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面积: 0.0625m ²		

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1、 通则

- 1.1 一般而言, 进行每一项试验是为了验证电气设备所具有的功能及其运地情况, 同时验证其安全保护装置。
- 1.2 用于轮机和甲板辅机的电气设备的试验方法, 参照轮机及舾装部分系泊试验大纲。
- 1.3 所有试验要在船东代表在场时做, 最后将签字的试验结果递交船东代表。

1.4 试验标准如下:

- 温度传感器 (PT100) : $\pm 2^{\circ}\text{C}$
- 压力开关: $\pm 2.5\%$
- 舵角指示: $\pm 1^{\circ}$
- 指示器: $\pm 1^{\circ}$
- 其他如制造厂标准。

1.5 电压降测试。

该试验用来测试电缆上的电压降。

1.5.1 试验过程

- (1) 选择一个距离相关发电机最远的用电设备。
- (2) 检查该用电设备在距它最近的分电箱的电压。
- (3) 为避免由于相序间的负载不平衡而致增加的电压, 在试验过程中, 仅测量两相之间的电压。
- (4) 确定电压降在规范所要求的+6% 和-10%之间。
- (5) 测量点如下表。

NO	FROM		TO		REMARK
1	主配电板440V电路	(V)	艏楼	(V)	
2	主配电板220V电路	(V)	驾驶室	(V)	
3	应急配电板440V电路	(V)	应急消防泵	(V)	
4	应急配电板220V电路	(V)	驾驶室	(V)	
5	直流24V电路	(V)	集控室	(V)	

2、主发电机

2.1 原动机安全装置试验

本试验参照“轮机系泊试验大纲”。

2.2 绝缘电阻试验

发电机负荷试验前和试验后，用直流500伏兆欧表测量下列回路的绝缘电阻。

电枢绕组对地

励磁绕组对地

空间加热器对地

调速电动机对地

注：对于半导体整流器，本试验应使用万用表测量。

2.3 运行试验

每台电机应在额定电压和额定转速下，用水电阻作为试验负载（ $\cos \phi = 1$ ），25~50%额定负荷下，运行试验15分钟，75%额定负荷下运行试验0.5小时，在100%额定负荷连续运行试验2小时，在110%额定负荷，运行试验0.5小时，待发电机组各功能试验结束后，在100%负荷下，测量绝缘电阻及温升。

测量结果记录在附表1，2，3中。

2.4 电压特性试验

用水电阻作负载（ $\cos \phi = 1$ ），在额定电流下，把每一台发电机的电压和频率调到额定值，然后，在功率因数为100%情况下，把电流从额定值起按75%~50%~25%调到0，又从0到额定值变化，测出在稳定下的电压和频率，并记录在附录4中。

上述试验期间，验证各点电压变化率应不超过 $\pm 2.5\%$ （ ± 11.25 伏）。

2.5 主发电机调速器试验

当突卸负荷和突加50%额定负荷，然后再突加50%额定负荷量，通过测量频率，电压的变化及其稳定时间来测量发电机转速的变化和稳定时间。

上述试验，所测结果记录在附录5中，并且应满足下列要求：

瞬态频率变化不超过 $\pm 10\%$ （ $\pm 6\text{Hz}$ ）

瞬态频率变化不超过 $\pm 5\%$ （ $\pm 3\text{Hz}$ ）

稳定时间不大于5秒。

2.6 主发电机并联运行试验

调节每台并联运行的发电机，使其能负担各自75%的额定功率，然后使并联发电机的总负荷按如下变化（ $\cos \phi = 1$ ）：

75%→100%→75%→50%→25%→50%→75%→100%

测量上述各点每台发电机的有功功率和电压，并计算并联运行发电机负荷相对于每台电机额定功率的偏差值，最大的偏差应不大于一台发电机额定功率的 $\pm 15\%$ （上述各测量点的运行时间3分钟）。

测量结果记录在附表6中。

3、 应急发电机

3.1 原动机安全装置试验

本试验参照轮机部分系泊试验大纲进行。

3.2 绝缘电阻试验

在应急发电机运行试验前和试验后，用直流500V兆欧表测量下列电路的绝缘电阻。

电枢绕组对地

励磁绕组对地

空间加热器对地

注：对半导体整流器，本试验应用万用表来测量。

3.3 运行试验

参照轮机部分

测量结果记录在附表1，2，3中。

3.4 电压特性试验

按照以下顺序运行: 25%-50%-75%-100%-75%-50%-25%

所测电压、频率值记录在附表4中。

上述各点电压变化率应不超过额定电压的 $\pm 3.5\%$ ($\pm 15.75V$)

3.5 调速器特性试验

当突卸100%负荷和突加100%额定负荷，通过测量频率、电压的变化及其稳定时间来测量发电机转速的变化率和稳定时间。

3.6 发电机在额定功率60kW 情况下运行时，起动应急消防泵试验。

3.7 自动起动试验

应急发电机在主电源故障（汇流排失电）情况下，应在45S内自动起动并合闸。这一试验可以在试航期间完成。

4、 主配电板

4.1 绝缘电阻试验

在所有主配电板的开关及保险丝处于断开位置时，用直流500伏兆欧表测量汇流排对地的绝缘电阻，及汇流排（包括220V屏）各相之间绝缘电阻。

4.2 逆功率继电器脱扣试验（ $\cos \phi = 1.0$ ）

逆功率继电器必须正确地延时动作，空气断路器延时断开。

逆功率设定值： 10%额定功率（72kW）

设定时间： <10秒

测量结果记录在附表7中。

4.3 过电流继电器脱扣试验

不启动原动机情况下,用电流互感器的二次回路的模拟电流进行过流继电器脱扣试验,空气断路器过流装置调整在下列设定值,确认其动作正确,且空气断路器延时断开。

DG:

(1) 电流设定值: $120\% \times 1.1 \times 1600 (I_o) = 2112A$

设定时间: 20 ± 2 秒

(2) 电流设定值: $250\% \times 1600 (I_o) = 4000A$

时间设定: 400ms

测量结果记录在附录8中

4.4 优先脱扣试验

(1) 发电机的优先脱扣装置调整在下列设定值,确认装置正确动作,在设定时间内,过流延时打开,切断一组负荷。

DG:

电流设定值: $120\% \times 1.1 \times 1600A (I_o) = 2112A$

设定时间: 10 ± 2 秒脱卸负荷。

(2) 脱扣负荷

24P 220V 厨房设备电力分电箱

25P 220V 舱室加热器电力分电箱

26P 220V 舱室风机电力分电箱

空调装置

集控室的空调设备

4P 440V 机修设备电力分电箱

7P 440V 厨房设备电力分电箱

测量结果记录在附表9中。

4.5 联锁功能试验

验证下述联锁电路的功能。

——发电机空气断路器(ACB)和岸电开关MCB联锁。

——发电机空间加热器和发电机空气断路器(ACB)联锁。

5、 应急配电板

5.1 绝缘电阻试验

方法同4.1。

5.2 过流继电器脱扣试验

方法同主配电板(见4、3)

(1) 电流设定值: $120\% \times 1.1 \times 175 (I_o) = 231A$

设定时间: 20 ± 2 秒

(2) 电流设定值: $3 \times 175 (I_o) \times 200\% = 1050A$

设定时间: 200ms

6、 自动电站

6.1 手动遥控起动和停止试验

发电机起停试验通过操作机旁就地控制箱和主配电板上的起停开关来完成。

6.2 报警保护及自动起动试验

在下列情况下，备用发电机自动起动。

6.2.1 在一台发电机单独运行情况下，另一台发电机作为备用。

- (1) 汇流排电压高 105% (472.5V) 以上，延时5秒报警，脱扣，备用机起动并合闸。
- (2) 汇流排电压低 90% (405V) 以下，5秒脱扣，备用机组启动合闸
- (3) 频率低 95% (57Hz) 以下，5秒脱扣，备用机组启动合闸
- (4) 频率高 105% (63Hz) 以上，5秒脱扣，备用机组启动合闸
- (5) 汇流排失压（全船失电） 备用机起动并合闸
- (6) 公共报警 脱扣并紧急停车
- (7) 起动故障 报警
- (8) 报警试验表要按照船级社和船厂的要求进行。

7、 变压器试验

7.1 绝缘试验

用直流500伏兆欧表测量下列电路的绝缘电阻。

- (1) 原边绕组对副边绕组
- (2) 原边绕组对地，副边绕组对地
- (3) 变压器试验后，进行温升数据记录。

7.2 在效用试验时，测量原边和付边的电压和电流。

8、 蓄电池充放电试验

验证充放电功能，测量电压和电流。

9、 电动机和控制器

9.1 测量所有电动机的绝缘电阻。

9.2 效用试验

在效用工况中验证电动机控制装置，参照“轮机部分系泊试验大纲”。

9.3 进行下面的功能试验

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<div> <div>9.3.1 自动切换下述机舱内的备用泵。</div> <div> 冷却海水泵（自动切换） 主机缸套冷却淡水泵（自动切换） 主滑油泵（自动切换） 低温冷却淡水泵（自动切换） </div> <div>9.3.2 自动起/停试验</div> <div> 淡水泵、燃油输送泵、柴油输送泵、饮水泵、主空压机、油渣泵（仅自动停泵）。 </div> <div>9.3.3 驾驶室遥控</div> <div>消防总用泵、应急消防泵的遥控起动（包括消防控制站）。</div> <div>9.3.4 舵机驾驶室遥控起动/停止</div> <div>9.3.5 上甲板遥控停止</div> <div>油渣泵、机舱日用舱底泵</div> <div>9.4 舵机报警试验</div> <div>在试航前,验证一台舵机应急操舵试验.</div> <div>9.5 程序起动系统试验（在航行试验时进行）</div> <div> 全船失电后，当电源重新恢复时，验证下列设备按程序重新起动（分5级） <div> <div>第一级：（0秒）</div> <div> AC220V负荷 燃油供油单元 无线电设备 照明变压器， 航行设备 尾管滑油泵 舵机（No. 1, No. 2） </div> </div> <div>第二级：（5秒）</div> <div>主滑油泵</div> <div>第三级：（10秒）</div> <div>低温冷却淡水泵</div> <div>第四级：（20秒）</div> <div>海水冷却泵</div> <div>第五级：（25秒）</div> <div>N01，2，3，4 机舱风机</div> </div> </div>		
<div>面积：0.0625m²</div>		

9.6 遥控应急切断系统试验

通过操纵设置在下列地方的应急停止按钮或开关进行试验

(1) 机舱入口处, 消防站可应急切断负荷如下

1P 440V电力分电箱
2P 440V电力分电箱
4P 440V电力分电箱
11P 440V电力分电箱
24P 220V 电力分电箱
组合锅炉
柴油输送泵
燃油输送泵
柴油泵
滑油输送泵
辅机预润滑油泵
NO.1~NO.4 机舱风机
油渣泵
焚烧炉
集控室空调设备
主滑油泵
尾管滑油泵

(2) 驾控台的紧急停止按钮分别切断舱室的风机, 使以下设备的电源断路器被切断。

7P 440V电力分电箱
9P 440V电力分电箱
空调设备
主机辅助鼓风机
分油机区域抽风机
26P 220V电力分电箱
应急发电机室风机
二氧化碳室风机

10、 厨房设备、洗衣机、加热器及其他设备

10.1 绝缘电阻试验 (运行后)

用直流500伏兆欧表测量, 导体对地的绝缘电阻。

10.2 效用试验

验证各设备的运行性能。

11、 照明设备

11.1 航行灯

(1) 绝缘电阻试验

用直流500伏兆欧表测量绝缘电阻。

(2) 运行试验

验证下列项目：

(a) 灯故障报警

(b) 电源转换

(C) 验证航行灯在驾控板内指示灯的正确对应性

11.2 信号灯

(1) 绝缘电阻试验

(2) 运行试验

(3) 验证信号灯在驾控板内指示灯的正确对应性

验证下列项目：

(a) 电源转换

11.3 一般照明

(1) 进行每个照明电路试验，并验证照明灯具、开关和附件的正确连接。

(2) 在驾驶室对室外工作灯进行遥控功能检验。

11.4 应急照明

(1) 进行每个照明电路的试验，并验证照明灯具、开关和附件的正确连接。

(2) 通过主配电板失电（模拟或实际），验证220V应急照明的自动照明系统功能。

(3) 通过应急配电板失电（模拟或实际），验证DC24V照明系统自动照明功能。

(4) 照明的绝缘电阻检查。

(5) 按照船东要求典型舱室进行照度测量，并记录。

12、 集中控制与检测报警系统

12.1 集控台和报警系统

(1) 其性能是否正常。

(2) 验证每个检测报警点功能。

12.2 呼叫系统

对下列系统进行验证：

(1) 机舱轮机员事故呼叫系统

(2) 轮机员呼叫系统

(3) 延伸报警呼叫系统

13、火警检测和报警系统

所有试验按船级社， SOLAS及船厂标准进行。

- (1) 每一火警探测器及按钮应进行模拟试验,检查各报警点的正确性.
试验按模拟图进行。
- (2) 控制面板上有关功能试验.
- (3) 应急电源试验.

14、航行设备

所有试验按船级社， SOLAS及船厂标准进行。

- (1) 检查下列设备及电缆安装的正确性、完整性及接地的可靠性。
- (2) 用仪器检查下列设备的绝缘性。

注：半导体电路用万用表来测量其绝缘。

14. 1 气象传真机

通过接收气象图来验证其功能。

14. 2 电罗经

- (1) 检查电罗经稳定时间
- (2) 检查电罗经交流电源故障报警功能
- (3) 检查主罗经和每个分罗经的基线及安装检查
- (4) 检查主罗经和分罗经之间的匹配精度
- (5) 当电罗经主电源失电后，操舵台、船长室及舱机房分罗经仍能正常工作。

14. 3 自动舵

- (1) 舵角指示器校正
- (2) 作随动、手动操舵的调整试验
- (3) 检查失电报警功能
- (4) 自动操舵试验

- (5) 检查舵机控制箱两路供电的正确性,油泵马达的启动和工作电流及绝缘电阻.
- (6) 检查电罗经、磁罗经与自动舵间接口的正确性
- (7) 检查舵机舵角与各舵角指示器的方向正确性及舵角指示误差 $<\pm 1^{\circ}$

14. 4 卫星导航仪

检查工作情况和功能试验。

14. 5 计程仪

- (1) 检查传感器部分安装质量及其水密性
- (2) 检查仪器工作是否正常
- (3) 检查复示器匹配精度

14. 6 测深仪

- (1) 检查传感器安装质量及其水密性
- (2) 码头水深试测, 检查仪器工作是否正常
- (3) 检查分显示器的功能及报警

14. 7 雷达

- (1) 检查仪器动作是否正常, 显示器上各档量程的屏幕图像是否清晰
- (2) 检查雷达选择器的工作情况
- (3) 检查雷达和电罗经的匹配情况
- (4) 检查雷达和计程仪的匹配情况
- (5) 检查雷达性能监视器
- (6) 与GPS接口

14. 8 风速风向仪

进行效用试验。

14.9 雨雪清除器和刮水器

进行效用试验。

14.10 雾笛

进行效用试验。

14.11 AIS系统

进行效用试验

14.12 VDR系统

检查电源与系统工作情况

14.13 磁罗经

检查磁罗经安装的完整性和正确性

检查磁罗经侧灯的功能效用

14.14 货舱进水报警系统

进行效用试验

15、内部通讯设备

(1) 检查下列设备电缆安装的正确性和安装完整性及接地的可靠性

(2) 用仪器检查下列设备的绝缘性能

注：对于半导体电路，用万用表来进行绝缘试验。

15. 1 子母钟

作母钟、子钟的定时效用试验。

15. 2 自动电话系统

(1) 通话效用试验

(2) 自动电话与广播联通试验

15. 3 声力电话

通话效用试验。

14. 4 广播系统和对讲系统

作收音机、放音及对讲效用试验。

15. 5 电视机、收音机天线共用器

用电视机、收音机对天线共用器作效用试验。

15. 6 对下列设备作效用试验

- (1) 病室呼叫
- (2) 总动员报警和火警报警
- (3) 冷库呼叫
- (4) CO₂施放报警
- (5) 舵角指示器
- (6) 主机转速表

15. 7 通用报警系统试验及火警报警与通用报警的联系试验。

16、配电系统——绝缘试验

用直流500伏兆表测量配电板和/或分配电板的每一路供电电路中的每相对地的绝缘电阻（各分路开关处于“断开”位置）。

注：用直流500V兆欧表测量时，一般绝缘电阻不低于1M Ω ，50V以下运行的电路、绝缘电阻不低于0.3 M Ω 。

17、GMDSS和卫通F

17. 1 无线电组合台

- (1) 无线电设备安装检查
- (2) MF/HF设备
 - a. 检查调谐工作情况
 - b. 通过电传和对话来校验设备的功能
 - c. 检查充电器的运行状况
 - d. 检查选择呼叫功能
 - e. 检查应急灯、BK及控制器的工作情况

(3) 卫通C

通过电传和对话来检验设备的功能。

17. 2 甚高频无线电话

通过对话来检验其功能。

17. 3 双向甚高频无线电话

通过对话来检验其功能。

17. 4 406MHz应急示位标

用自测功能来作效用试验

17. 5 雷达应答器

用船上雷达作雷达应答器效用试验

17. 6 卫通F

通过电传和对话来检验设备的功能。

18、附表

TABLES

Generator test。

发电机试验。

Table 1

Load (%)	75	100	75	50	20	50	75	100	75
POWER(kW)									
NO.1GEN.									
NO.2GEN.									
NO.3GEN									
UNBALANCE(%)									
CURRENT (A)									
NO.1GEN.									
NO.2GEN.									
NO.3GEN									
FREQUENCY(Hz)									
VOLTAGE (V)									

发电机运行试验。

Table 2

表2

Load 负载 (%)	Time 时间	Reading of meters仪表读数						Remark 备注
		Output (kW)	Voltage (V)	Frequency (Hz)	Current (A)			
					R	S	T	
0								
25								
50								
75								
100								
110								

Measuring of generator

发电机参数测量

表3

Table 3

Measuring item 测量项目	No.1D/G	No.2 D/G	No.3 D/G	E/G
Temp. of stater 定子温度				
Temp. of gen. body 本体温度				
Temp. of bearing 轴承温度				
Air temp. (inlet) 进风口温度				
Air temp. (outlet) 出风口温度				
Ambient temp. 环境温度				

Voltage characteristic test

(cos ϕ =1.0)

电压特性试验

表4

Table 4

LOAD RATING (%)负载	NO.1 D/G			NO.2 D/G			NO.3 D/G			E/G		
	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)
100	720	440	60	720	440	60	720	440	60	99	450	60
75	540			540			540			74.25		
50	360			360			360			49.5		
25	180			180			180			24.75		
0	0			0			0			0		
25	180			180			180			24.75		
50	360			360			360			49.5		
75	540			540			540			74.25		
100	720			720			720			99		

Speed variation test

($\cos \phi = 1.0$)

调速特性试验

Table 5

表5

Load 负载变化 Changing	Condition	NO.1 D/G		NO.2 D/G		NO.3 D/G		E/G		
		Volt. (V)	Freq. (Hz)	Volt. (V)	Freq. (Hz)	Volt. (V)	Freq. (Hz)		Volt. (V)	Freq. (Hz)
100% ↓ 0	Before variation 变化前							100%		
	Instant 瞬态							↓		
	Settled 稳态							0		
0 ↓ 50%	Before variation							0		
	Instant							↓		
	Settled							50%		
50% ↓ 100%	Before variation							50%		
	Instant							↓		
	Settled							100%		

Parallel running test

($\cos \phi = 1.0$)

并联运行试验

Table 6

表6

Load (%)	Freq. (Hz)	Volt. (V)	Gen. No.1		Gen. No.2		Gen. No.3	
			Current (A)	Output (kW)	Current (A)	Output (kW)	Current (A)	Output (kW)
75								
100								
75								
50								
25								
50								
75								

Test of reverse power

($\cos \phi = 1.0$)

逆功率试验

Table 7

表7

Generator 发电机	Test	Operation power (kW) 动作功率	Time (sec) 时间	Remarks 备注
NO.1 D/G	1st	72		
	2nd	72		
NO.2 D/G	1st	72		
	2nd	72		
NO.3 D/G	1st	72		
	2nd	72		

Test of over current

过电流试验

D/G $I_{t1} = 120\% \times 1.1 \times 1600(I_o) = 2112A$

$I_{t2} = 3 \times 1600(I_o) \times 150\% = 7200A$

E/G $I_{t1} = 120\% \times 1.1 \times 175(I_o) = 231A$

$I_{t2} = 3 \times 175(I_o) \times 200\% = 1050A$

Table 8

表8

Generator	Test	Operation current(A)	Time (sec)	remarks
NO.1 D/G	1st			
	2nd			
NO.2 D/G	1st			
	2nd			
NO.3 D/G	1st			
	2nd			
E/G	1st			
	2nd			

Test of over current for pref. trip

过电流优先脱扣试验

D/G:

$$I_P = 120\% \times 1.1 \times 1600(I_0) = 2112A$$

表9

Generator	Test	Operation current(A)	Time (sec)	Remarks
NO.1 D/G	1st			
	2nd			
NO.2 D/G	1st			
	2nd			
NO.3 D/G	1st			
	2nd			

二. 航行试验

1. 无线电、导航及船内通信设备

1. 1 1#/2# VHF甚高频无线电话

通过无线电话与海岸电台进行通话试验, 以检查其功能。

1. 2 无线电组装台

1. 2.1 无线电台

用SSB电话, Telex, NBDP及DSC等进行实际使用, 以验证其功能。

1. 2.2 卫通C

用电传作通信试验, 以检查其功能。

1. 3 卫通F

用电话、电传和电报作通信试验, 以检查其功能, 并试验延伸报警。

1. 4 NAVTEX

接收导航信息, 以检查其功能。

1. 5 气象传真仪

通过接收气象传真图, 以检查设备的性能。

1. 6 磁罗经, 纠正磁罗经偏差和确认

1. 7 电罗经

在罗经叠标处, 利用方位圈在左右舷观察罗经叠标方位的读数。
并和罗经叠标的实际方位进行比较, 若固定误差 >0.5 , 则修正之。

1. 8 GPS卫星导航仪

在航行过程中, 使用导航仪在海图上定位2-3次, 用打印机将定位数据打印出来, 并与用其它手段定位进行比较, 以判别设备是否正常。

1. 9 多普勒计程仪

1. 9.1 计程仪航速校正应在测速区内且海况良好的情况下进行。

1. 9.2 选择一个航速与适当的距离进行测速，并计算出计程平均航速、平均真速和航速的补偿值。

1. 9.3 根据说明进行误差修正。

1. 10 测深仪

1. 10.1 检查零位线并将吃水线调整至本船吃水深度。

1. 10.2 在约15米深的海区内，将测深仪读数与海图（加减潮讯的深度）进行比较，以检查其工作是否正常。

1. 11 雷达

1. 11.1 令小船距本船0.6海里的圈周上慢速航行，用方位圈和X-波段以及方位圈和S-波段雷达分别观察小船的方位，每隔10°记录一次，分别求出二者方位之差的算术平均值，以检查是否正常。

1. 11.2 在航行过程中分别将避碰装置和X-波段雷达或S-波段雷达连接，观察工作是否正常。设置警戒圈距离，令小船驶向本船作警戒报警试验。

2. 主电站失电试验

2. 1 备用主发电机组自动启动及供电试验

这个试验是为了验证主配电板失电后备用发电机自动起动功能以及恢复供电后预先设定的电气设备程序起动的功能。

2. 2 应急发电机组自动启动及供电试验

这个试验是为了验证当主配电板失电后应急发电机自动起动以及向各应急用电设备的供电及其自动启动功能可靠性。

3. 集合警铃兼火警报警音响试验

集合警铃兼火警报警的喇叭、警铃等需进行试验、确认在机舱、
舱室各处均能听到。另外航行时，火警的探头都要试验。

4. 防海生物装置试验

效用试验。

I Dock Trial

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II Sea Trial

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1 General

- 1.1 In general, the purpose for each test is to verify the functions of the electrical equipment and their running status, and at the same time to verify their safety protection device
- 1.2 The test method of electric equipment for machinery & deck auxiliaries shall be consulted in accordance with mooring test programme of machinery part.
- 1.3 All tests and inspections listed in the document are to be witnessed by Owner representative. Final signed test result shall be submitted to Owner representative.
- 1.4 Allowable acceptance criteria for testing is as follows:
- Temperature sensor (PT100): $\pm 2^{\circ}\text{C}$
 - Pressure switch: $\pm 2.5\%$
 - Rudder angle indication: $\pm 1^{\circ}$
 - Indicator: $\pm 1^{\circ}$
 - Other as per Maker's recommendation.
- 1.5 Voltage drop test.
- This procedure shall be applied to the test of voltage drop of cable installed.
- 1.5.1 Test procedure
- (1) Select proper electric power consumer which is located at the most remote area from the related electric power generator.
 - (2) Check the voltage of the consumer side at the nearest distribution panel.
 - (3) During test, to be measured only two selected phase in order to avoid adding the voltage which is made by unbalance load between phases.
 - (4) Confirm the voltage drop is within the requirement of classification society of +6% and -10%.
 - (5) Measuring points are shown on attached test record.

NO	FROM		TO		REMARK
1	MSB 440V A.C CIRCUIT	(V)	F'CLE	(V)	
2	MSB 220V A.C CIRCUIT	(V)	W/H	(V)	
3	EM'CY SWTICHBOARD 440V	(V)	EM'CY F.P	(V)	
4	EM'CY SWITCHBOARD 220V	(V)	W/H	(V)	
5	DC 24V BATTERY CIRCUIT	(V)	ECC	(V)	

2 Main Generator

- 2.1 Safety device test of prime mover
Detail see the test program of machinery part.
- 2.2 Insulation resistance test
Before and after the load test, insulation resistance of the following circuits shall be measured by a DC 500V megger.
Stator winding to earth
Rotor winding to earth
Space heater to earth
Note: for semi-conductive rectifiers, an ohmmeter shall be used for this test
- 2.3 Running test
Running test of each generator shall be continuously carried out for 15 minutes at 25~50% rated load, carried out for half an hour at 75% rated load, carried out for 1 hour at 100% rated load and running for half an hour at 110% rated load. After accomplish generators' all function tests, temperature rises and insulation resistance should be checked at 100% rated load.
The results of the test should be record in the No.1, No.2, No.3 tables.
- 2.4 Voltage characteristic test
Use water resistance as load ($\cos \phi = 1.0$), under rating current, adjust the voltage and frequency of each main generator to the rating, when the power factor is 100%, adjust the current from rating varies as 75%~50%~25% then to zero, then from zero varies as 25%~50%~75% then to the rating, measure the voltage and frequency at each state after stable, and record in the No.4 table.
During the above measurement, it shall be verified that the voltage variation rate shall not exceed $\pm 2.5\%$ ($\pm 11.25V$).
- 2.5 Governor test of main generator
When generator unload and add 50% rated load with sudden, then add 50% rated load once more with sudden, via measure frequency and the variation of voltage and the steady time to measure the generator's variable revolution and the stable time.
The result of test should be recorded into the No.5 tables.
Instantaneous frequency variation shouldn't more than 10%. ($\pm 6Hz$)
Stable variation shouldn't more than 5%. ($\pm 3Hz$)
Stable time shouldn't more than 5 seconds.

- 2.6 Parallel running test of generator
Each generator running in parallel shall both be set about 75% of rated power and then the total load shall be changed as below mentions. ($\cos \phi = 1.0$)
75% → 100% → 75% → 50% → 25% → 50% → 75% → 100%
At the same time, voltage & active power at each load shall be measured and calculate the divergence of the parallel running generators' load relative to rated power of each generator, and the divergence shall not exceed $\pm 15\%$ rated power of one generator. (the running time of every measured point is 3 minutes.)
The result of test should be recorded into the No.6 tables.

3 Emergency Generator

- 3.1 Safety device test of prime motor
Detail see the test program of machinery part
- 3.2 Insulation resistance test
Before and after the running test, insulation resistance of the following circuits shall be measured by a DC 500V megger.
Stator winding to earth
Rotor winding to earth
Space heater to earth
Note: for semi-conductive rectifiers, an ohmmeter shall be used for this test
- 3.3 Running test
Detail see the test program of machinery part.
The results of test should be record in the No.1, No.2, No.3 tables.
- 3.4 Voltage characteristic test
Running at:
25% - 50% - 75% - 100% - 75% - 50% - 25%
The result of test should be recorded into the No.4 tables.
During the above measurement , it shall be verified that the voltage variation rate at each point is within $\pm 3.5\%$ ($\pm 15.75V$)
- 3.5 Governor test
When generator no-load and add 100% rated load with sudden, via measure frequency and the variation of voltage and the steady time to measure the generator's variable rate of revolution and the stable time.
- 3.6 Start emergency fire pump to test when generator running with rated power 60KW.

3.7 Start automatically

Emergency generator should be start automatically in 45 sec and switch on when the main power failure. The test may finish during trial.

4. Main Switchboard

4.1 Insulation resistance test

The insulation resistance between bus-bar to earth and the resistance between bus-bar's (include 220V panel) each phase, shall be measured by a DC 500V megger. Test to be before and after continuous load test.

4.2 Reverse power relay trip test

Reverse power relay must delay act correctly, the ACB break delay.
Reverse power setting: 10% rated power (72KW)
Setting time: <10 seconds
The result of test should be recorded into the No.7 tables.

4.3 Over-current relay trip test

Adopt the simulate current of the secondary circuit of the current transformer which can't bring start up condition to the prime motor and do this over-current relay trip test. Adjust the over-current device of the ACB to the set values as follows, confirm that the operation is correct and the ACB break delay.

DG

(1) Current setting: $1.20 \times 1.1 \times 1600(I_0) = 2112A$

Setting time: $20 \pm 2sec.$

(2) Current setting: $250\% \times 1600(I_0) = 4000A$

Setting time: 400ms

The result of test should be recorded into the No.8 tables.

4.4 Perferential trip test

(1) Adjust the perferential trip device of generator to following settings, confirm that the operation is correct, within the setting time, over-current opened delay, shut-off one group load.

DG

Current setting: $1.20 \times 1.1 \times 1600(I_0) = 2112A$

Setting time: $10 \pm 2sec.$

(2) Tripped loads

24P 220V PDB for galley equipment

25P 220V PDB for accommodation heaters

26P 220V PDB for accommodation fans and laundry equipment

Air-condition plant
Air-condition for ECR
4P 440V PDB for workshop equipment
7P 440V PDB for galley equipment
The result of test should be recorded into the No.9 tables.

- 4.5 Interlock function test
Verify the function of following interlock circuits.
Generator ACB and shore power MCB interlock.
Generator ACB and its space heater interlock.

5. Emergency Switchboard

- 5.1 Insulation resistance test
The test be same as 4.1
- 5.2 Over-current relay trip test
Method is same as MSB. (see 4.3)
(1) Current setting: $120\% \times 1.1 \times 175(I_0) = 231A$
Setting time: $20 \pm 2\text{sec}$.
(2) Current setting: $3 \times 175(I_0) \times 200\% = 1050A$
Setting time: 200ms

6. Automatic Power Station

- Voltage record at ACB trip at under voltage test to be incorporated.
- 6.1 Manual remote start and stop test
Generator start/stop test accomplished via local control box at the engine side and the start/stop switch on the MSB.
- 6.2 Alarm protection & automatic start test
Stand-by generator shall start automatically at following conditions.
- 6.2.1 When one set is running separately, the other set is stand-by.
- (1) Bus voltage high $> 105\% (473V)$ delay 5 second alarm, trip, the stand-by generator start and switch on.
 - (2) Bus voltage low $< 90\% (405V)$ delay 5 seconds trip, stand-by generator start and switch on
 - (3) Frequency low $< 95\% (57Hz)$ delay 5 seconds trip, stand-by generator start and switch on
 - (4) Frequency high $> 105\% (63Hz)$ 5 seconds trip, stand-by generator start and switch on
 - (5) Bus no-voltage (main power failure) stand-by generator start and switch on
 - (6) General alarm trip and emergency stop
 - (7) Start failure alarm

(8) Alarm test list shall be issued in compliance with Class and Maker's requirements.

7. Transformer Test.

- 7.1 Insulation resistance test
Insulation resistance of following circuits shall be measured by a DC500V megger
- (1) Primary coil to secondary coil.
 - (2) Primary coil to earth and secondary coil to earth.
 - (3) After test and temperature rising measurements of transformer shall be recooded.
- 7.2 Voltage & current of primary & secondary side shall be measured under efficiency test.

8. Batteries & Charging Device

Verify the battery and charging functions , measure voltage and current.

9. Motor And Controller

- 9.1 Measure the insulation resistance of all motors.
- 9.2 Efficiency test
Under the efficiency conditions to verify the control device of the motors, refer to the mooring test programme of machinery & hull part.
- 9.3 Carry out the following test about function
- 9.3.1 Changing-over following stand-by pumps which inside engine room automatically.
Main sea water cooling pumps (changing-over automatically)
M/E jacket cooling F.W. pumps (changing-over automatically)
Main L.O. pump (changing-over automatically)
L.T.F.W. cooling pump (changing-over automatically)
- 9.3.2 Automatic start/stop operation test
- Fresh water pump
 - F.O. transfer pump
 - M.D.O. transfer pump
 - Drinking water pump
 - Main air compressor
 - Sludge pump (only stop automatically)
- 9.3.3 Remote in wheel house

The remote start of fire & general service pump, emergency fire pump (including fire control station).

9.3.4 Steering gear start/stop remote controlled from wheelhouse test.

9.3.5 Upper deck remote stop
Sludge pump & Daily blige pump

9.4 Steering gear alarm test
Demonstration of one steering gear running under ESB power before sea trial.

9.5 Program start system test (carry out in trial)
After black-out, it to be confirmed that the following equipment shall be reset after recovery of main power supply.
First stage: (0 sec)

AC 220V loads

F.O. supply unit

Radio equipment

Lighting transformer

Navigation equipment

Stern tube L.O. pump

Steering gear (No.1&No.2)

Second stage: (5 sec)

Main L.O. pump

Third stage: (10 sec)

L.T.F.W. cooling pump

Forth stage: (20 sec)

C.S.W pump

Fifth stage: (25 sec)

No.1,2,3,4 engine room fa

9.6 Emergency remote stop system test
Test via operation the emergency stop buttons or switches that set at following positions.

(1) Emergency shut-off load at E/R exit and fire station as follows:

1P 440V PDB

2P 440V PDB

4P 440V PDB

11P 440V PDB

24P 220V PDB

Composite boiler

M.D.O. transfer pump
H.F.O. transfer pump
M.D.O pump
L.O. transfer pump
A/E L.O. priming pump
No.1 ~4 E/R vent. fans
Sludge pump
Incinerator
Air conditioner for ECR.
Main L.O. pump
Stern tube L.O. pump

(2) The emergency stop buttons on the wheelhouse control console be use to shut-off accommodation fans, so the power ACB of following devices shut-off.

7P 440V PDB

9P 440 PDB

Air –condition device

M/E auxiliary blower

Purifier space exh. fan

26P 220 PDB

Emergency generator room fan

CO2 room fan

10. Galley, Washing Machine, Heater And Other Equipment

10.1 Insulation resistance test (after running)
Insulation resistance between each conductor and earth shall be measured by a DC 500V megger.

10.2 Efficiency test
Verify the running performance of each equipment.

11. Lighting Equipment

11.1 Navigation light
(1) Insulation resistance test.
Insulation resistance shall be measured by a DC 500V megger.
(2) Running test
Following items shall be demonstrated.
(a) Lighting failure alarm
(b) Power source changeover
(c) Check the navigation lights and the indicators in navigation light panel corresponding correctly.

11.2 Signal light

- (1) Insulation resistance test
- (2) Working test
- (3) Check the signal lights and the indicators in signal light panel corresponding correctly.

Following items shall be demonstrated:

Power source change

11.3 General lighting

- (1) Light test shall be carried out on each circuit and test the correct connection of the light fixtures, switch and accessories.
- (2) It shall be verified that outdoor lights can remote controlled in wheel house.
- (3) Check the insulation resistance of lighting.

11.4 Emergency lighting

- (1) Light test shall be carried out on each circuit and test the correct connection of the light fixtures, switch and accessories.
- (2) Verify the automatic lighting functions of the 220V emergency lighting via MSB failure.(simulate or practice)
- (3) Verify the automatic lighting functions of the DC24V lighting system via ESB failure.(simulate or practice)
- (4) Check the insulation resistance of lighting.
- (5) According to OWNER request, measuring records of illumination intensity shall be recorded.

12. Central Control and Detecting Alarm System

Engine control console and alarm system

- (1) Whether the performance is normal or not.
- (2) Verify the functions of every detector alarm point.

Calling system

Following system shall be demonstrated

- (1) Engine room patrol alarm system (deadman calling)
- (2) Engineer calling system
- (3) Extend alarm system

13. Fire Detection & Alarm System

To be tested in accordance with Class and SOLAS Requirements.

- (1) This simulate test shall be demonstrated by operation of each fire detector and every push button. Check the correctness of each alarm point. Test to be carried out with mimic signal in order to confirm all alarms.
- (2) Concern functions of control panel test.

(3) Emergency power source test.

14. Navigation Equipment

ALL test to be carried out in accordance with Class, SOLAS and Maker's rules and recommendations.

(1) Check following equipment to see if they are correctly & completely installed and reliable earthen.

(2) Check the insulation of following equipment specified by instrument.

Note: For semiconductor circuits, an Ohm meter should be used for insulation test.

14.1 Weather facsimile

Check the function of the equipment by receiving weather chart.

14.2 Gyro compass

(1) Check the stable time of gyrocompass.

(2) Check AC power failure alarm function of gyrocompass.

(3) Check the base line and installation of each repeater and main compass.

(4) Check the matching precision between main compass and each repeater compass.

(5) When the main power of Gyrocompass failure, repeaters at the steering stand & captain room and in E.R are still working normally.

14.3 Autopilot

(1) Coordination test for rudder angle indicator.

(2) Coordination test for follow and no-follow operation.

(3) Check alarm function of power failure.

(4) Handle steering automatically test.

(5) Check the correctness of two circuits supply for the steering gear control box, the startup and working current and the insulation resistance of the oil pump motor.

(6) Check the correctness of the interfaces of the Gyro compass, magnetic compass and autopilot.

(7) Check the direction correctness of the rudder angle of steering gear and of each rudder angle indicators, the indicate error should less than $\pm 1^\circ$.

14.4 GPS receiver

Check the equipment for operational condition and functional test.

14.5 Log

(1) Check the transducer part for installation quality and water tightness.

- (2) Check the equipment for operational condition.
- (3) Check the matching precision of repeaters.

14.6 Echo sounder

- (1) Check the transducer part for installation quality and water tightness.
- (2) Deep test at wharf and check the equipment for operational condition.
- (3) Check the function of repeaters and alarm.

14.7 Radars

- (1) Check the function of equipment and whether the image of display is clear in different measurement.
- (2) Check the function of radar's change-switch.
- (3) Check the matching condition between radars and gyrocompass.
- (4) Check the matching condition between radars and speed log.
- (5) Check the performance monitor of radars.
- (6) Interfaced with GPS.

14.8 Anemometer & anemoscope

Carrying out the efficiency test.

14.9 Clean view screen & window wiper

Carrying out the efficiency test.

14.10 Fog horn

Carrying out the efficiency test.

14.11 AIS system

Carrying out the efficiency test.

14.12 VDR system

Check correctness of power supply, and operation condition.

14.13 Magnetic compass.

Check the completion and correctness of installation of magnetic compass.

14.14 Water ingress alarm system for cargo hold

Carrying out the efficiency test.

15. Interior Communication System

- (1) Check following equipment to see if they are correctly & completely installed and reliable earthen.
- (2) Check the insulation of following equipment specified by instrument.

Note: For semiconductor circuits, an OHM meter should be used for insulation test.

- 15.1 Crystal clock
Carry out the timing efficiency test
- 15.2 Automatic telephone
 - (1) Carry out communication efficiency test.
 - (2) Automatic telephone system connects to public addresser test.
- 15.3 Sound powered telephone system.
Carry out communication efficiency test.
- 15.4 Public addresser & talk back system
Functional test for receiving, broadcasting and talk back efficiency test.
- 15.5 Radio & TV antenna multi-coupler
Efficiency test for multi-coupler by radio and TV.
- 15.6 Efficiency test for the following devices.
 - (1) Hospital call
 - (2) General alarm & fire alarm
 - (3) Ref. Chamber call
 - (4) CO₂ release alarm
 - (5) Rudder angle indicator
 - (6) M/E RPM indicator
- 15.7 General alarm system test and the connection between fire alarm system and the general alarm system test.

16. Distribution System—insulation resistance test

Measure the insulation resistance of each phase to earth of every supply circuit for switchboard and/or distribution switchboard with DC 500V megger. (breakers of each branch circuit should be at “off” position.)

Note: when use DC 500V megger measure insulation resistance value at heat state shall not be less than 1M Ω at lowest and circuits running below 50V the insulation resistance shall not be less than 0.3 M Ω .

17. GMDSS & Inmarsat F

- 17.1 Radio console
 - (1) Check the completion and correctness of installation for radio equipment.
 - (2) MF/HF radio equipment

- a. Check the working condition of tune.
- b. Check the function of equipment by telegraph and communication test.
- c. Check the running function of the charger.
- d. Check the function of selective calling.
- e. Check the working condition of emergency light, BK & controller.

(3) Inmarsat C

Check the function of equipment by telegraph and communication test.

17.2 VHF radio telephone

Check the function of equipment by communication test.

17.3 Two-way-VHF radio telephone

Check the function of equipment by communication test.

17.4 406MHz EPIRB

Carrying out the efficiency test by function of self-checking.

17.5 Radar transponder

Carrying out the radar transponder efficiency test by the use of ship radars.

17.6 Inmarsat F

Check the function of equipment by telegraph and communication test.
Check the working condition of the facsimile.

18. TABLES

Generator test

Table 1

Load (%)	75	100	75	50	20	50	75	100	75
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POWER (kW)									
NO.1GEN.									
NO.2GEN.									
NO.3GEN.									
UNBALANCE (%)									
CURRENT (A)									
NO.1GEN.									
NO.2GEN.									
NO.3GEN.									
FREQUENCY(H2)									
VOLTAGE (V)									

Running test of generator.

Table 2

Load (%)	Time	Reading of meters						Remark
		Output (kW)	Voltage (V)	Frequency (Hz)	Current (A)			
					R	S	T	
0								
25								
50								
75								
100								
110								

Measuring of generator

Table 3

Measuring item	No.1 D/G	No.2 D/G	No.3 D/G	E/G
Temp. of stater				
Temp. of gen. body				
Temp. of bearing				
Air temp. (inlet)				

Air temp. (outlet)				
Ambient temp.				

Voltage characteristic test

(cos ϕ =1.0)

Table 4

LOAD RATING (%)	NO.1 D/G			NO.2 D/G			NO.3 D/G			E/G		
	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)	Output (kW)	Volt. (V)	Freq. (Hz)
100	720	440	60	720	440	60	720	440	60	99	450	60
75	540			540			540			74.25		
50	360			360			360			49.5		
25	180			180			180			24.75		
0	0			0			0			0		
25	180			180			180			24.75		
50	360			360			360			49.5		
75	540			540			540			74.25		
100	720			720			720			99		

Speed variation test

(cos ϕ =1.0)

Table 5

Load Changing	Condition	NO.1 D/G		NO.2 D/G		NO.3 D/G		E/G		
		Volt. (V)	Freq. (Hz)	Volt. (V)	Freq. (Hz)	Volt. (V)	Freq. (Hz)		Volt. (V)	Freq. (Hz)
100%	Before variation							100%		
	Instant									

↓ 0	Settled							↓ 0		
0	Before variation							0		
↓	Instant							↓		
50%	Settled							50%		
50%	Before variation							50%		
↓	Instant							↓		
100%	Settled							100%		

Parallel running test

($\cos \phi = 1.0$)

Table 6

Load (%)	Freq. (Hz)	Volt. (V)	Gen. No.1		Gen. No.2		Gen. No.3	
			Current (A)	Output (kW)	Current (A)	Output (kW)	Current (A)	Output (kW)
75								
100								
75								
50								
25								
50								
75								

Test of reverse power

($\cos \phi = 1.0$)

Table 7

Generator	Test	Operation power (kW)	Time (sec)	Remarks
NO.1 D/G	1st	72		
	2nd	“		
NO.2 D/G	1st	“		
	2nd	“		
NO.3 D/G	1st	“		
	2nd	72		

Test of over current

D/G $I_{t1} = 120\% \times 1.1 \times 1600(I_0) = 2112A$

$I_{t2} = 3 \times 1600(I_0) \times 150\% = 7200A$

E/G $I_{t1}=120\% \times 1.1 \times 175(I_o)=231A$

$I_{t2}=3 \times 175(I_o) \times 200\% =1050A$

Table 8

Generator	Test	Operation current(A)	Time (sec)	remarks
NO.1 D/G	1st			
	2nd			
NO.2 D/G	1st			
	2nd			
NO.3 D/G	1st			
	2nd			
E/G	1st			
	2nd			

Test of over current for pref. trip

DG:

$I_P=120\% \times 1.1 \times 1600(I_o)=2112A$

Table 9

Generator	Test	Operation current(A)	Time (sec)	remarks
NO.1 D/G	1st			
	2nd			
NO.2 D/G	1st			
	2nd			
NO.3 D/G	1st			
	2nd			

II Sea Trial

1 Radio & Navigation and Interior Communication Equipment.

1.1 #1,#2 VHF radio telephone

Check the function of VHF by communication test between radio telephone and shore radio.

1.2 GMDSS

1.2.1 Radio control console

Make actual service of the SSB telephone, Telex, NBDP and DSC to verify functions.

1.2.2 Inmarsat C

Check the function of equipment by telegraph communication test.

1.3 Inmarsat F

Make communication test of telephone, telegraph and telex to check function, test the extending alarm panel either.

1.4 NAVTEX

Check the function of equipment by receiving navigation messages.

1.5 Weather fax

Check the performance of equipment by receiving weather fax-picture.

1.6 Magnetic compass

Rectify and confirm the divergence of magnetic compass.

1.7 Gyro compass

Use azimuth circle at port & starboard sides to observe the reading of the fold sign azimuth at the compass fold sign side.

1.8 GPS navigator

Use GPS navigator to orient 2-3 times on chart during trial, print the orientation data, compare with the other orient methods to estimate if this equipment works normal.

1.9 Doppler log

1.9.1 The rectification for the log speed should be carried out in the speed measure field moreover the sea condition should be good either.

1.9.2 Choose a speed and a suitable distance to measure speed, calculate the average speed, average actual speed and the compensating value of the speed.

1.9.3 Modify the errors according to specification.

1.10 Echo sound

1.10.1 Check the zero line and adjust the draft line to the draft depth of this ship.

1.10.2 Compare the readings of the echo sound and the chart (minus and plus the depth of the spring tide) at the sea area of about 15m deep.

1.11 Radar

1.11.1 Let a small ship sail slowly in a circle round our ship that the distance between us is 0.6 sea miles, use the azimuth circle and the X-band and the azimuth circle and the S-band to observe the orientation of the small ship separately, and record at intervals of 10 degree, then work out the arithmetic mean value of the difference of these two azimuth values so as to check whether it is normal or not.

1.11.2 In the sea trial, connect the ARPA device to the X-band and S-band separately, observe that whether it could normal work or not. Setting the distance of the guard circle, let the small ship heading to our ship to do the guard alarm test.

2 Main Power Station Failure Test.

2.1 The stand-by main generators start automatically and power supply test.

This test applied to prove the function of the stand-by generators start automatically after the MSB failure, and the function of the electrical equipment programming starting which set in advance after power recovered.

2.2 The emergency generators start automatically and power supply test.

This test applied to verify that when the MSB failure, the emergency generator can start automatically and feed every emergency consumers, and prove the reliability of the start automatically function.

3. The general emergency alarm & fire alarm sound test.

The buzzers and the bells of the general emergency alarm and fire alarm should be tested to confirm that it could be hear in engine room and everywhere of accommodations.

Furthermore, fire alarm test to be carried out with smoke or electric heater during Sea Trials.

4. M.G.P.S Test

Efficiency test