

一、船体部分航行实验 sea trials for Hull part

1. 航速试验（船装计程仪法）： speed trials(log to be provided on board)

a. 试验条件 sea trials condition:

试验海区有足够的助航距离和回旋余地。

sea trial area to be larger enough for navigation and making circle.

风力不超过蒲氏 4 级，海浪不超过 3 级，潮流平稳。

wind speed to be not over Beaufort 4 grade, wave not over 3 grade, tide smoothly
在压载状态下测速。

The tug to be tested speed in ballast condition

b. 试验内容及程序： sea trials content and procedure

一次双程往返，主推进马达 100%转速（1600rpm）。

One double trip at M/E 100% revolution(1600rpm)

一次双程往返，主推进马达 90%转速(1440rpm)。

One double trip at M/E 90% revolution(1440rpm)

一次双程往返，主推进马达 75%转速(1200rpm)。

One double trip at M/E 90% revolution(1200rpm)

2. 停船试验 stopping trials:

a. 试验条件： sea trials condition

试验海区有足够的助航距离和回旋余地。

sea trial area to be larger enough for navigation and making circle.

风力不超过蒲氏 4 级，海浪不超过 3 级，潮流平稳。

wind speed to be not over Beaufort 4 grade, wave not over 3 grade, tide smoothly
在压载状态下测速。

The tug to be tested speed in ballast condition

b. 船舶保持正舵，测定主机在半速正车、全速正车情况下自停车令发出至船舶停止前进时船舶滑行距离和滑行时间以及观察船舶方位变化。

With the vessel proceeding ahead on a straight course at full power and half power the main engine controls are to be moved from 'full ahead' to 'stop' and the following records taken:

1) Time to move controls from 'full ahead' to 'stop'

2) Estimate of distance run between initiation of order and stopping of vessel.

3) Change of ship azimuth.

- c. 船舶保持正舵，测定主机在半速倒车、全速倒车情况下自停车令发出至船舶停止后退时船舶滑行距离和滑行时间以及观察船舶方位变化。

With the vessel proceeding astern on a straight course at full power and half power the main engine controls are to be moved from 'full astern' to 'stop' and the following records taken:

- 1) Time to move controls from 'full astern' to 'stop'
- 2) Estimate of distance run between initiation of order and stopping of vessel.
- 3) Change of ship azimuth.

3. 回转性试验: turning performance

a. 试验条件: trials condition

试验海区有足够的助航距离和回旋余地。

sea trial area to be larger enough for navigation and making circle.

风力不超过蒲氏 4 级，海浪不超过 3 级，潮流平稳。

wind speed to be not over Beaufort 4 grade, wave not over 3 grade, tide smoothly

在压载状态下测速。

The tug to be tested speed in ballast condition

- b. 船舶在主推进马达 90% 转速(1440rpm)下，在预定航向上稳速直航 2~3min，按规定操舵至 35° 或允许最大舵角，待船首向角变化达到 540° 时，即一个回转试验结束。测定回转直径、时间和最大横倾角。按相同程序反方向操舵进行下一个回转试验。

- c. 在回转过程中，连续记录时间、航速、首向角、横倾角，测量船舶在转动 90°、180°、270°、360° 时所需时间和坐标。

4. 侧向推进器试验 bow thruster trials

船舶为零航速时：开动首侧推，在其最大功率时，测量船首向角变化，记录时间，连续试验 3~5min;

船舶为低航速时：将舵置于满角，开动首侧推，在其最大功率时，测量船首向角变化，记录时间，连续试验 3~5min;

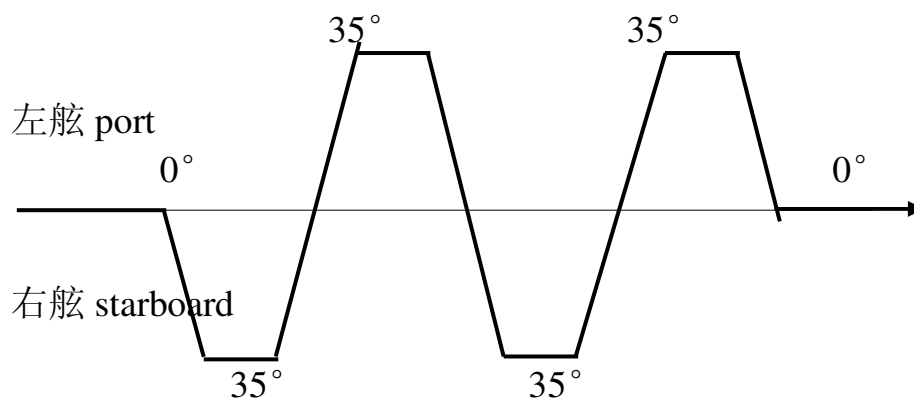
5. 操舵试验 Steering Trials

- (1) 条件：与航速试验同。

Condition: steering trials is to be carried out in conjunction with speed trials.

- (2) 船舶前进（主机转速约 1200 rpm）时，在驾驶室按下图操纵舵桨：

With the vessel proceeding at M/E 1200rpm, the helm to be operated in wheelhouse according to the following drawing:



记录从一舷 35° 到另一舷 35° 所需时间，及船舶的最大横倾角。

A total time taken to complete the manoeuvre: from 35 degrees port to 35 degrees starboard t, is to be recorded. The max. bank angle to be also recorded.

机旁操舵(应急舵)试验与上述试验相似，角度为 15°

The manoeuvring trials at local to be carried out same as the above and the rudder angle to be 15° .

6. 航向稳定性试验 course steady trials

- (1) 舵角不变，测量航向变化：保持正舵全速不变，隔 20S 测量罗径读数，连续 3~5 次。顺水、逆水各 1 次。

Course change to be measured with anchor angle kept steady and course to be measured: with the vessel full ahead on straight course, the compass records to be taken every 20s for 3-5 times. The above trials to be carried out for one time in downstream and counter current respectively.

- (2) 航向不变，测量操舵情况：在全速直航情况下，为保持航向不变，检测操舵次数和最大操舵角。时间为 3min，顺、逆水各 1 次。

Manoeuvring trials to be measured with steady course: with the vessel full ahead on straight course, the time of manoeuvring and max. manoeuvring angle for keeping course steady to be recorded. The trials to be lasted for 3 min. The above trials to be carried out for one time in downstream and counter current respectively

7. 抛锚试验: anchoring test

- a. 左锚、右锚分别抛出 1 次，在抛锚过程中刹车 3 次，检查刹车可靠性。

Port and starboard anchors are to be laid out for one time respectively, during this trials, brake reliability to be checked for three time.

- b. 锚抛定后，用甲板拏链器定位锚链，再用微速倒车将锚链拉紧，检查拏链器的可靠性。

chain cable to be located by Deck chain cable stopper and to be tightened by slow astern. The stopper reliability to be checked.

- c. 启动锚机收起左锚、右锚，破土后测量起锚速度。锚收妥后，检查锚与船体的贴合情况是否良好。

Starting anchor windlass to lift Port & starboard anchors and speed record after breaking ground is to be taken. The condition of joint between anchor and hull to be checked after anchor to be in anchor pocket.

- d. 在抛锚和起锚过程中应做如下检查: The following checks to be taken

锚链和卸扣通过锚链筒、拏链器和链轮的情况，锚链通过链轮时应无过分跳动和翻链现象。

The conditions for chain cable and shackle through hawser pipe, chain-stopper and chain wheel to be checked during trials. Improper jumping and reverse cable are not allowed when cable chain through chain wheel.

锚链冲水装置的冲洗效果是否良好。

Washing for Chain cable to be checked.

检查各运动部件是否有异常发热、敲击等现象。

All movable parts to be checked for abnormal heating and knocking.

7. 系柱拖力试验 bollard pull test

- (1) 条件: 吃水约 3.0 米，航道水深为尾吃水的 2 倍以上水深，风速小于 3 m/s，任何方向的水流速度不超过 1 节。

Trials ambient condition: the draft to be 3.0m, the water depth of the sea-route to be more 2 times than that of stern draft, wind speed to be less than 3 m/s, flow speed to be not more than 1 knot.

- (2) 试验在较开阔的水域进行，船离岸要有足够的距离，以避免岸壁效应。

The bollard pull test to be carried out in larger sea area and the distance between shore and tug to be enough to avoid quay effect.

(3) 试验水域码头上必须配备有适合本船最大系柱拖力的缆桩（约为 50 吨）。

The dock bollard should be suitable for the requirement pull test(max bollard pull to be about 50t.)

(4) 试验时主机转速和航向必须稳定，船上拖索必须成一直线，舵、桨处于中央位置。

During the test, M/E speed and sailing course to be steady, and towing line to be in straight, rudder and propeller to be at middle position.

(5) 用拖钩作拖力试验. Bollard pull test by towing hook

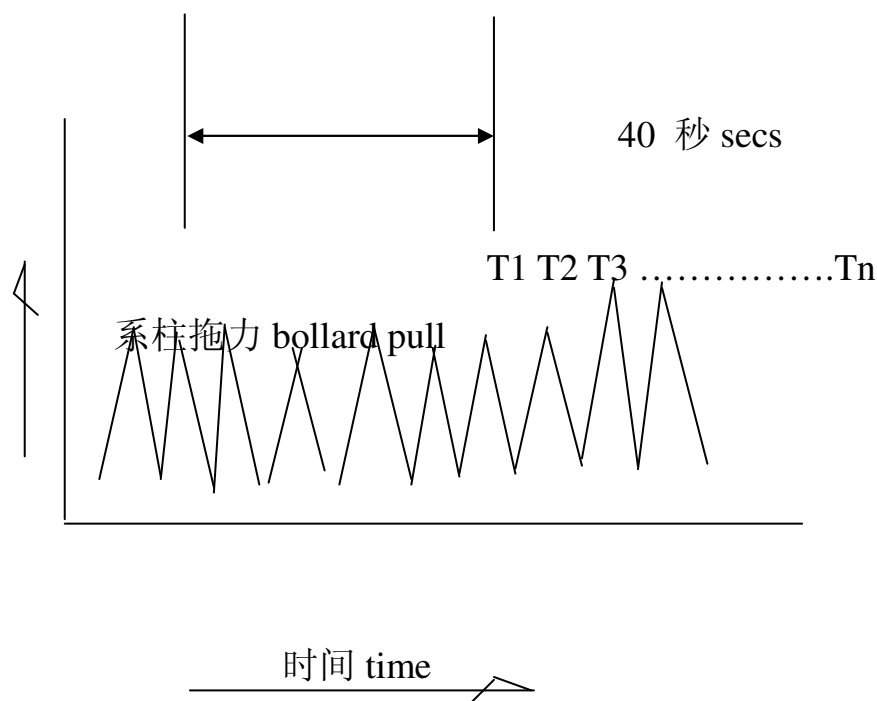
用直径 42mm 的钢缆一端挂于拖钩,一端系于码头系缆桩上,用记录仪测试.

One end of steel line $\Phi 42\text{mm}$ to be hung on towing hook and the other end of steel line to be tied on the dock bollard. The bollard pull test to be recorded by track meter.

主机转速 M/E speed 1000 rpm 1200 rpm 1400 rpm 1600 rpm

试验结束绘制拖力曲线，从中求出最大拖力值。

The max. pull value to be get from bollard pull curve taken from the above test results.



$$\text{最大平均系柱拖力 max. average bollard pull} = \frac{T_1 + T_2 + T_3 + \dots + T_n}{n}$$

二、轮机部分航行实验 sea trials for machinery part

海上试验应在系泊试验完成后进行且应包括以下各项:

The following sea trials are to be arranged and carried out after finishing the dock test.

1) 验证主副机包括监测、报警和安全系统在实际使用条件下的正常运行.

Test the efficiency of supervise system, alarm and safety system for main and auxiliary engines in common running condition.

2) 当其中一台重要副机变的不能运行时, 对推进能力的效核.

Test and adjust the propulsion ability when one unit key aux. engine failure.

3) 在需要时, 通过读取必须的数据来检测危险的振动.

Inspect danger vibration by read relevant data in case of need.

除非实际上不可能, 或在应予个别考虑的其他情况下, 否则海上试航应在尽可能接近其载重量(满载)或此载重量的一半(半载)的排水量之下进行.

The above sea trials to be arranged and carried out with approach deadweight (full load) or half the deadweight(half load), except un-practice or considering other especial condition.

2.1 主机、轴系及舵桨的运行试验 M/E, shafting system and rudder propeller running test

2.1.1 主机的运行试验 M/E running test

(1) 主机试验的工况及时间按下表 (r/min)

test condition according to below requirements:

序号 no.	转速(对额定转速%) speed(rated speed %)	转速(r/min) speed	时间 (h) time	舵桨角度 rudder angle
1	70%	1120	0.25	0°
2	87%	1392	0.25	0°
3	(常用功率转数) ~95% (common power rev.)	1520	1	0°
4	100%	1600	2	0°
5	103.2%	1651	0.25	0°
6	(倒车)70% (astern)	1120	10min	

试验应连续进行，中间因故停止时间一般应不超过 15min

The test to be carried out continuous, and the interval not more than 15min.

- (2) 检查各部分的运转情况，在额定工况时每隔 0.5h~1h 测量并记录燃油、滑油、冷却水、排气温度、爆发压力等数据，其它工况在各档试验结束后即行测量并记录。

Checking the parts running condition. F.O., L.O., cooling FW, exhaust temperature, break mean effective pressure etc. to be measured and recorded every 0.5h~1h. Other running conditions to be measured and recorded instantly.

- (3) 为主机运转服务的各系统的备用泵，辅助设备及海底阀等应进行替代使用，使用时间可各占约二分之一的时间。

Stand-by pump, assistant equipments and sea chest to be tested, and the time to be not less than half test time.

- (4) 测定主机不带负荷时的最低稳定工作转速，并在此转速下运转 5 min。

The lower firm speed of M/E unload to be recorded and the test to be carried out for 5min.

- (5) 对紧急停车装置进行效用试验。

The crush-stop fitting to be tested in efficiency.

- (6) 试验结束后，由工厂整理试验数据，填写试验报告。

The test report to be prepared by the yard according to the test result after test.

注：航行试验前后，主机曲轴的臂矩差应作冷热态测量并记录。

The lever of M/E crankshaft to be measured at cold and hot condition and the record to be taken before and after sea trial.

2.1.2 轴系部分的航行试验 shafting system sea trial

2.1.2.1 按系泊试验所规定的内容进行 according to the requirement of dock test.

2.1.2.2 进行扭转振动试验 torsional vibration test

(1) 试验条件 test condition

- a) 一般应在 5 级风以下进行，螺旋桨全部没于水中，船舶应处于直航状态；

The wind strong to be low 5 grade, the propellers to be immersed into sea water completely, and the ship to be in sailing on straight course.

- b) 主机各缸负荷均匀，各缸爆炸压力的差值应小于 $\pm 5\%$ 。

The cylinders to be have equally loaded, and the difference value of explosion pressure between cylinders to be less than $\pm 5\%$

(2) 扭转振动试验 torsional vibration test

- a) 测量应变的仪器，测点应布置在节点处。测量角位移的仪器，测点应布置在曲轴自由端。如果曲轴自由端布置测点有困难时，可把测点布置在轴系上相对振幅较大处。如果两个振型的不同共振转速相近而相互干扰时，则除了在自由端布置点外，还应在轴系其它位置上布置测点，以便把不同振型的振幅分开。

The instrument used to measure change to be located at node point. The instrument used to measure angle displacement to be located at free end of crankshaft, or the point which having larger swing on shafting system. If the two vibration models which having similar resonance speed to disturb each other, the measure point to be arranged not only at free end, but at other point on shafting system to division two different swings.

- b) 测试时，主机从最低稳定转速开始到额定转速为止，转速分档进行测量，在共振区附近，转速间隔应适当减少，应与机架振动测量时同步进行。

M/E speed to be measured from lowest firm speed to rated speed running, and engine bedplate vibration to be measured at the same time, speed interval to be suitable reduce around resonance area.

- c) 对装有高弹性联轴器的轴系，测试时应注意防止在共振转速时由于过大的振动扭矩而造成弹性联轴器受损，如计算时发现存在上述现象时，则应迅速越过。

Damage to flexible couple should be avoided because of over large vibration torque during trial.

(3) 试验记录 test record:

扭转振动试验，每一转数各测点的简谐次数、振幅或应变、固有频率、各轴的扭振应力、各弹性连接的振动扭矩，作出应力/扭矩-转数曲线图，且加绘其许用值。

Torsional vibration test to be carried out. Simple harmonic times, swing or crash change, fitted frequency at each measure point, torsional vibration of shafts, vibration torque of flexible connection to be recorded, and curve of stress/torque-revolution to be drawn and allowed value to be taken.

2.1.3 舵桨的附属设备的航行试验 accessory equipments test

(1) 舵桨的航行试验 rudder propeller trial

说明：有关舵桨的操舵试验见总体有关部分。

Note: for the steering trial to see the general part in sea trial.

推进装置在主机额定转数连续运转 2 小时，每隔 1 小时记录下舵桨的附属设备的压力、温度、试验时间，温度不得超过预定值，机械部分的振动不得超过一般接受的程度。试

验结束后，由工厂整理试验数据，填写试验报告。

Propulsion equipment to be tested against M/E running at rated speed for 2 hours, and the pressure, temperature, test time to be recorded. When sea trial, the propulsion equipment temperature is not allowed over schedule value, and machinery vibration is also not allowed over common acceptable degree. The trial report to be prepared by the yard against the trial result.

(2) 舵桨附属设备的航行试验 accessory equipments test

在船舶航行试验时，按照需要投入工作。According to the sea trial practice requirement.

(3) 机旁操舵试验和驾驶台手动试验.

Steering control in local and in wheelhouse.

2.2 柴油发电机组的运行试验 diesel generator running test

船舶进行航行试验时，各柴油发电机组应互相替换配合主机工作。电站的自动控制系统（包括报警等装置），在试航试其功能和动作应准确可靠。在船舶每种工况时应测量并记录柴油机的油、水、气的温度和压力。

When sea trial, all the generator unit should be displaced each other to cooperate with M/E running. Auto-control of electric station(including alarm) to be tested for correct and reliability. The temperature and pressure for fuel oil, water and air of diesel engine to be recorded for each condition.

2.3 其它辅助设备和系统的运行试验 other aux. machinery and system

在船舶航行试验时，按照需要投入工作。According practice requirement of sea trial.

2.4 侧向推进器试验 side thruster test

- 1) 试验条件 a..船舶处于停航（航速为零）或低航速 trial speed to be zero or low
test condition b.试验海区有足够的助航距离和回旋余地 sea trial area to be larger
enough for navigation and making circle.
c.风力不超过蒲氏 4 级，海浪不超过 2 级，潮流平稳 wind power not
over Beaufort 4 grade, wave not over 2 grade, tide smoothly
d.船舶处于压载状态 ballast condition

2) 试验内容及程序 test content and process

- a. 船舶为零航速时，when trial speed to be zero

开动船艏侧向推进器，在其最大功率时测量船艏向角变化，记录时间，连续试验 3-5min
Start the bow thruster and record the bow angle and time at max. power. This test to be

continuous for 3-5min

b. 船舶为低航速时，将舵置于满舵角，重复上述试验。

Move the rudder to 'hard over' 35° port or starboard and carry out above test again when low trial speed

c. 根据试验数据，绘制对应情况下船首向角随时间变化的曲线。

The curve of bow angle change against time according to test data to be taken.

3.5 拖力试验结束后，根据具体情况可对一缸进行吊缸检查。

Remove one piston to check according to practice after finishing bollard pull test.

三、电气部分航行试验 sea trials for electrical part

航行试验只有待系泊试验完成并排除所有发现的问题之后方能进行。

The following sea trials are to be arranged and carried out after finishing the dock test and correcting all the defects found in dock trial.

3.1 发电机组及电网运行试验 test for generator and supply system

(1) 船舶进行航行试验时，各柴油发电机组互相替换配合主机工作。并进行并车试验。检查并车时工作是否正常。

When sea trial, all the generator units should be displaced each other to cooperate with M/E running. Parallel running test for generator units to be carried out during sea trial.

(2) 检查三相三线系统各相间负载的不平衡度。

Unbalance loads condition during the phases of three phase three line system to be checked.

(3) 航行结束后测量并记录主配电板的热态绝缘电阻。

Insulated resistance value under hot condition of main switchboard to be measured and recorded after sea trial.

3.2 助航及无线电设备试验 aid navigation and radio equipments test

(1) 磁罗经 magnetic compass

船舶航行中，对磁罗经进行自差校正。

Adjust and rectify compass deviation during sea trial.

(2) 导航雷达 navigation radar

对雷达进行效用试验，并测量雷达的最大作用距离和盲区，检验船艏标志的正确性。

The navigation radar to be tested for efficiency and measured max. distance and dead

area. The bow mark to be checked for correct.

(3) GPS 卫星导航仪 GPS test

对 GPS 作效用试验，检查其工作情况。

GPS to be tested for efficiency and checked working condition.

(4) 测深仪 sounder

对测深仪作效用试验，检查其工作情况。

Sounder to be tested for efficiency and checked working condition.

(5) 甚高频无线电话 VHF radiophone

对甚高频无线电话作效用试验，检查其工作情况。

VHF radiophone to be tested for efficiency and checked working condition.

(6) 中/高频无线电话 M/HF radiophone

对中/高频无线电话进行效用试验，检查其工作情况。

M/HF radiophone to be tested for efficiency and checked working condition.

(7) 航警接收机 NAVTEX

对航警接收机进行效用试验，检查其工作情况。

NAVTEX to be tested for efficiency and checked working condition.

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