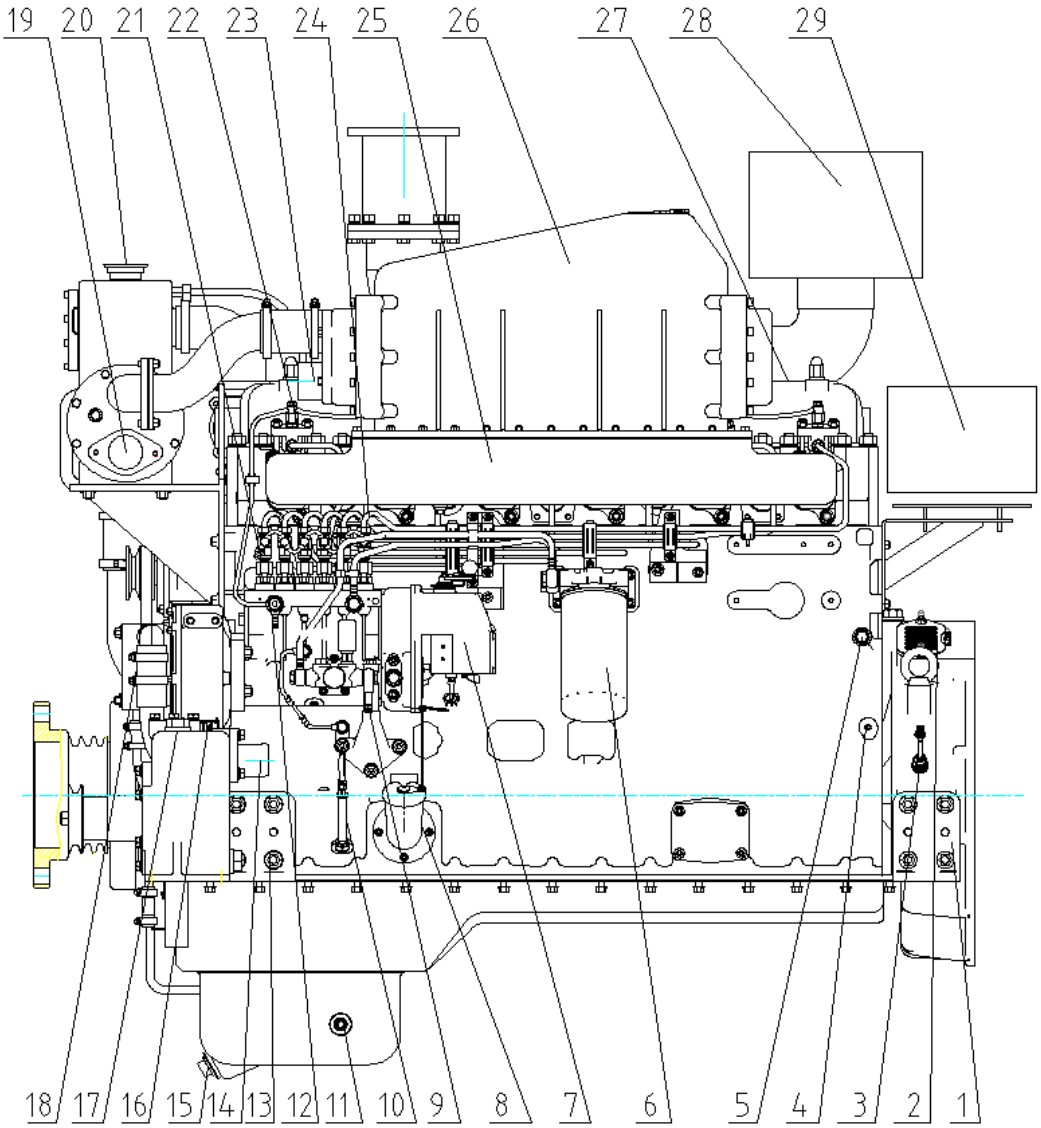
37：Flywheel hosing 38：Rear engine support 39：Speed sensor connector

40：Engine coolant outlet 41：Exhaust manifold 42：Turbocharger oil inlet pipe

43：Turbocharger 44：Water temperature sensor connector 45：Thermostat

46：Intercooler air inlet pipe 47：Radiator inlet pipe 48：Front lifting ring

2.1.2 Outline Diagram of engine for marine application



Intake Side

1：Rear engine support 2：Rear lifting ring 3：Tachometer connector 4：Oil manometer connector

5：Water drain plug 6：Fuel filter 7：Fuel injection pump 8：Oil filler 9： Fuel transfer pump inlet joint

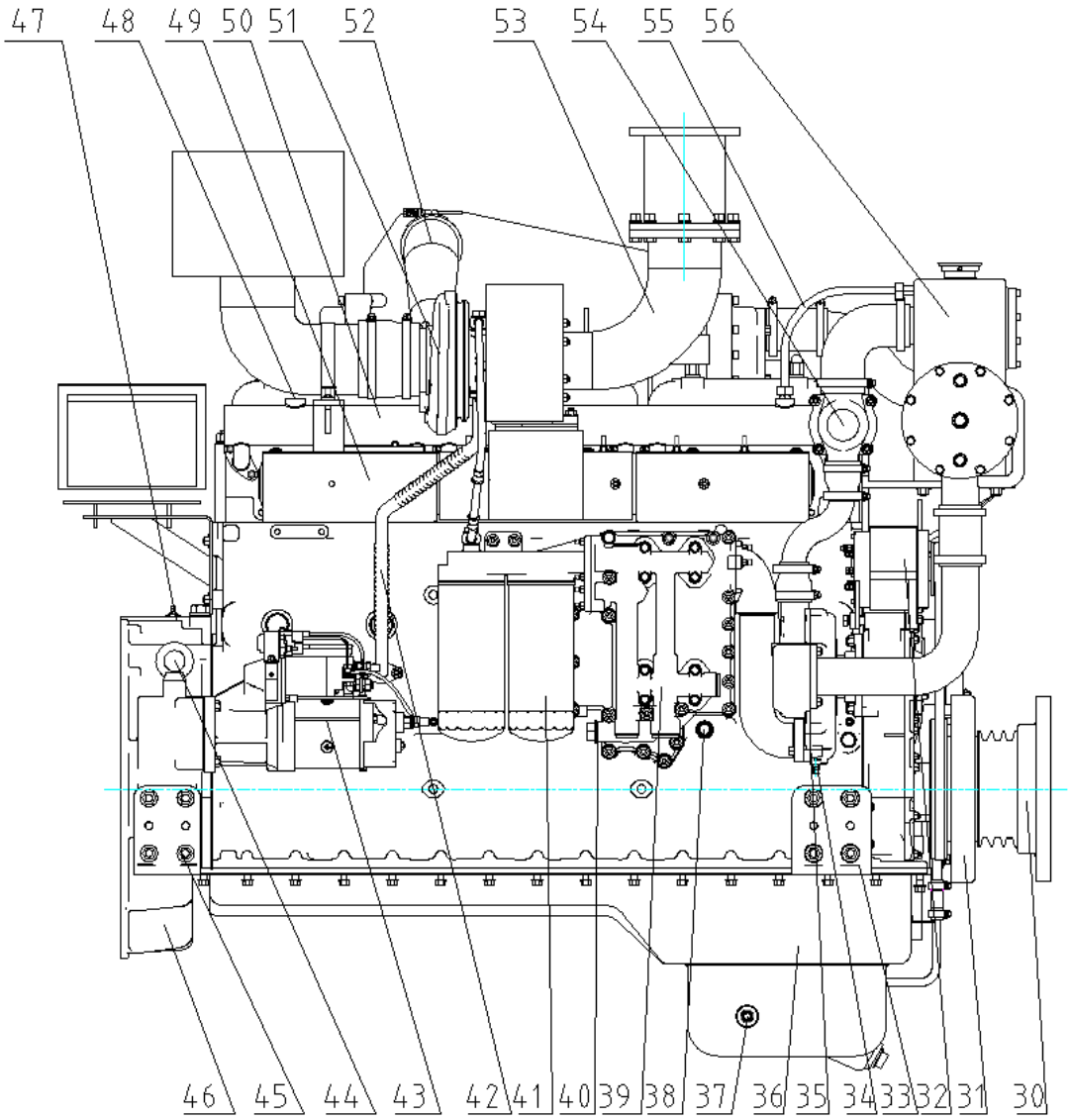
10：Oil dipstick 11：Oil temperature sensor joint 12：Fuel return pipe 13：Front engine support

14：Raw water pump inlet 15：Oil drain plug 16：Engine nameplate 17：Raw water pump outlet

18：Oil separator 19：Heat exchanger raw water inlet 20：Flesh water filler 21：Front lifting ring

22：Fuel injector 23：Intercooler raw water inlet 24：High-pressure fuel pipe 25：Intake manifold

26：Intercooler 27：Valve cover 28：Air filter 29：Instrument case



Exhaust Side

30：Drive pulley for application 31：Vibration damper 32：Alternator 33：Front engine support

34：Flesh water pump drain cock 35：Flesh water pump 36：Oil pan 37：Oil thermometer connector

38：Water drain plug 39：Oil cooler 40：Oil pressure regulating valve 41：Oil filler

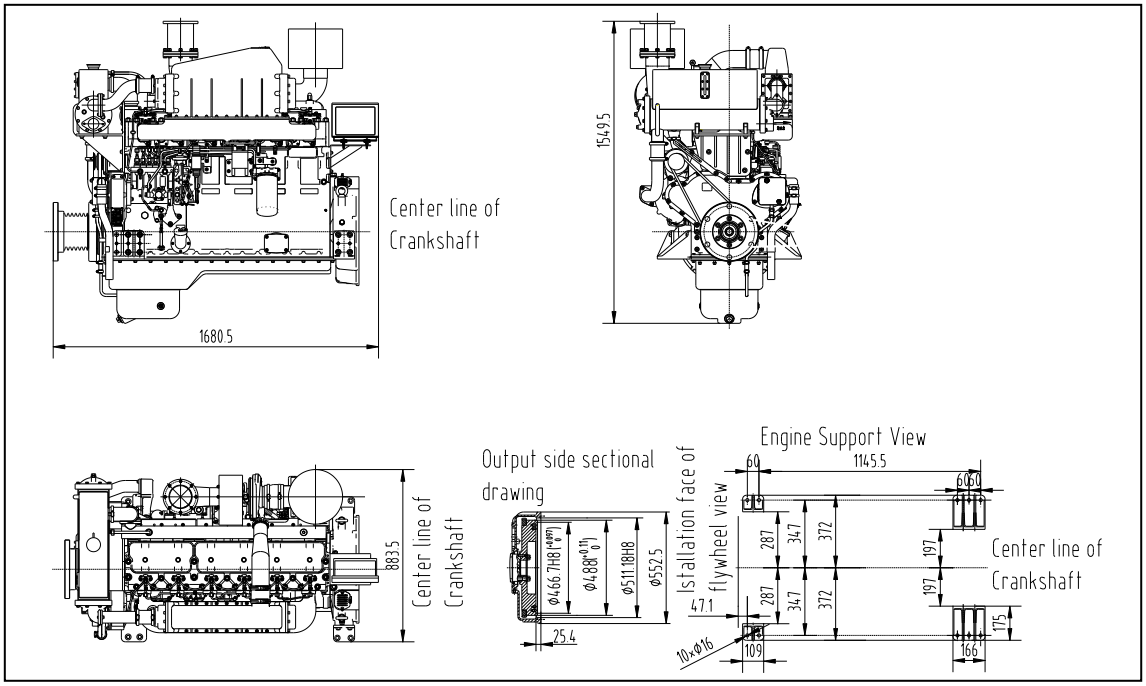
42：Turbocharger oil return pipe 43：Starting motor 44：Rear lifting ring 45：Rear engine support

46：Flywheel housing 47：Speed sensor connector 48：Coolant temperature sensor connector

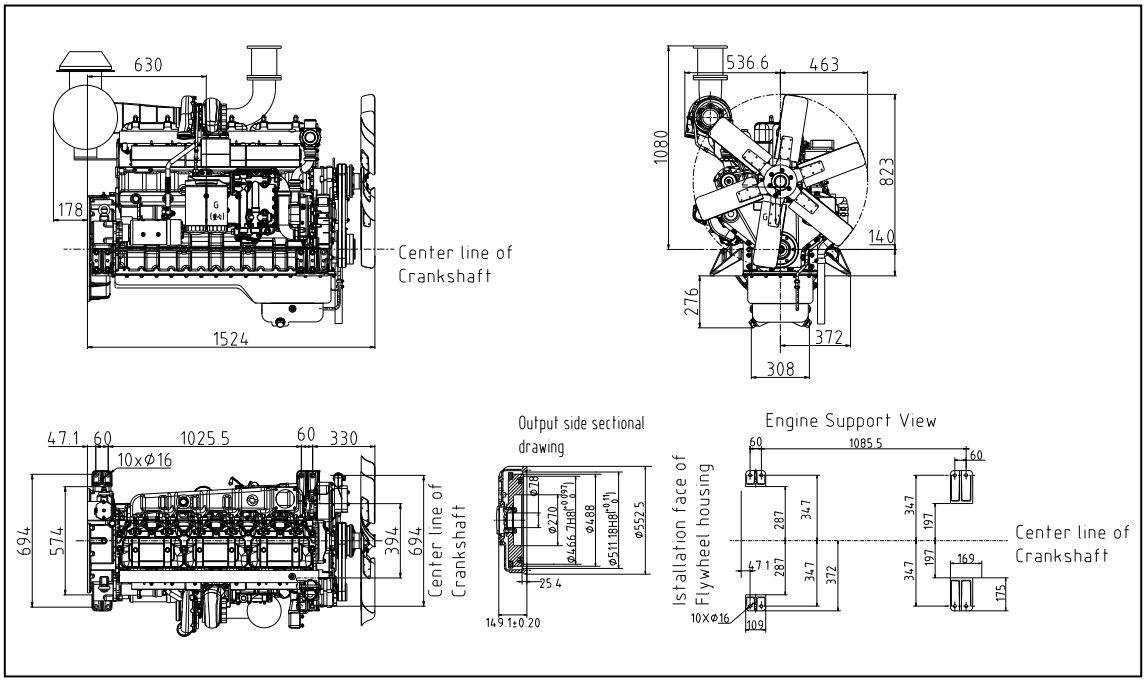
49：Exhaust manifold and heat shield 50：Engine coolant outlet pipe 51：Turbocharger and heat shield

52：Intercooler air inlet pipe 53：Exhaust tail pipe 54：Thermostat 55：Air bleed pipe 56：Heat exchanger

2.1.3 Engine installation dimensions



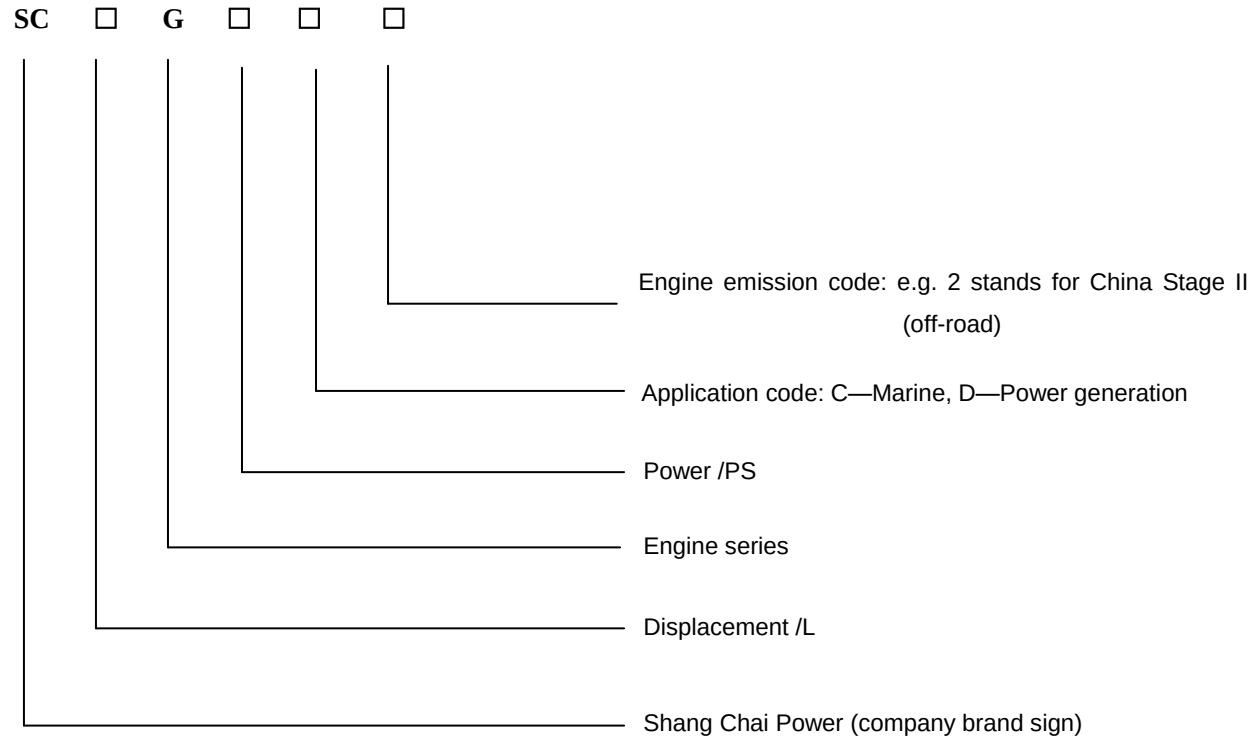
Engine Installation Dimensions for Marine Application



Engine Installation Dimensions for Generator Sets

2.2 Engine Model Identification

2.2.1 Engine model description (1)

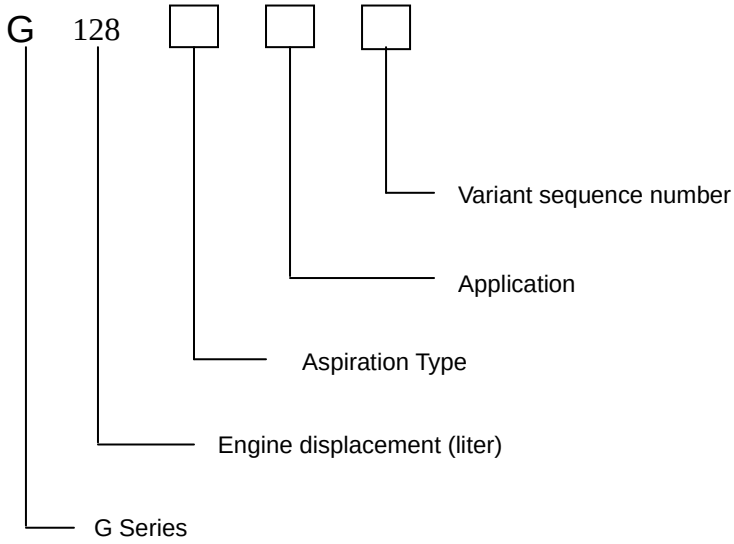


For example: SC15G500D2 stands for Shang Chai Power G series diesel engine of 15 liters with power of 500 PS and compliant with China II for generator sets

SC13G420D2 stands for Shang Chai Power G series diesel engine of 13 liters with power of 420 PS and compliant with China II for generator sets

SC15G500CA2 stands for Shang Chai Power G series diesel engine of 15 liters with power of 500 PS and compliant with China II for marine application

2.2.2 Engine Model description (2)



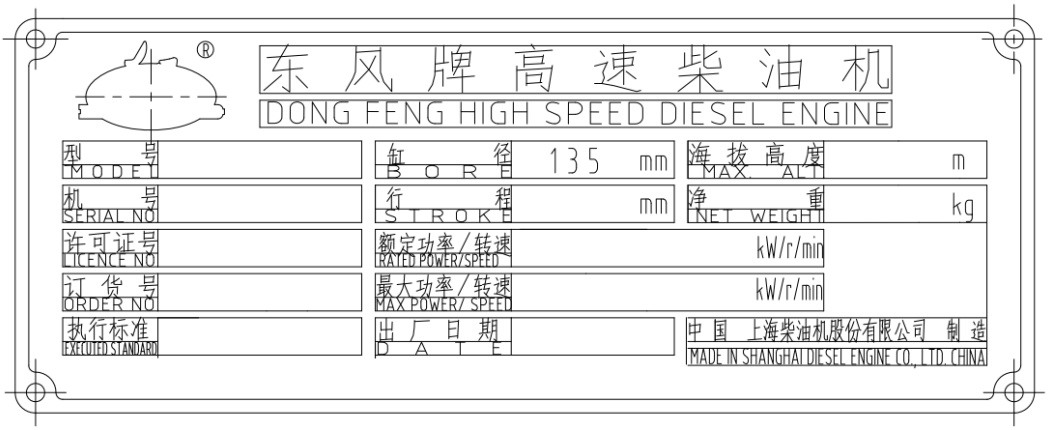
For example: G128ZLCa stands for basic engine model of G series turbocharged and charge air intercooled diesel engine of 12.8 liters for marine application

G128ZLCa stands for first variant of G series turbocharged and charge air intercooled diesel engine of 12.8 liters for marine application

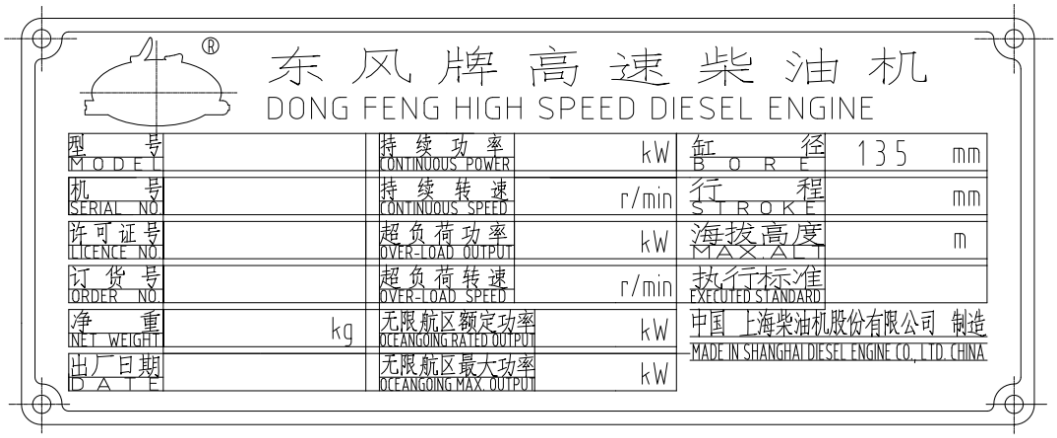
2.3 Engine Nameplate

The engine nameplate indicates the main technical data and information: engine model, order number, serial number, date of manufacture, rated power and rated speed, which are the major basis for you to purchase service parts and for SDEC to conduct after-sale technical service. We hope you to put the information and data into the daily work record of your engine or equipment for later repair and reflection of quality problems. This is helpful to the correct settlement of your problems. The nameplate locates on the side of the front cover. Protect it from being damaged.

For generator sets application



For marine application



Note: **Do not change the nameplate without our permission!**

2.4 Specifications and Parameters

2.4.1 Specifications

Engine model		SC15G500D2	SC15G500CA2	SC13G420D2	G128ZLCa5
Type		In-line, six- cylinder, water cooled, four-stroke, direct injection			
Aspiration type		Turbocharged with air-to-air cooler	Turbocharged with air-to-water cooler	Turbocharged with air-to-air cooler	Turbocharged with air-to-water cooler
Bore/mm		135	135	135	135
Stroke/mm		165	165	150	150
Displacement/L		14.16	14.16	12.88	12.88
Starting temperature/℃		≥-10	≥-10	≥-10	≥-10
Crankshaft rotation (viewed from flywheel end)		Counterclockwise	Counterclockwise	Counterclockwise	Counterclockwise
Firing order (from frond end)		1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Rated point	Power/kW	330	330	280	267
	Speed/(r/min)	1500	1500	1500	1500
Over load	Power/kW	363	363	308	294
	Speed/(r/min)	1500	1545	1500	1545
Emissions		China Stage II (Off road)	China Stage II (Off road)	China Stage II (Off road)	China Stage II (Off road)
Starting mode		Electric	Electric	Electric	Electric
Altitude/m		2,000	2,000	2,000	2,000
Net weight/kg		1 265 ± 50 (without radiator)	1 320 ± 50 (without raw water pump）	1 265 ± 50 (without radiator)	1 320 ± 50 (without raw water pump）
Dimensions	Length/mm	1,702	1,620	1,702	1,620
	Width/mm	1,000	884	1,000	884
	Height/mm	1,550	1,550	1,550	1,550

Note: 1) The listed engine performance data are obtained at the standard test conditions: ambient temperature is 25℃, relative humidity 30% and barometric pressure 100 kPa.

2) When the engine operates on over 2,000 meters above the seal level, its power output will decrease and its performance become bad. So it is required to reduce the engine power output when it runs at altitude higher than 2,000 meter. It is not recommended to run the engine over 4,000 meters above the sea level.

2.4.2 Parameters

Engine model		SC15G500D2	SC15G500CA2	SC13G420D2	G128ZLCa5
Exhaust temperature (before turbine)/℃		≤680	≤680	≤680	≤680
Oil temperature in oil pan/℃	Max. allowance	115	115	115	115
	Operational range	90 -110	90-110	90-110	90-110
Pressure of oil in Main gallery/MPa	@ rated speed	0.4～0.60	0.4～0.60	0.4～0.60	0.4～0.60
	@ idle	≥0.15 (Oil temperature ≥75℃)	≥0.15 (Oil temperature ≥75℃)	≥0.15 (Oil temperature ≥75℃)	≥0.15 (Oil temperature ≥75℃)
Oil pan capacity (upper mark-lower mark)		30-22	30-22	30-22	30-22
Lubricating system capacity/L		32.5	32.5	32.5	32.5
Minimum coolant temperature (inlet) /℃		60	60	60	60
Maximum coolant temperature (outlet) /℃		100	100	100	100
Operational water temperature rang/℃		75～95	75～95	75～95	75～95
Governor performance	Min. stable idle speed/(r/min)	900	650	900	650
	Fluctuation at Min. stable idle speed /(r/min)	±20	±25	±20	±25
	Max. stable idle speed/(r/min)	1,545	1650	1,545	1650
	Transit governing rate/%	≤10 (electric)	≤15 (mechanical)	≤10 (electric)	≤15 (mechanical)
	Stable speed recovery time/s	≤3 (electric)	≤10 (mechanical)	≤3 (electric)	≤10 (mechanical)
Battery	Minimum recommended battery capacity/Ah*	180	180	180	180
	Battery current of at -18℃ for cold starting /CCA	750	750	750	750
	Voltage/V	2×12	2×12	2×12	2×12
Starting motor	Voltage/V	24	24	24	24
	Power/kW	8.5	8.5	8.5	8.5
Alternator	Voltage/V	28	28	28	28
	Current/A	40	36	40	36
	Rated power/kW	1	1	1	1

***** The capacity of battery should be properly increased for a starting with higher requirement.

2.4.3 Application requirement

The table below gives requirements on the maximum power output and other operational data for turbocharged engine with air-to-air intercooler because ambient condition has a great effect on the operation of such engine. It is required to choose proper intercooler, radiator, muffler and connecting pipeline according to the requirements listed in the table, maintain the air filter timely, and to control engine load to avoid overloaded operation that can lead to damage to the engine.

Ambient temperature /℃	Speed r/min	Max. Allowable Power rate /%	Intercooler outlet Temperature /℃	Intercooler pressure drop /kPa	Coolant temperature /℃	Oil temp. (in oil pan) /℃	Air intake resistance /kPa	Exhaust back pressure /kPa
≤30	1,500	100	≤50	≤6	＜100	≤115	≤3	≤6
40	1,500	95	≤60	≤6	＜100	≤115	≤3	≤6
50	1500	88	≤70	≤6	＜100	≤115	≤3	≤6

3 Engine Installation and Connection

3.1 Engine Installation

There are four engine installation supports on the both sides of the gear housing and flywheel housing.

There are lifting rings and plates on the engine, strong enough to bear the engine weight. Chain pulley or other facilities can be used when lifting the engine. However, attention should be paid to avoid thin parts or instrument parts of the engine being pressed by stressed chains, causing damage to them. Keep the lifting rings and plates from bearing bent moment and keep smooth handling when lifting to remain the engine in horizontal position. The engine should be placed on a special base or stable block to prevent the oil sump from directly bearing the engine weight.

3.2 Engine Connection

3.2.1 Intake pipe extended

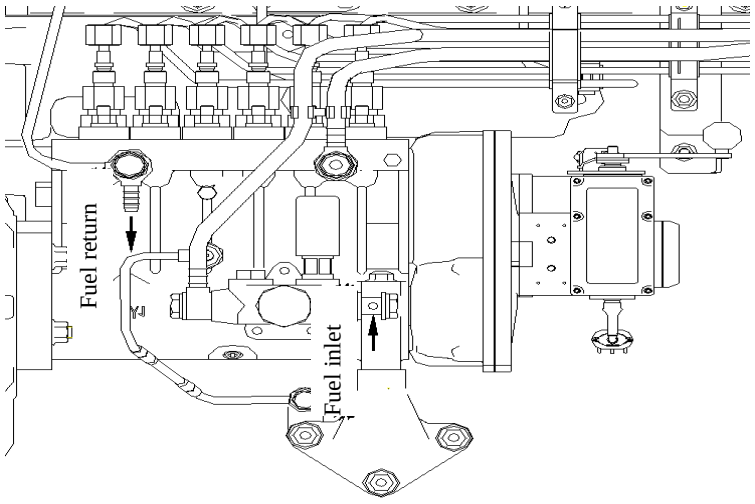
△ Caution：The cross section of an extended air intake pipe must be large enough. To avoid big air intake resistance, a pipe with inner diameter of 100 mm and without sharp angles or over length is recommended for the pipes before and after the intercooler. Air intake pipes must be well sealed or early engine wear can happen.

3.2.2 Coolant pipe extended

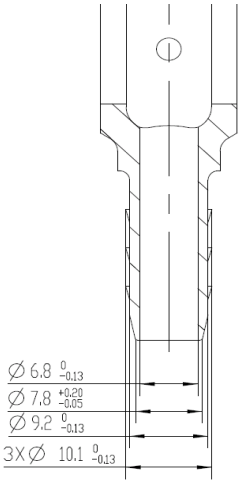
The G series diesel engine (improved model) has a close loop cooling system, so there is no need to have water pool or water tank. The recommended inner diameter of water pump inlet is 61 mm and that of thermostat outlet pipe 54 mm.

3.2.3 Fuel line extended

The fuel inlet from and the fuel return to the fuel tank are showed in the figure below. The fuel inlet banjo bolt is M14×1.5. It is recommended to use fuel inlet pipe with inner diameter of 9 mm and fuel return pipe with inner diameter of 8 mm. The dimensions of the fuel return pipe joint is showed in the figure below.



Fuel return pipe joint



The capacity of the fuel tank should be large enough to hold the fuel that can be used for more than 8 hours. The fuel tank should be such positioned that the lowest fuel level of fuel supply is 1 meter higher than the center of the fuel transfer pump. The inlet port of the fuel suction pipe should be more than 50 mm above the bottom of fuel tank. It is better to add a strainer at the inlet port to avoid sucking in sediments that can block of the pipeline, and to have a drain valve at the bottom of the fuel tank for an easy cleaning. The fuel tank should be away from the heat source (such as exhaust manifold or exhaust pipes) and electrical equipments.

3.2.4 Engine power output

Engine power output for driving the equipment is taken from flywheel. When using coupling to connect the equipment, the centerline of the equipment should be in alignment with the centerline of the crankshaft. If using an elastic coupling, the misalignment shall not be greater than φ0.30mm. If using a rigid coupling, the misalignment shall not be greater than φ0.10mm.

⚠ Caution: The engine should not be started with load. So there should be a kind of clutch device between the engine and driven equipment.

A certain power can be taken from the front crankshaft of the engine. But the output power for transverse driving with a belt directly on the front crankshaft pulley should not exceed 11 kW.

It is forbidden to directly install a pulley on the flywheel to drive equipment transversely by belt because such operation can easily damage the crankshaft and main bearings. If it is required to have a transverse driving, use an engine or an additional device that is suitable for transverse driving. Do not let the crankshaft and main bearings sustain transverse forces directly.

4 Engine Operation

Proper use of your engine can not only keep it in normal working order and good performance, but also extent its service life and reduce its use cost. Adopt proper fuel, oil and coolant, as well as the correct operation steps stipulated in this section.

4.1 Diesel fuel

The specifications of the diesel fuel used for the engine should be in accordance with the standards GB252-2011 General Diesel Fuels. Proper fuel designation should be chosen for the engine according to ambient temperature. In cold winter, fuel with low-freezing-point should be adopted, while contrary in summer. You may choose the right fuel according to the standards GB252-2011 or refer to the table below, e.g. fuel with the designation of -35# should be used for ambient temperature of -27℃.

Relationship between fuel designations and applicable minimum temperatures

Fuel designation	0	-10	-20	-35
Cetane number	≥45	≥45	≥45	≥45
Solid point/℃	≤0	≤-10	-20	-35
Minimum applicable temperature (engine working temperature)/℃	Above 4℃	Above -5℃	Above -14℃	Above -29℃

△ Caution: Fuel must be kept at the highest level of cleanness and not polluted by dust, impurities or water.

4.2 Engine oil

Lubricating oil of grade CF-4 and above is required for the engine in order to ensure its normal operation and long service life and to improve its emissions. Lubricating oil of CF-4 l5W-40 is required for common environment temperature, and lubricating oil of CF-4 5W-30 may be used for environment temperature lower than -5℃ to favor cold starting, but continuous use of the low viscosity lube oil will increase the wear of engine. The specifications of the oil used for the engine should meet the requirements of the national standards GB 11122-2006.

Specifications of lubricating oil (GB11122－2006)

Specifications / Viscosity class	Kinematical viscosity (100℃)	Flash point(open)	Pour point	Mechanical impurities	Water
	mm^2/s	≥℃	≤℃	≤%	≤%
5W-30	9.3 - <12.5	200	-35	0.01	Trace
15W-40	12.5 - <16.3	215	-23	0.01	Trace

△Caution: Lubricating oil must be kept clean and free from dust, impurities or water.

△ Caution: Do not use the mixture of oil of different specifications.

4.3 Coolant

In order to ensure the normal operation and long service life of the engines, use SDEC- designated special organic coolant (anti-freezing type) under any kind of climate. The coolant proves antifreeze, anticorrosion, good thermal conductivity, performance stability, and environmental friendliness.

Name	Part No.	Freezing point/℃	Boiling point/℃
SDEC-designated special organic coolant	F/LQY-45	-45	108

△Note：Never use raw water as engine coolant for marine application.

4.4 Power Matching

When choosing a diesel engine, it is not only need to consider the power required by the equipment to be driven, but also engine operation type, such as intermittent use or continuous use. Meanwhile, operational economy is an important item to be considered that is, the characteristics of equipment load and engine power output must be reasonably matched. Correct power rating and reasonable match between engine power output and equipment load are essential to guarantee a reliable, long-life and economic operation of an engine. Otherwise, it would lead to overloaded operation and unnecessary failure of an engine. Or load is too small and the capacity of an engine cannot be fully used, which is not an economic way to use an engine and also easy to lead to oil carry-over.

4.5 Engine Start

Before using the engine, choose proper lubricating oil, fuel and coolant according to ambient conditions. Besides, the following work should be done before starting:

- Make a surround inspection of the engine and its starting system, and solve problems in time if any.
- Check oil pressure and temperature gauges, coolant temperature gauge, warning lights and other instruments for normality.
- Check the service indicator of the air filter for appearance in red.

△Caution: Do not to start the engine without an air filter to avoid early engine wear. Marine engine is exceptional.

- Check the oil level for being within the specified range.
- Check the coolant level for being within the specified range.
- Check the electrolyte level for being within the specified range.
- When the engine is first put into use or is out of service for some days, or its fuel filter has just been replaced, there can be air in the fuel system. It is required to prime the fuel system with the priming pump. Refer to section 5.3 for specific priming operation.
- Check the electric starting wires for normality.
- Check the starting motor for right wire connection, and battery for sufficient electricity.
- All the safety devices must be installed in place.
- Check the accelerator lever for free movement.
- When the engine is new or is out of service for over 5 days, rotate the crankshaft 3 to 5 circles before starting.

4.5.1 Normal starting procedure

The G series diesel engine (improved model) can be started smoothly at temperature of -10℃ and above. Starting procedure is as follows:

- Disengage the engine from the drive system.
- Put the mechanical operating devices into the “running” position.
- Push the governor controlling handle to the unload position.
- Insert electric key and turn the switch from the OFF position to the START position to start the engine. If it cannot start up in 10 seconds, turn the switch from the position START to the OFF position. Make another starting after 2 minutes. If the engine cannot start up for three times, stop starting and refer to Section 6 for troubleshooting guideline to find cause. Each starting lasts 2 to 3 seconds.

△Caution: The engine should be started without load.

- After the engine has started up, the switch key goes back to the ON position from the START position automatically. The oil pressure gauge must show reading of higher than 0.15 MPa within 15 seconds after the engine has started up; otherwise, stop the engine immediately to prevent damage to the engine and find the cause and remove the fault(s)

according to Section 6 Troubleshooting Guidelines.

•Having started up from a hot state, the engine should run at idle for 1-3 minutes before being accelerated and loaded gradually.

•Having started up from a cold state, the engine should run at idle for 3-5 minutes. Increase engine speed slowly to 1,000 -1,200 r/min and run the engine with partial load. Do not run the engine with full load until the outlet coolant temperature is higher than 75℃, oil temperature 50℃ and oil pressure 0.40 MPa.

△Caution: Especially starting the engine from a cold stat, increase the engine speed slowly as far as possible to have every bearing adequately lubricated and oil pressure stable.

•Check the instruments during the engine running at idle to see whether they work normally.

△Caution: Do not accelerate and load the engine immediately after it has started up.

△Caution: Do not idle the engine for a long period of time or it can cause problems to the engine. When an engine idles, the temperature in combustion chamber is low and combustion is not complete. It can cause carbon deposit in cylinder resulting in block of the orifices of fuel injector, as well as seizures of piston rings and valves, thus leading to engine performance deterioration.

△Caution: If the engine is start by a jumper cable, parallel connection of the cable should be adopted by connecting the positive pole to the positive terminal and the negative pole to the negative terminal. If the engine is start by external power supply, the circuit breaker should be set to the position OFF. Take out the key to prevent accidental activation before connecting a jumper cable.

4.5.2 Cold Starting

Cold start refers to starting the engine at temperature below -10℃. Choose proper cold starting aid to warm the engine according to ambient temperature and then follow the normal starting procedures to start the engine. There are, in general, several ways to warm the engine:

•Warming the lubricating oil and coolant to 40～50℃;

•Installing a heating device in the air inlet pipe or heating air by fire at the entrance of the air inlet pipe, with which special precaution must be paid for safety;

•Increasing the surrounding temperature of the engine room;

•Using diesel fuel, lubricating oil and coolant that are suitable for cold areas;

•Warming battery or using battery of larger capacity or having higher discharge rate (special battery for low temperature).

4.5.3 Starting after longtime stop or replacement of lubricating oil

If the engine hasn't been used for more than 30 days or its lubricating oil has just been replaced, it is necessary to fill the lubricating system with oil. Crank the engine and make oil enter moving parts. Start the engine only after you feel light when cranking the engine. Finish the following preparation before starting the engine according to the procedures of normal starting or cold starting:

•Check the oil level for being within the dipstick marks range.

•Check the voltage of the battery for abnormality.

•Prime the fuel system. Refer to Section 5.3 for operation.

In order to have a quick starting of a standby engine for emergency need, start the engine every three to five days and operate it until its lubricating oil and coolant temperatures reach 60℃ and above.

4.6 Engine Operation

Cautions for operation of the engine:

•Pay frequent attention to oil pressure and coolant temperature. In case of any abnormality, stop the engine immediately for inspection.

Lubricating oil pressure:

150 kPa @ idle speed (minimum allowable)

400 kPa @ rated speed (minimum allowable)

600 kPa @ rated speed (maximum allowable)

Coolant temperature:

75-95℃ (normal working range)

●When engine overheating starts to happen that is indicated by the coolant temperature alarming, reduce engine speed or load or take the both actions until the coolant temperature falls down into the normal range; otherwise, find the cause and remove the fault as per Section 6 Troubleshooting Guidelines.

●During the operation, especially sudden decrease of load, attention should be paid to avoid the failure of the governor, which can cause sudden increase of engine speed exceeding the defined value (usually called flying away). Once such case happens, make an emergency stop first and then check the engine for the cause.

△**Caution: Overspeed running will cause serious damage to the engine.**

There are significant signs before most engine faults occur, such as changes in performance, sound, or engine appearance. Listening and observing will help detect in advance or predict some problems of the engine that will occur later, with which the proper measures can be taken in time to eliminate such problems as can lead to a serious engine failure.

Typical engine fault signs:

- ●Engine misfires
- ●Engine vibrates abnormally
- ●Engine sounds abnormal
- ●Engine coolant temperature and oil pressure change abruptly
- ●Engine produces black smoke
- ●Engine power output is insufficient
- ●Engine oil consumption is too much
- ●Fuel consumption is too much
- ●There is leakage of oil, fuel or/and coolant

4.7 Engine Shutdown

4.7.1 Normal shutdown

If the engine has just worked at a high speed and heavy load for a long time, reduce its load and speed gradually and run it at idle for 5 minutes before stopping it to let the engine cool down evenly and turbocharger speed fall considerably so as to protect the engine and turbocharger. Turn off the cock on the fuel tank, and turn off raw water inlet cock (marine engine) after the engine has stopped.

If the engine will not be used for a period of time (6 months at most), keep it properly. Refer to Section 7 for engine storage.

4.7.2 Emergency shutdown

Under emergency or special condition, make an emergency stop to avoid serious engine failure. Manually pulling of the emergency stop handle can achieve an emergency shutdown.

4.8 Running-In of a New or Overhauled Engine

When the engine is new or has been overhauled, before running it in full load condition, run it for 60 hours in running-in condition and change its oil thereafter so as to improve its moving parts working condition and its reliability and service life.

The way of running-in varies from one engine application and loading manner to another. In principle, engine speed and load in running-in process will be increased gradually with the running-in going on. Load should be 50%-80% of its full load, and speed should not exceed 80% of its rated speed. If the engine is for generator sets with constant speed, it is allowed to run-in at rated speed. However, longtime running at idle or with too small load at the beginning of running-in is not recommended.

Do not run the engine at idle or with low load for longtime either in running-in period or normal working period thereafter. Continuous running at idle should not be longer than 10 minutes to avoid early wear due to carbon deposit or engine performance being affected.

The above running-in process with less time should also be required every time the cylinder liner, piston, piston rings, connecting rod bearings, main bearings or/and crankshaft are replaced.

5 Engine Maintenance

5.1 Maintenance Plan

The following table gives maintenance intervals and tasks. Make regular maintenance based on this table. If the engine frequently operates at the ambient temperature below -18°C or above 38°C, or in dusty environment, the maintenance interval should be shortened properly.

Maintenance tasks	First maintenance 60 hrs	Daily	Every 250 hrs or 3 months	Every 500 hrs or 6 months	Every 1,000 hrs or 12 months	Every 2,000 hrs or 2 years
Checking engine periphery	●	●	●	●	●	●
Checking fuel tank	●	●	●	●	●	●
Checking air filter service indicator	●	●	●	●	●	●
Checking oil level	●	●	●	●	●	●
Checking coolant level	●	●	●	●	●	●
Checking electrolyte level	●	●	●	●	●	●
Checking drive belt *	●	●	●	●	●	●
Checking cooling fan	●	●	●	●	●	●
Checking intake system			●	●	●	●
Adding grease			●	●	●	●
Checking belt tension	●		●	●	●	●
Changing lubricating oil and oil filter	●		●	●	●	●
Changing fuel filter				●	●	●
Priming fuel system				●	●	●
Checking and adjusting valve clearance	●			●	●	●
Checking intercooler and its lines					●	●
Checking fan bearing						●
Checking turbocharger						●
Checking vibration damper						●
Changing coolant and cleaning cooling system						●

* The Belt must be replaced when it has crack or defect(s) that affects its use.

Note：For marine application engine, clean air filter element when changing oil and oil filter. Refer to section 5.3.22 for cleaning requirement and procedure.

Note: The maintenance intervals in this table are in hour, month or year, whichever comes first.

5.2 Maintenance Record

Make a regular maintenance record. You may make your own maintenance log by referring to the format of Maintenance Record below.

Maintenance Record

Engine serial number_____ Engine model & order No._____

User_____ Equipment description & serial No. _____

Date	Hour or Interval	Maintenance	Operator	Remark

5.3 Tasks and Methods of Engine Maintenance

5.3.1 Checking engine periphery

Check the periphery of the engine each time before starting:

- Check if the engine is in clean state and free from useless things on it.
- Check the joints and connections of the fuel system, cooling system and lubricating system for leakage.
- Check if the fan and its safety guard are fastened in place.
- Check the fastening condition of the accessories.
- Check the electrical the circuits and wires for intact.
- Check the drive belt for intact.

5.3.2 Checking fuel tank

Check the fuel level in the fuel tank daily.

5.3.3 Checking air filter service indicator

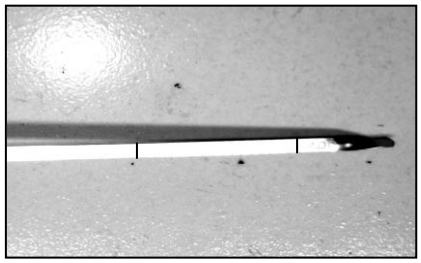
Check the maintenance indicator of the air filter every day. If the viewing window shows the red piston, it represents that the intake resistance of the air filter exceeds the specified value, and the filter element requires to be replaced. Refer to Section 5.3.21 for the requirement and procedure of the replacement. Press the button on the top of the service indicator for reset after the replacement.

△Caution: Do not start the engine without an air filter, and failure to do so can easily cause early engine wear. Marine application is exceptional.

5.3.4 Checking oil level

Check the oil level daily before starting the engine or the engine is in stop (at least 10 minutes after the engine has stopped to provide enough time for oil to flow back to the oil pan). The oil level should be between the high level mark (upper mark) and low level mark (lower mark). If oil is not enough, supplement it to near the high level mark.

△Caution: Do not run the engine when the oil level is below the lower mark, otherwise it can result in poor engine performance, or even damage to the engine. But the oil level should not exceed the high level mark.



5.3.5 Checking coolant level

Check the coolant level daily before starting the engine or after the engine has stopped.

▲Warning: At operating temperature, engine coolant is hot and under pressure, and the coolant steam can

cause personal injury. Do not remove the pressure cap on the radiator until the engine stops and the coolant temperature drops to below 50℃. Slowly loosen the cap to release the cooling system pressure before checking the coolant level or making supplement.

▲Warning: Avoid skin or eye contact with coolant to prevent personal injury because the coolant contains alkali.

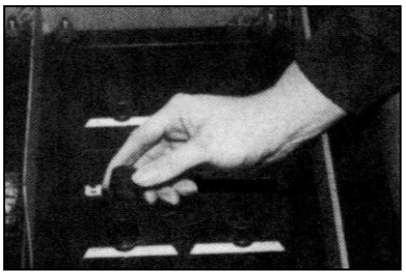
(1) Slowly loosen the pressure cap on the radiator to release pressure before starting the engine or after the engine has stopped and the coolant temperature has gone below 50℃.

(2) Remove the pressure cap and check coolant level from the filler or inspection port. The coolant level should remain between the marks in the radiator or expansion tank, or meet the requirement of the equipment manufacturer.

(3) Add if necessary. Coolant should be added near the high level mark or meet the requirement of the equipment manufacturer.

△ Caution: Coolant should be added slowly to avoid air block.

5.3.6 Checking electrolyte level



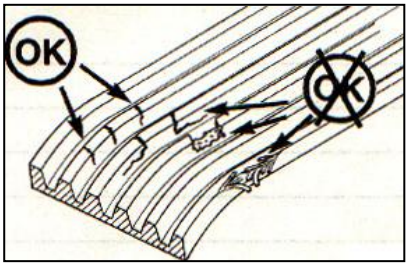
Some batteries are free from maintenance. Pay attention to its lifetime and change it when the lifetime is due. Refer to the instruction on the battery for the lifetime.

Some batteries need maintenance (adding special liquid or distilled water).

(1) Check the electrolyte level before starting the engine. Remove the filler cap and check the electrolyte level. It should be at the bottom of the filler port. If necessary, make supplement as per requirement.

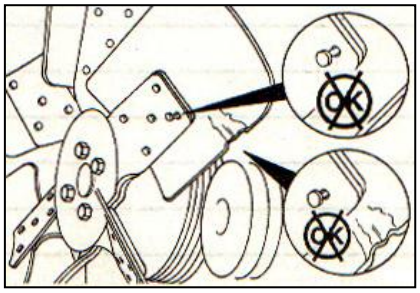
△ Caution： Never pure drinking water for battery, because pure water contains many microelement that will do harm to battery.

5.3.7 Checking drive belt



Perform visual check on the drive belt everyday for any intersecting cracks. Transverse cracks along the width direction of the belt are acceptable, while longitudinal cracks (along the length direction) that intersect with transverse cracks are not allowed. If any wear or abrasion occurs, replace it.

5.3.8 Checking cooling fan



Perform visual check on the cooling fan for crack, loose rivet or blade bent or any other defect. The fan should be installed reliably. Tighten the fastening bolts or replace the damaged fan if necessary.

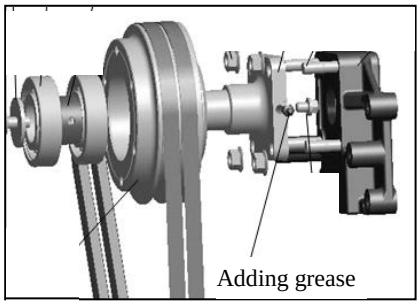
▲Warning: Damaged fan blade can cause serious personal injury. Do not pull or pry the fan, and do not rotate the engine with the fan.

5.3.9 Checking intake system

Check the intake hoses for any crack and perforation, and check clamps for looseness. Replace the hose(s) if any fault is found, and tighten clamp screws if looseness is found to ensure the intake system free from leakage.

5.3.10 Adding grease

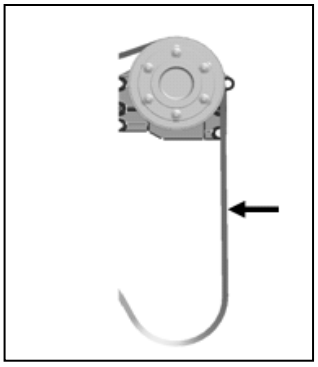
Add proper amount of sodium based lubricating grease in the small hole.



5.3.11 Checking belt tension

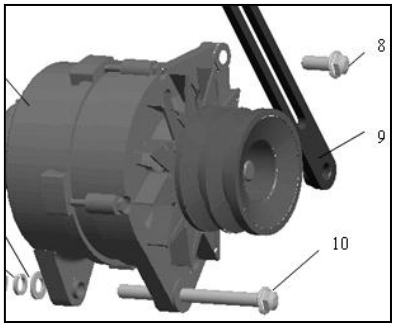
Check

Apply a force of about 98 N on the middle point of the belt span between the two pulleys with finger by pressing and pulling, and check the position change of that point. The change should be within 8 -12 mm. If it is out of the range, make adjustment.



Adjustment

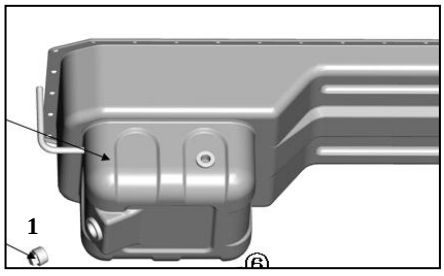
(1) Unscrew bolts and nuts on the alternator and alternator brace 9 and change the positions of the alternator and its brace to adjust belt tension.
(2) Tighten the bolts and nuts to 40 - 45 N·m.



5.3.12 Changing lubricating oil and oil filter

▲Warning: Be careful when changing lubricating oil and oil filter because skin contact with the hot oil or hot engine surface can cause scald.

(1) Don't stop the engine until the temperature of the coolant reaches 60°C, then remove the oil drain plug, scrap the washer and drain the lubricating oil.

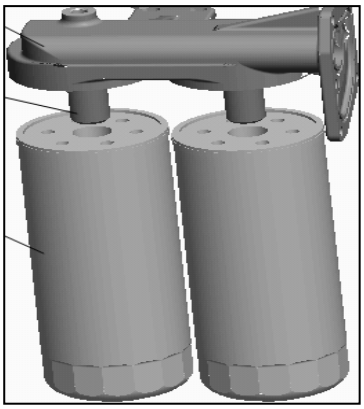


▵ Caution: Do not drain lube oil when the engine is in cold state at which foreign particles has deposited and attached to the bottom of the oil pan, and will not drain with the oil. When the lube oil is warm, foreign particles suspend in it and can easily drain with it.

(2) Clean the installation surface of the oil drain plug on the oil pan. Install the drain plug with sealant Tonsan 1567F and tighten it to 60 -70 N·m.

(3) Clean the outside surface of the oil filter. Remove the oil filter with tool and scrap it.

(4) Clean the sealing surface of the filter head, and there should be no old O-ring left.



(5) Before installing a new oil filter, fill it with clean oil from the 8 peripheral holes. The oil level should be 3-15 mm below the threaded hole. Apply a light film of Vaseline or clean lubricating oil to the O-ring on the new filter to form a lubricating film.

△Caution: Do not add oil from the central hole of the filter.

(6) Turn the filter by hand until the O-ring contacts the seal surface of the filter head, and further tighten it to 45 ± 5 N·m or 3/4 to one of a turn with tool.

(7) Open the filler cap, and fill the engine with clean lubricating oil until the oil level is near the high level mark in the oil dipstick. The lubricating system capacity is about 32.5 L.

(8) Start the engine and keep it running at idle, and then check the oil filter and drain plug for oil leak.

(9) Shut off the engine, wait for about 10 minutes to provide enough time for the oil to flow back to the oil pan, and check the oil level. If required, add lubricating oil until it is near the high level mark in the oil dipstick.

(10) Install the filler cap and tighten it until you feel suitable.

5.3.13 Changing fuel filter

(1) Clean the outside surface of the fuel filter. Remove the filter with tool and scrap it.

(2) Clean the filter head and its sealing surface. There should be no old O-ring left.

(3) Before installing a new fuel filter, fill it with clean fuel from the 8 peripheral holes. The fuel level should be 3-15 mm below the threaded hole. Apply a light film of Vaseline or clean lubricating oil on the O-ring on the new filter to form a lubricating film.

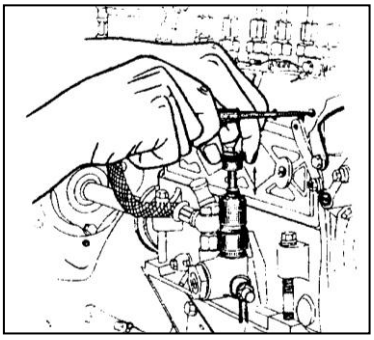
△Caution: Do not add fuel from the central hole of the filter.

(4) Screw the filter by hand until the O-ring contacts the seal surface of the filter head, and further tighten it to 45 ± 5 N·m or 3/4 to one of a turn with tool.

5.3.14 Priming fuel system

If the engine has not been used for a long time or fuel filter is changed, air will enter the fuel system. It is required to prime the fuel system as per following steps:

(1) Loosen the air bleed screw on the fuel injection pump.
(2) Prime the priming pump until there is no bubble visible in the fuel that outflows from the screw.
(3) Tighten the screw.



△ Caution: Priming the fuel system is required if air enters the fuel pipeline due to untimely fuel supplement or there is air in the fuel system due to other reasons.

5.3.15 Checking and adjusting valve clearance

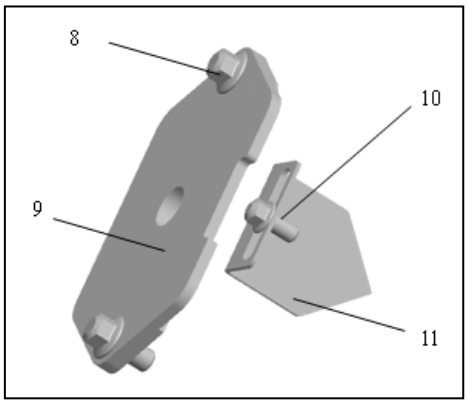
When doing the first maintenance for a new or overhauled engine, conduct valve-clearance checking to timely regulate and correct the initial changes of the valve clearances. Later valve clearance checking and regulating should be done based on the maintenance plan if the engine operates normally.

Valve clearance checking should be conducted after the engine has stopped and the coolant temperature has fallen to below 60℃.

(1) Remove the nut on the valve cover and scrap the cover and scrap the seals and gaskets

(2) Rotate the engine and make the piston of No. 1 or No.6 cylinder position at the top dead center on compression stroke.

Note: When the indicator 11 on the flywheel housing points at mark “0” in the flywheel viewed from the observing window on the flywheel housing plate 9, the piston of No 1 or No. 6 cylinder is at the top dead center.



(3) Rotate the intake or exhaust push rod of No.1. If the push rod can be rotated, the piston of No. 1 cylinder is at the top dead center on compression stroke; if not, the piston of No. 6 cylinder is at the top dead center on compression stroke.

(4) When the piston of No.1 cylinder is at the TDC on compression stroke, check with a feeler gauge the intake valve clearances of No. 1, 2 and 4 cylinders, as well as the exhaust valve clearances of No.1, 3 and 5 cylinders. When the

piston of No.6 cylinder is at the TDC on compression stroke, check with a feeler gauge the intake valve clearances of No. 3, 5 and 6 cylinders as well as the exhaust valve clearances of No. 2, 4 and 6 cylinders.

Note: The clearance is correct when some resistance is felt at which the feeler gauge is slipped between a valve stem and a rocker arm.

(5) If a valve clearance fails to meet the requirement, loosen the adjusting screw locknut on the corresponding rocker arm, adjust the clearance to the specified value and tighten the locknut to 50 - 60 N·m. Check the valve clearance again and it should not change.

Valve clearance:

Intake……0.30 - 0.35 mm

Exhaust……0.35 - 0.40 mm

(6) Mark a sign on the damper and rotate the crankshaft for a circle (360 degrees). Follow the same steps to adjust the rest intake and exhaust valve clearances.

(7) Install the valve cover with new seals and gaskets and tighten the cover nuts to 10-15 N·m.

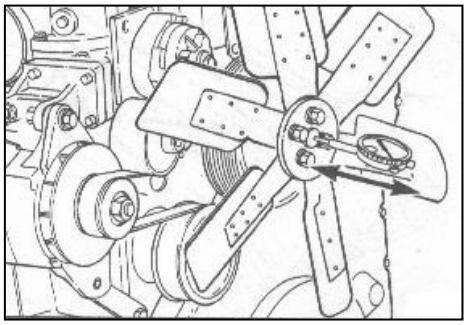
5.3.16 Checking intercooler and its lines

Perform visual check on the air inlet and outlet chambers of the intercooler for crack, perforation or other damages, and on the air inlet and outlet pipes of the intercooler for sealing-off and other damages. Replace the intercooler if necessary.

Perform visual check on the hoses of the air inlet and outlet pipes and water inlet and outlet pipes (water-to-air intercooler) for crack, and check clamps for looseness. Replace the hose(s) if any fault is found, and tighten clamp screws if looseness is found

5.3.17 Checking fan bearing

Remove the drive belt. Turn the fan to check the fan bearing for normality. When rotating the fan, there should be no vibration or excessive axial or/and radial movement. Replace the fan hub if necessary.



5.3.18 Checking turbocharger

Perform visual check on the impeller blades of the turbine and compressor of the turbocharger for damage, crack, or contact with their housings when a light finger pressure applied on them. And check the turbocharger shaft for not being free spinning. In case that any of the above problems occur, the turbocharger should be replaced.

5.3.19 Checking vibration damper

Check the vibration damper for damping fluid (silicon fluid) leak and surface dents. Also examine the thickness of damper to confirm if the damper has become deformed. In case that any of the above problems occur, the damper should be replaced.

5.3.20 Changing coolant and cleaning cooling system

In order to ensure the engine coolant to be good in cooling and anticorrosion, changing of coolant and cleaning of cooling system are required every 2,000 hours or 2 years, whichever comes first.

▲Warning: At operating temperature, engine coolant is hot and under pressure, and coolant steam can cause personal injury. Do not remover the pressure cap on the radiator until the engine stops and coolant temperature goes below 50℃. Slowly unscrew the pressure cap to release the cooling system pressure.

▲Warning: The anti-rust additive in the coolant contains alkali. Avoid skin and eye contact with it to prevent personal injury.

(1) Stop the engine and wait until the temperature of the coolant falls to below 50℃. Slowly unscrew the pressure cap to release the cooling system pressure and remove it. Loosen the drain cock on the radiator to completely drain the coolant in the radiator.

(2) Remove the two water drain plugs on the engine (one on the intake side, near the flywheel housing, the other near the bottom of the oil cooler), unscrew the drain cock on the water pump and completely drain the coolant in the cooling system.

(3) Clean the cooling system according to the following steps.

(a) Install and screw up all the drain cocks and plugs, and add the sodium carbonate solution (or the mixture of sodium carbonate and water that is available in market) into the cooling system from the coolant filler.

△Caution: Each 23 L of water should be mixed with 0.5 kg sodium carbonate. Do not use caustic cleaner, or it will do harm to aluminum parts.

△Purge the air in the coolant system while adding the cleaning fluid. Pour the cleaning fluid slowly to avoid air block. The cleaning fluid should be added up to the bottom of the filler in the radiator and wait for about 3-5 minutes for a full purge of air.

(b) Start the engine and keep it running for 5 minutes after the cleaning fluid temperature has gone up to above 80℃, then stop the engine and completely drain the cleaning fluid in the cooling system.

△Caution: During the whole cleaning process the pressure cap should not be on and the engine runs without the cap on.

(c) Add clean water into the cooling system

△Caution: Pour clean water slowly to avoid air block. Clean water should be added up to the bottom of the filler in the radiator and wait for about 3-5 minutes for a full purge of air.

(d) Start the engine and keep it running for 5 minutes after the water temperature has gone up to above 80℃, then stop the engine and completely drain the clean water in the cooling system.

△Caution: If the discharged water is still dirty, clean the cooling system again according to the aforesaid steps until discharged water becomes clean.

(4) After the cleaning, tighten the water drain cock on the radiator, and the drain cock on the water pump. Apply sealant Tonsan 1567F to the threads of the two water drain plugs on the engine and tighten them by 60-80 N·m.

(5) Add coolant. Fill the cooling system with proper coolant. The total coolant capacity of the SC15G engine is 25.5 liters and that of SC13G 23 liters.

△ Caution: Engine coolant capacity listed above refers to the coolant volume in the engine cooling system. The actual amount of coolant should refer to the equipment data.

△ Caution: Add coolant slowly to avoid air block. Coolant should be added up to the bottom of the filler in the radiator or meet the requirement of the equipment manufacturer. Wait for about 3-5 minutes for a full purge of air.

(6) Install the pressure cap on the radiator, start and run the engine until coolant temperature reaches 80℃, then stop

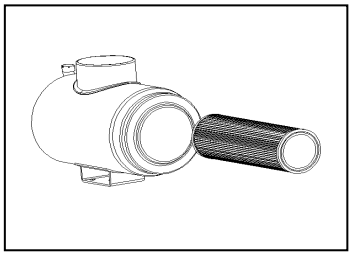
the engine and check the cooling system for leakage.

(7) Stop the engine and wait until the coolant temperature falls to below 50℃. Then open the pressure cap and recheck the coolant level. Supplement properly, if necessary.

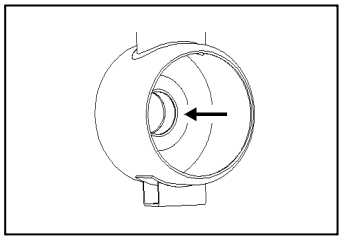
5.3.21 Replacing air filter element (paper element)

(1)Blow off dirt on the filter with compressed air.

(2)Remove the filter cover, remove and scrap the element.



Cover the compressor inlet from inside the air filter body with clean stuff to prevent dirt from entering the intake system.



Clean the inside of the filter body. Check the new filter element for any defects and remove the covering stuff from the compressor inlet. Install the new element and make sure a sound seal at both ends. Install the air filter cover and the service indicator.

△ Caution: Be sure that both end faces of the air filter are reliably sealed without leakage after the air filter element has been changed.

5.3.22 Cleaning air filter element (non-paper element)

Remove the air filter cover and the element. Dip the element in warm neutral cleaning liquid to remove oily dirt on it. Do not use brush for cleaning. Dry the element after cleaning. Flushing afterward with clean water is necessary when non-neutral cleaning liquid is used. Check the element for any damage after cleaning. Install the element and make sure a sound seal at both ends. Install the cover.

△ Caution: Be sure that both end faces of the air filter are reliably sealed without leakage after the air filter element has been changed.

6 Troubleshooting Guidelines

6.1 General

Be calm and careful when the engine has faults, analyze the feature of a fault and judge the cause of a failure according to the following principles.

1) If there is abnormal phenomenon during the operation of the engine, use “see, hear, touch, and smell” to comprehensively judge which part or which system has problems.

“**See**” —to observe the readings of each instrument, and changes of the color of exhaust smoke, coolant temperature and oil pressure.

“**Listen**” —to listen to the sound of the movements of moving part and its change with a slim metal rod or screw-driver as “stethoscope” on the relevant surfaces of the engine.

“**Touch**”— to feel for the working condition of the valve train parts and the engine vibration with finger.

“**Smell**”— to smell abnormal engine odor.

2) The engine should be stopped timely for inspection when the engine suddenly goes wrong or the cause of a failure has been found and the failure will affect the normal engine operation. If it is difficult to identify the cause of a failure, reduce engine speed and keep the engine running at low-speed without load for observation and inspection in order to avoid a serious failure.

3) When a failure is judged as a serious one or the engine suddenly stops, it should be disassembled for inspection and repair.

4) Failure causes especially big ones as well as solutions to the failures should be recorded in the log of the engine as a reference for next maintenance.

The common faults and correction methods listed in this chapter are only for reference. In practical work, it should be flexible to find out internal and external causes of malfunctions according to specific engine operation condition and practical experience, provide right remedy to eliminate failures.

6.2 Troubleshooting Guidelines

Some typical and simple diesel engine fault modes, possible causes and troubleshooting steps are listed in the table below. If any one of symptoms occurs in engine operation, it is required to eliminate it by taking appropriate measures. Otherwise, it can lead to severe engine failure. For simple engine faults, you can locate and eliminate them on your own. For complex faults, contact SDEC’s after-sale service center (spare@sdecie.com) for technical guidance.

No.	Fault Mode	No.	Fault Mode
1	Engine will not start	6	Oil temperature and consumption too high
2	Engine power output low	7	Coolant in lube oil
3	Abnormal noise and vibration	8	Coolant temperature too high
4	Abnormal smoke	9	Coolant temperature too low
5	Abnormal oil pressure	10	Oil in coolant

No.	Typical system or component fault Mode	No.	Typical system or component fault Mode
11	Electrical system fault	14	Fuel feed pump fault
12	Fuel injection pump fault	15	Fuel injector fault
13	Governor fault	16	Turbocharger fault

1) Engine will not start

Fault feature	Possible cause	Correction
The engine cannot fire after being driven by starter, and no fuel in the fuel pump return pipe	Malfunction of fuel system: (1)Air in the fuel system	Remove air from the fuel system and refer to Section 5.3 for the procedure
	(2)Fuel liquidity affected because of cold weather	Choose proper fuel specified in this manual based on ambient condition
	(3)The fuel pipe is blocked	Check and clean the pipe
	(4)The fuel filter is blocked	Clean the strainer and replace the fuel filter
	(5)The fuel feed pump cannot supply or continuously supply fuel	Check the inlet pipe for leakage and the inlet pipe joint strainer for blockage. If it doesn't work, check the inlet pipe and feed pump.
	(6)The position of governor control handle is not correct	The handle should be placed to min. stable idle speed. Let a professional serviceman adjust the control handle when required
	(7)Improper fuel injection pump timing	Check and adjust the fuel injection pump timing
	(8)Very small or no injected fuel flow or no fuel atomization	Let a professional serviceman inspect the injector, and adjust the injection pressure to the specified value on a test stand. Replace the injector(s) if required
Engine will not crank when the starting switch gets on	(1)The wire of circuit connects incorrectly or contact is not good	Check whether the wire connection is correct or reliable
	(2)Insufficient battery power	Charge battery, or adopt a battery with sufficient output or add some more batteries in parallel
	(3)Poor contact between the electric brush and reverser of the starter	Repair or replace the carbon bush, clean the reverser surface by wood abrasive paper, and blowing-off, or regulate the spring pressure
	(4)Internal mechanical problem hiders the cranking	Disconnect the engine with driven equipment and barring the engine to check if the crank train rotate with difficulty due to bearing seizure of crankshaft, connecting rod or piston or wrong camshaft gear timing
There is no fire while the fuel injection is right, and there is fuel in exhaust pipe	Insufficient cylinder compression pressure: (1)Over wear of piston ring or cylinder liner	Replace the piston ring and replace the cylinder liner according to the wear condition
	(2) Leakage at valves	Check the valve clearance, valve spring, valve guide and the sealing condition of the valve seat. Make replacement, repair or grinding if necessary
Starting time is long and there is no fire	Too low of ambient temperature	Use cold starting aid according to ambient temperature

2) Engine power output low

Fault feature	Possible cause	Correction
Power or speed does not go up after increasing the fuel supply	Failure of fuel system: (1)The fuel pipeline broken, or leakage at the pipeline joints, fuel filter blocked or air in the fuel system	Replace the damaged fuel pipe, tighten the joints, clean the strainer, replace fuel filter, and priming the fuel system
	(2)Not enough fuel, or water and impurity in the fuel tank	Make sure there is enough fuel in the fuel Tank. Discharge water and sediments in the fuel tank. Change the fuel in the tank with clean fuel if necessary
	(3)Incorrect fuel injection pump timing	Check and adjust the fuel injection pump timing
	(4)Not enough fuel supply from the fuel injection pump	Check the fuel injection pump and replace it if required
	(5)Poor fuel atomization or low injection pressure	Let a professional serviceman inspect the injectors for injection spray and injection pressure, and make adjustment. Replace the injector(s) if necessary
Higher exhaust temperature and poor smoke at normal working condition	Failure of inlet and exhaust system: (1)Block of the air filter	Clean the filter element and replace it when required
	(2)Leakage in the intake system	Check the pipeline somewhere between the outlet of the compressor and the inlet of intake manifold for leakage and remove the leak source
	(3)Block of the exhaust pipe, the connecting pipe too long , or with too small elbow, or with too many elbows	Remove the carbon deposit inside the exhaust pipe, reduce elbows to no more than 3 and increase across area
	(4)Wrong valve clearance	Check and adjust the valve clearance and refer to Section of 5.3 for the procedure
	(5)Wrong fuel injection pump timing	Check and adjust the fuel injection pump timing
Poor engine performance at all speeds	Change of fuel injection pump timing	Check and adjust the fuel injection pump timing
Engine overheat	(1) Ambient temperature too high	Improve the ventilation condition and take a good temporary cooling measure if the ambient temperature is too high
	(2)The temperatures of lube oil and cooling water are very high and the exhaust temperature is also high	Check and repair the cooler and radiator, and remove the scale. Inspect the diameter of relevant pipelines for too small across areas.

Fault feature	Possible cause	Correction
Not only low power output and poor engine performance, but also gas leak, black smoke from the intake pipe and knocking noise	Failure of cylinder head group: (1)Looseness of cylinder head nuts or the damage of the cylinder gasket due to gas leak from the joint plane of cylinder head and engine block, especially flowing out from the cylinder head gasket during transit operation	Tighten the cylinder head nuts to the defined torque. Replace the cylinder head gasket, and repair the joint plane if necessary
	(2)Leakage at intake or exhaust valve(s)	Disassembly and inspect the intake and exhaust valves, repair and grind. Replace the valve seat(s) or/and valve(s) if required
	(3)Valve spring(s) damaged	Replace the damaged spring(s)
	(4)Wrong valve clearance	Check and adjust the valve clearance and refer to Section of 5.3 for the procedure
	(5)Leakage at fuel injector hole or the damage of injector copper washer	Check and repair the damaged parts. Replace the relevant parts when required
	(6)Insufficient compression pressure due to the seizure of piston ring or valve stem	Check the piston rings, pistons, cylinder lines and valves. Make replacement if necessary
Abnormal noise and drop of the oil pressure	Seizure of the connecting rod bearing(s) and crankshaft	Check the large end of connecting rods for the side clearances as well as backward and forward movement. If the connecting rods cannot movement, repair the crankshaft pin and change the connecting rod bearing(s)
Drop of speed, decrease of inlet air pressure, air leak or abnormal noise, etc.	Fault of the turbocharger: (1)Wear of the turbocharger bearing and contact of the blades of the compressor or turbine to their housings	Let a professional serviceman check the turbocharger. Make replacement if necessary
	(2)Dirt and block of the compressor and air leak at inlet pipe(s)	Let a professional serviceman clean the compressor. And tighten the joint nuts and clamps

3) Abnormal noise

Fault feature	Possible cause	Correction
There is rhythmic and clear metal slapping noise made by in the cylinder	Too early fuel supply	Check and adjust the fuel injection pump timing
There is low and non-clear slapping noise in the cylinder	Too late fuel supply	Check and adjust the fuel injection pump timing
There is light and speculate noise, which is clearer during idle running.	Clearance between piston pin and small end bushing of connecting rod is too big	Check the small end bushings of the connecting rods and replace the connecting rod(s) if necessary
There is collision noise from the cylinder block. The noise would be loader when the speed is increased	Clearance between piston and cylinder liner is too large	Check the pistons and liners for wear and make replacement of piston or liner according to wear condition
There is collision noise in crankshaft case during running. There is heavy and forceful collision noise when reducing the speed suddenly	Too large clearance between a crankshaft pin and connecting rod bearings due to bearing wear	Disassembly and inspect connecting rod bearings. Replace them if necessary
There is collision noise made by the shuttle of the crankshaft during idle running	Too large crankshaft endplay due to wear of the crankshaft thrust bearing leads to the shuttle of the crankshaft	Check the crankshaft endplay and the wear condition of the thrust bearing. Replace the thrust bearing if necessary
There is rhythmic and light slapping noise at cylinder head	Valve spring broken, push rod bent, tappet sleeve wear or valve damaged	Replace the damaged parts and adjust the valve clearance according to the process in 5.3
There is low, uniform and rhythmic slapping noise at cylinder head during running and collision can be felt when nipping the nuts of the cylinder head cover	Valve collided with piston	Remove the cylinder head cover, find out the collision cause, and adjust the valve clearance. If necessary, check if wrong piston(s) is used.
There is abnormal noise at front cover, collision noise can be heard when reducing speed suddenly	Too big gear backlash due to tooth wear	Adjust the tooth clearance, and replace the gear according to the wear condition
There is noise like “Zhi Zhi” at the cylinder head, which is caused by dry friction	Lack of lube oil between rocker-arm adjusting screw and push rod	Remove the cylinder head cover, and check and find out the cause
There is rhythmic and louder noise at cylinder head	Valve clearance too large	Check and adjust the valve clearance according to the process in 5.3

Fault feature	Possible cause	Correction
There is abnormal collision noise from the turbocharger	Poor lubrication due to blocked oil passage leads to the blade(s) bent because of bearing wear	Disassembly and check whether the bearing is worn out and the blade(s) is bent. Make replacement if necessary. Clean the oil inlet and outlet passages to ensure smooth oil flow
Heavy combustion noise	(1)Poor fuel quality (2)Fuel pump fault	Discharge the fuel in the tank and add clean fuel specified in the manual. And replace the fuel filter. Determine the fuel pump problem by making one cylinder stop working at a time or by testing the fuel pump on a pump test bench to check fuel supply for fuel flow or evenness
Serious engine vibration	(1)Injector(s) or fuel injection pump plunger(s) doesn't work (2)Looseness of the nuts fixing the engine to the equipment (3)Offset of the central lines of the engine and propeller shaft (marine application)	Check the injector(s) or the fuel pump plunger and barrel assembly(s). Replace the injector(s) or fuel injection pump if required Tighten the nuts Make the central lines in alignment

4) Abnormal smoke

Fault feature	Possible cause	Correction
Black smoke	(1)The engine load exceeds the defined value	Reduce the load to the defined range
	(2)Uneven fuel supply of each cylinder	Adjust the fuel injection pump
	(3)Wrong valve clearance and bad seal of valve lead to leakage at valve and bad combustion	Adjust the valve clearance, check valve facing condition and eliminate the defects
	(4)Too late fuel supply due to too small injection advance angle leads to part of fuel burning in the exhaust manifold	Check and adjust the fuel injection pump timing
	(5)Poor fuel atomization	Let a professional serviceman check injector(s) for fuel atomization
	(6)Insufficient inlet air due to block of air filter or inlet pipe, or the compressor housing too dirty	Clean and remove the dust. Replace the filter element if necessary
	(7)The elastic gas seal ring of the turbocharger is burn or wear. There is leakage at the connections of the turbine	Let a professional serviceman check the seal ring, and replace it if necessary. And tighten all connecting bolts of the turbine
	(8)Bad wear of piston rings	Replace the piston rings
White smoke	(1)Bad fuel atomization with fuel dripping and too low injection pressure	Let a professional serviceman check the fuel injector nozzle assembly(s), maintain or replace the assembly(s), and regulate the injection pressure to the defined value
	(2)The fuel in some cylinders cannot burn during engine start-up (especially in winter)	Increase speed and load, and keep the engine running at high speed and load for longer time
	(3)Too much water in the fuel	Remove the water in the fuel
	(4)Coolant entering cylinder due to crack of the cylinder head	Check the exhaust pipe for water condensation and replace the cylinder head if necessary
Blue smoke	(1)Poor air intake due to the block of the air filter	Remove and clean the air filter
	(2)Lube oil in the combustion chamber resulting from seizure or much wear or insufficient elasticity of piston ring, or incorrect ring chamfer direction due to wrong installation	Remove and check the piston rings, make replacement if necessary
	(3)Large clearance between piston and cylinder liner due to long time low-load running (less than 40% of rated power) facilitates oil entering the combustion chambers	Increase load to a proper degree, and choose a proper application power
	(4)Too much lube oil in oil sump	Adjust lube oil level near high level mark in the dipstick
	(5)Damage of the oil seal of the turbocharger leads to lube oil into the intake manifold	Check the intake manifold for oil trace, check or replace the turbocharger when necessary

5) Abnormal oil pressure

Fault feature	Possible cause	Correction
Oil pressure decreases and it cannot be corrected by the pressure regulating valve and the reading of the pressure gauge fluctuates	(1)Oil leak the at lube oil pipeline	Check and tighten the nuts
	(2)Air in the oil pump, or insufficient oil in oil pan	Add oil to the defined level
	(3)Block of the oil cooler or oil filter, fracture of the cooler core, or oil leak at the oil seal gasket	Clean the oil cooler, and replace damaged parts and oil filter if necessary
	(4)Bad oil leak at the crankshaft bearing(s), crankshaft front and rear oil seals, camshaft bearing(s), connecting rod bearing(s), rocker arm shaft(s) or rocker arm(s)	Check each part, and replace those whose wear exceeds the defined value
	(5)Fuel in oil	Find out the location of fuel entering oil and make necessary repair. Change the oil and oil filter
	(6) The piston cooling jet(s) is not installed	Install the missing piston cooling jet(s)
	(7)Oil is diluted	Find the cause and change the oil and oil filter
No oil pressure, the indicator of the pressure gauge keeps standstill	(1)The oil pressure gauge is damaged	Make replacement
	(2)Block of the oil duct	Clean the oil duct
	(3)Serious damage or seizure of the oil pump due to incorrect assembly	Reinstall the oil pump and replace it if required
	(4)Oil pressure regulating valve does not work due to the damage of its spring	Replace the regulating valve

6) Oil temperature and consumption too high

Fault feature	Possible cause	Correction
The reading of oil temperature gauge exceeds the defined value, and still be after the enhancement of cooling. Meanwhile, there is black smoke from the exhaust pipe	(1)Overload of the engine (2)The reading of the thermometer is incorrect (3)Oil level is too low or too high (4)Insufficient cooling water or fan wind flow (5)Block of the oil cooler	Decrease load Regulate the thermometer and replace it when required Add lube oil to the defined level Pay attention to keep smooth flow of coolant and regulate the belt tension to reach the defined speed of the water pump and fan Clean the oil cooler
The oil level decreases rapidly, and the oil color is black. There is white smoke at the oil filler port and ventilation pipe, and blue smoke from the exhaust pipe	(1)Low-load running for a long time (2)The specification of used oil is not correct (3)The failure of the elastic seal of the turbocharger (4)The oil return hole of the piston oil ring is block by carbon deposit (5)The seizure or serious wear of the piston ring(s) or/and over wear of cylinder liner leads to oil into combustion chamber and the combustion gas into the crankshaft case (6)Wear of valve guide(s)	Enhance load to a proper degree Choose oil according to the defined specification in this manual Let a professional serviceman repair the turbocharger. Make replacement if necessary Clean off the carbon deposit and replace the oil ring(s) if necessary Replace the piston rings, and replace the cylinder liner(s) if necessary Repair the valve guide(s) and make replacement if required

7) Coolant in oil

Fault feature	Possible cause	Correction
There is yellow bubble in oil, and coolant steam condenses on the surface of the crankcase ventilation pipe	Coolant leak due to the damage of the cylinder liner seals	Change the liner seals
	Coolant leak at the contacting planes of the cylinder line and cylinder block	Check the contacting planes for flatness and the gasket for damage, and make replacement if necessary
	Coolant leak due to cavitation in the cylinder liner	Change the liner
	Coolant leak due to the damage of the cylinder head gasket	Change the head gasket
	Mixture of oil and coolant due to the damage of the oil cooler core	Check the cooler core and replace it if necessary
	Coolant into the oil pan: (1)Coolant leak at the water pump shaft seal ring (2)Damage of the water seal ring of the water pump	Check the water pump, and replace the water pump if necessary Replace the water pump
	Coolant leak due to the cylinder block cavitation (especially at the side of the push rods)	Change the cylinder block

8) Coolant temperature too high

Fault feature	Possible cause	Correction
There is no or less coolant from the engine, and coolant temperature increases continually after the engine has started up	There is air in the cooling system	Loosen the air bleed joint on the water pipe, discharge the air until the smooth flow of the outlet coolant, and tighten all joints of the water pipeline
The temperature of the coolant is too high under high-load and the oil temperature also increases	(1)The speed of the water pump or fan cannot reach the defined value	Adjust the belt tension to the defined value
	(2)Not enough coolant in the cooling system	Add coolant to the defined level
	(3)Malfunction of the pressure cap of the radiator	Check the pressure cap for function and replace it if required
	(4)Block of the water pipeline	Clean the water pipeline
	(5)There are too many scale on the surface of the radiator, which affects the performance of the radiator	Remove the scale deposit and wash the radiator
	(6)Incorrect water temperature gauge	Check the water temperature gauge, and replace it if necessary
	(7)Failure of thermostat	Check whether the opening and close temperatures of the thermostat are correct, and replace the thermostat if necessary
	(8)The clearance between the impeller and housing of the water pump is too large	Replace the water pump
	(9)The water pump impeller is damaged	Replace the water pump
The coolant in radiator is bubbling	There is crack at the shoulder of the cylinder line (s)	Replace the cylinder liner(s)

9) Coolant temperature too low

Fault feature	Possible cause	Correction
	Low ambient temperature, low load	Increase load to a proper degree
	The reading of water thermometer is not correct	Regulate or replace the thermometer when required
	The thermostat doesn't work well or was damaged	Replace the thermostat

10) Oil in coolant

Fault feature	Possible cause	Correction
	Damage of the oil cooler core	Replace the oil cooler core
	Fault of the cylinder head gasket	Replace the gasket

11) Electrical system fault

Fault feature	Possible cause	Correction
Starting motor does not work	(1)Poor contact of the connecting wires	Clean and tighten the terminals or joints
	(2)Poor contact of electromagnetic switch	Check the switch contactor and grind it by sandpaper
	(3)Poor contact of the electric brush	Clean the surface of the reverser or replace the electric brush
	(4)Short-circuit of the starting motor	Locate and fix the short-circuit issue. Replace the starting motor if required
	(5)Poor electric charging or the capacity of battery too small	Charge the battery, or add more batteries with parallel connection. Replace the battery if required
The starting motor rotates but no engine starting takes places	(1)Poor contact of the electric brush or terminal or sealing off	Clean the surface and weld firm. Make replacement if necessary
	(2)Wear of the bearing sleeve	Replace the bearing sleeve
	(3)Partial short-circuit of magnetic field winding or electric field winding	Locate the short-circuit and fix it out
	(4)Poor contact of the electromagnetic switch	Check the switch contact and grind it by sandpaper
	(5)Poor electric charging or the capacity of battery too small, and a big drop of starting motor circuit voltage	Charge the battery and replace it if needed. Increase the wire cross section or decrease the wire length
The starting motor gear collides with flywheel ring gear or the gear of the starting motor cannot set back	(1) The center of the starting motor is not parallel with that of flywheel ring gear	Install the starting motor again to make the two centers parallel
	(2)The switch contact of electro- magnetic switch fused together	Check the switch contact and grind it by sandpaper
The starting motor keeps running when the starting button is released	(1)The electric key or button cannot reset	Regulate it again
	(2)The dynamic contactor of the electromagnetic switch is fused with the connecting screw	Repair
	(3)Start-up relay is fused firmly	Regulate it again
Alternator cannot charge	(1)The alternator belt is loose	Adjust the belt to a proper tension
	(2)Poor terminal contact of the alternator or/and battery	Clean or tighten all terminals and connects of the alternator and battery, and replace wires and terminals and joints if required
	(3)Rotor failure（magnetic coil）	Change the rotor
Too low alternator voltage or abnormal alternator charge	(1)The drive belt is loose	Adjust the belt to a proper tension
	(2)Poor terminal contact of the alternator or/and battery	Clean and tighten all the terminals and connects of the alternator and battery. Replace wires and terminals if required
	(3)The voltage regulator of the alternator is damaged	Replace the voltage regulator
	(4)Rotor failure（magnetic coil）	Replace the rotor
	(5)Burn of the rectifier diode	Replace the rectifier diode

Fault feature	Possible cause	Correction
Too big voltage of the Alternator	(1)Poor contact of the connector of the alternator or its voltage regulator	Tighten the all connectors
	(2)Fault of the alternator voltage regulator	Change the regulator
Abnormal noise from the alternator	(1)Abrasion or damage of the drive belt	Change the belt
	(2)The drive belt is loose	Adjust the belt to a proper tension
	(3)The centers of the drive belt and pulleys are not in alignment	Adjust and make them in alignment
	(4)Wear of the bushing	Change the alternator
	(5)The armature or rotor bent	Change the alternator
	(6)The alternator rectifier circuit is short	Change the alternator

12) Fuel injection pump fault

Fault feature	Possible cause	Correction
Fuel injection pump does not supply fuel	(1)No fuel in the fuel tank	Add fuel in time
	(2)There is air in the fuel system	Prime the fuel system, refer to Section 5.3 for the procedure
	(3)Block of the fuel filter or fuel pipes	Replace filter element and clean the low pressure fuel pipeline
	(4)Failure of the fuel transfer pump	Replace the fuel transfer pump
	(5)Seizure of the plunger and barrel	Let a professional serviceman check and repair the plunger and barrel assembly(s), and make replacement if necessary
	(6)Poor seal at the fuel delivery valve seat(s)	Let a professional serviceman check and repair the fuel delivery valve seat(s), and make replacement if necessary
Uneven fuel supply	(1)There is air in the fuel pipeline, resulting in intermittent fuel supply	Priming the fuel system and refer to Section 5.3 for the procedure
	(2)Break of the delivery valve spring(s)	Replace the fuel injection pump
	(3)Wear of the delivery valve-seat(s)	Let a professional serviceman replace the fuel delivery valve seat(s)
	(4)Impurity leads to the seizure of plunger	Let a professional serviceman clean the plunger and barrel assembly(s) and make replacement if necessary
	(5)Fuel inlet pressure too small	Check the strainer of the inlet connector in the fuel transfer pump and the fuel filter for block. Clean and replace them if necessary. And maintain them according to the maintenance plan
Insufficient fuel supply	(1)Fuel leak at the delivery valve assembly(s)	Let a professional serviceman check the delivery valve assembly(s), and replace the assembly(s) when required
	(2)Block of fuel strainer on the fuel transfer pump or block of fuel filter	Clean the strainer, replace the fuel filter
	(3)Wear of plunger and barrel assembly	Let a professional serviceman replace the plunger and barrel assembly(s)

13) Governor fault

Fault feature	Possible cause	Correction
Instability of engine speed (engine hunting)	(1)Non-even fuel supply of each cylinder	Let professional serviceman readjust the supply flow of each cylinder
	(2)Carbon deposit and fuel dripping at fuel nozzle	Let professional serviceman clean and repair the nozzle assembly(s), or replace the nozzle assembly(s)
	(3) Lose connecting pin of the rack	Let professional serviceman repair it. Or replace the fuel injection pump
	(4)The camshaft endplay is too large	Let professional serviceman regulate it. Or replace the fuel injection pump
	(5)Lose flying-weight pin due to wear	Let professional serviceman repair it. Or replace the fuel injection pump
	(6)The clearance between the control rack and the control gear is too large or there is burr between them	Let professional serviceman repair it. Or replace the fuel injection pump
	(7)The control rack or accelerator lever doesn't move freely	Let professional serviceman repair it. Or replace the fuel injection pump
	(8)There is air in the fuel system	Prime the fuel system
	(9)The flyweight or flyweight seat doesn't open freely	Let professional serviceman repair it. Or replace the fuel injection pump
	(10)Low speed is not set properly	Let professional serviceman adjust it
The engine cannot reach rated speed	(1)Permanent deformation of the governor spring	Let professional serviceman repair it. Or the fuel injection pump
	(2)Not enough fuel supply from the fuel injection pump	Refer to Fuel Injection Pump Fault for troubleshooting
	(3)The operation handle does not reach the max. speed position	Let professional serviceman check and adjust the operation handle
The engine cannot reach idle speed	(1)The operation handle does not reach the idle speed position	Let professional serviceman repair it. Or replace the fuel injection pump
	(2)Slight seizure of the rack and ring gear	Let professional serviceman repair it. Or replace the fuel injection pump
	(3)The low-speed setting is not proper	Let professional serviceman adjust it
The governor doesn't work and speed exceeds 110% of the rated speed (usually called flying away)	(1)Speed is too high	Make emergency stop at once by cutting off fuel supply or air supply. Let professional serviceman check and repair it. Or replace the fuel injection pump if necessary
	(2)Deadlock of control rack or accelerator lever	Let professional serviceman repair it. Or replace the fuel injection pump
	(3)Dropout of the pin connecting the rack and drag link	Let professional serviceman repair it. Or replace the fuel injection pump
	(4)Dropout of the accelerator lever screw	Let professional serviceman repair it. Or replace the fuel injection pump
	(5)Break of speed governing spring	Let professional serviceman repair it. Or replace the fuel injection pump

14) Fuel transfer pump fault

Fault feature	Possible cause	Correction
Not enough fuel supply	(1)Wear or break of the check-valve	Replace the fuel transfer pump
	(2)Wear of the piston	Replace the fuel transfer pump
	(3)Fuel leak at the fuel pipe joint(s)	Retighten the joint(s)
	(4)Block at the fuel inlet joint strainer	Clean the strainer
	(5)Lack of fuel due to the piston seizure	Replace the fuel transfer pump
	(6) Fuel leak at the transfer pump	Check the fuel transfer pump, and replace the pump if necessary

15) Fuel injector fault

Fault feature	Possible cause	Correction
A little or no fuel injected	(1)There is air in the fuel supply system	Prime the fuel system
	(2)Seizure of the fuel injector nozzle(s)	Let a professional serviceman check and replace the nozzle assembly(s)
	(3)Abnormal fuel supply from the fuel injection pump	Refer to Fuel Injection Pump Fault for troubleshooting
	(4)Oil leak at high-pressure fuel pipe(s)	Tighten the pipe locknut and replace the pipes with crack, make replacement if required
	(5)Wear of fuel injector nozzle(s)	Let a professional serviceman replace the nozzle assembly(s)
Too low fuel injection pressure	(1)Lose pressure regulating screw	Let a professional serviceman readjust the screw to the defined pressure and tighten the locknut
	(2)Deformation or break of the pressure regulating spring	Let a professional serviceman replace the injector spring
	(3)Seizure of needle valve(s)	Let a professional serviceman replace the nozzle assembly(s)
Too high fuel injection pressure	(1) Pressure regulating spring force too high	Let a professional serviceman readjust the spring force
	(2)Seizure of the needle valve(s)	Let a professional serviceman replace the nozzle assembly(s)
	(3)Block of the injection holes	Let a professional serviceman check and clean the injection holes. Replace the injector(s) if necessary
Fuel leak at fuel injector	(1)Break of pressure regulating spring(s)	Let a professional serviceman replace the spring(s)
	(2)Damage of needle valve facing(s)	Let a professional serviceman replace the nozzle assembly(s)
	(3)Seizure of needle valve(s)	Let a professional serviceman replace the nozzle assembly(s)
	(4)Deformation of tightening cap(s)	Let a professional serviceman replace the cap(s)
	(5)Poor contact between nozzle and injector body	Let a professional serviceman repair or replace the nozzle assembly(s). Replace the injector(s) if required
Poor fuel atomization	(1)Decay of pressure regulating spring force or break of spring(s)	Let a professional serviceman replace the spring(s)
	(2)Wear of fuel injector nozzle seat surface(s)	Let a professional serviceman repair or replace the nozzle assembly(s)
	(3)There is impurity on the fitting plane of fuel injector nozzle assembly(s)	Let a professional serviceman clean the nozzles

	(4)Deformation or wear of nozzle assembly(s) (5)Seizure of needle valve(s)	Let a professional serviceman replace the nozzle assembly(s) Let a professional serviceman replace the nozzle assembly(s)
Fuel spray in line or fuel dripping	(1)Carbon deposit at nozzle holes and block of injection holes (2)Wear of needle valve seat surface(s) (3)Seizure of needle valve(s)	Let a professional serviceman clean the injection holes. Replace the nozzle assembly(s) if necessary Let a professional serviceman replace the nozzle assembly(s) Let a professional serviceman replace the nozzle assembly(s)
The surface of needle valve is burn or in blue-black	The engine is overheating	Check the cooling system and do not over-load the engine for a long time. Let a professional serviceman check the nozzle assembly(s) and make replacement if necessary

16) Turbocharger fault

Fault feature	Possible cause	Correction
The engine cannot reach the rated power	(1)Wear of the turbocharger bearing	Let a professional serviceman replace the bearing
	(2)There is dirt on the blades and housing of the compressor	Let a professional serviceman clean the turbocharger
	(3)Too much carbon deposit at the back of the blades and seal ring of the turbine and compressor and turbine	Let a professional serviceman clean the turbocharger
The exhaust color is abnormal. There is black smoke (not enough of inlet air)	(1)There is dirt on the compressor	Let a professional serviceman clean it
	(2)Air leak at the compressor	Let a professional serviceman check the seal condition and remove the air leak problem
Blue smoke	(1)The elastic seal ring is lack of elasticity or over wear	Let a professional serviceman replace the seal ring
	(2)The oil return passage in the middle housing blocked or deformed	Let a professional serviceman clean and repair the middle housing
Abnormal noise and vibration	(1)Surge of the compressor, and large amplitude when the turbocharger vibrates (one of the reasons is that there is serious dirt in compressor inlet passage, air inlet pipe and turbine outlet passage)	Let a professional serviceman clean the turbocharger
	(2)Incorrect assembly (lack of dynamic balance of turbine and compressor impellers, or collision between rotating parts and fixed parts)	Let a professional serviceman disassemble and inspect the turbocharger
	(3)The turbine impeller or compressor impeller is damaged by foreign material.	Let a professional serviceman check and repair the turbocharger. Replace the turbocharger if necessary
	(4) Collision of the turbine impeller to its housing due to deformation of the housing	Let a professional serviceman inspect the turbocharger. Replace the turbocharger if necessary
	(5)There is foreign material in the passage of the turbine housing. Abnormal noise can be heard at idle.	Let a professional serviceman inspect the turbocharger. Check the intake and exhaust system
The impeller of turbine or/and compressor cannot rotate or not spin freely	Serious carbon deposit on the turbine, back of compressor impeller and seal ring	Let a professional serviceman clean the turbocharger. Check the engine for poor combustion and oil leak
Bearing burn and collision between impellers and their housings	(1)Too dirty oil, too low oil pressure or block of oil pipe	Check the lubricating system and change the oil and oil filter
	(2)Too high oil inlet temperature	Find the cause and take measures to reduce oil temperature
	(3)Damage of the dynamic balance of the impellers of the turbine and compressor or incorrect assembly	Let a professional serviceman check and make dynamic balance
	(4)High exhaust temperature and over speed of turbocharger	Check whether there are serious gas leak, deformation and block of the exhaust manifold or pipe, repair and clean them
	(5)Deformation of the turbine housing	Let a professional serviceman check and find the cause. Replace the turbocharger if necessary
Speed drop, intake pressure drop, air leakage or abnormal noise	(1)Wear of the turbocharger bushing, collision of the turbocharger impellers with their housings	Let a professional serviceman repair the turbocharger. Replace the turbocharger if necessary
	(2)The compressor intake passage is dirty, blocked or leaks	Let a professional serviceman clean the turbocharger. Tighten joints and clamps

7 Engine Storage

7.1 Short time storage

If the engine is to be out of service for a period of time (1 to 3 months), measures of cleaning and necessary oil seal should be taken for rust protection.

7.1.1 Before storage

(1) Clean the engine surface and check for any dirt, or oil stain or water stain and rust. Dry the engine with compressed air. Apply anti-rust oil to the unpainted machining surfaces of the engine with a brush and keep the parts of rubber, plastic and fiber free from the anti-rust oil.

△ Caution: The surfaces of the front drive pulleys must be kept from rust.

The anti-rust oil requirement for outside engine is as follows:

Item		Requirement
Appearance		Brown in even
Moisture		None
Drop point		≥55
Freezing resistance		Qualified
Oil stability（ml）		≤2
Salt test	Steel sheet	≥14
	Cast iron sheet	≥7
Humid heat test	Steel sheet	≥30
	Cast iron sheet	≥14
Lamination test（7 days）	Steel sheet	Qualified
Corrosion test（14 days）	Steel sheet	Qualified
	Cast iron sheet	Qualified

(2) Disconnect the battery, clean terminals and apply a light film of grease. Charge the battery.

(3) Let the drive belt in loose.

(4) Seal all ports of air, fuel, oil and coolant, as well as the air filter with damp-proof material or plastic one.

(5) Cover the engine with plastic cover or similar stuff and place the engine in a dry area with good ventilation.

7.1.2 During the storage

Charge the battery every month. Check the battery electrolyte level before charging. Crank the crankshaft three to four turns every month with barring tool.

7.1.3 After storage

When putting the engine into use, remove the fuel pump and send it to the authorized service provider for adjustment. Remove the engine cover and all port seals. Install the fuel pump and prime the fuel system. Connect battery and install the belt. Check lubricating oil and coolant levels, and add proper amount of clean lubricating oil into the turbocharger from its oil inlet. Crank the engine three to five circles with barring tool. Then follow the starting procedure in Section 4.5 to start the engine.

7.2 Long time storage

7.2.1 Before storage

If the engine is to be out of service for a long time (more than 3 months), proper storage of the engine is required.

(1) On last engine operation, drain the lubricating oil in the engine and oil filter after the engine has stopped and cooled down to warm state. It is not necessary to drain coolant because it is anti-rust. Add qualified anti-rust oil (dewatered CF 15W-40 oil) into the engine, start the engine to idle for 1-1.5 minutes and stop it, then drain the anti-rust oil.

(2) Refer to Article 1, 2, 3, 4 and 5 in Section 7.1.1 Short Time Storage for cleaning, preventing rust and other requirements. And put a tag which reads “The engine does not contain oil and do not use it.”

7.2.2 During the storage

Refer to 7.1.2 for storage.

7.2.3 After storage

When putting the engine into use, remove the fuel pump and send it to the authorized service provider for adjustment. Remove the engine cover and all port covers, and connect necessary lines. Install the fuel pump and prime the fuel system. Connect battery and install the belt. Fill the engine and oil filter with clean lubricating oil and add proper amount of clean lubricating oil into turbocharger from its oil inlet. Check oil and coolant levels, and crank the engine three to five circles with a barring tool. Then follow the starting procedures in Section 4.5 to start the engine. If the engine is stored for over 2 years, its coolant should be changed and its cooling system should be cleaned.