SPECIFICATIONS
FOR
MAIN DIESEL GENERATOR ENGINE

(2400 kW ACG x 720 min-1 4 sets/ship)

[redacted]

DAIHATSU DIESEL MFG.CO.,LTD.
TECHNICAL DEPARTMENT
OSAKA JAPAN

HULL NO.		DRAWN BY	K. Shimokawa
ENG. MODEL	8DK–28	CHECKED BY	N. Iwata
LIST NO.	AQA10004479B		
DATE	FEB. 22, 2008	APPROVED BY	
REVISION	B : P.9,10 K.S		

1. GENERAL

These four diesel generators are intended to additionally install in the new engine room aft where built up extendedly to poop deck, for conversion plan to shuttle tanker with dynamic positioning system of Suez-max tanker, and to supply the electric power to additional three thrusters, which consist of bow azimuth-thruster probably retractable, cargo-end azimuth thruster probably retractable and stern tunnel- thruster.

1.1 Rules and Regulations

The diesel generator engine will be complied with the requirements of the following rules and regulations of the latest issue.

1) Det Norske Veritas ..... DNV E0
2)Compliance for Engine Air Pollution Prevention with Marpol, AnnexⅥ,Regulation 13
3) Miscellaneous
The other not specifically mentioned in this specifications will be manufactured on the basis of manufacturer's quality control standard.
4) Country of ship's registry.....

1.2 Conditions

Machinery	ambient temp. +5 to 45℃ cooling sea water temp. 32℃ relative humidity 60 % barometric press. 100kPa
General power source	AC 690 V 60 Hz 3-phase
Control power source	AC 230 V 60 Hz 1-phase and DC 24 V
Starting air source	3.0 MPa
Control air source	0.7 MPa
Heating steam source	0.8 MPa saturated, working

1.3 Installations

Diesel engine will be flexible rubber coupled to the generator and placed together on the common bed.
Diesel generator set should be elastically installed onto the hull structure.

1.4 Pipe connection flanges

Pipe connection flanges which are connected to the shipyard's piping will be provided in accordance with JIS (Japanese Industrial Standard).
Counter-flanges with gasket, bolt and nut will not be supplied by Daihatsu.

1.5 Name and caution plates

Written language : English.
The caution plate will be written in English
Unit : the SI system

1.6 Painting

After coating with anti-corrosive paint in accordance with manufacturer's standard, the finished color will be painted as follows.

Generator engine and accessories.....	Munsell 7.5BG7/2
Electric control panel.....	Munsell 7.5BG7/2
Exhaust manifold cover	Aluminum heat resisting paint

1.7 Plans

Approval plan.....	10 copies
Working plan.....	5 copies
Final plan.....	5 copies of final drawings, instruction manuals and test report for each ship Original of certificate for each ship

1.8 Fuel oil

Heavy Fuel Oil (hereinafter referred to as HFO) .....ISO 8217 F-RMH45
of viscosity up to 600 mm^2/s(cSt) at 50℃
Marine Diesel Oil (hereinafter referred to as MDO)...ISO 8217 DMB or better grade

1.9 Notes for Fuel oil pre-treatment

1) Upon deep deliberation with separator maker, the best centrifugal separation system should be applied.
2) Recommended fuel properties before engine
Aluminum content :＜10 mg/kg
Water content :＜0.2 % by volume
Sodium content :＜50 mg/kg

1.10 Fuel oil when engine starting and stopping

at start and stop..... MDO
at normal operation ..... HFO

Note: In case that the engine is started on HFO, the standby engine needs to be pre-heated up with the circulating jacket water of 70℃.

1.11 Notices for operation

The engine, together with proper external system arrangements, can be operated on the above-mentioned fuel, still:

- fuel oil viscosity at the inlet port of engine should be kept to 14±1.5mm^2/s(cSt) in any case.

- recommendable continuous low load is down to 20% on condition that CCAI (Calculated Carbon Aromaticity Index) of fuel is below 850.

- no load operation on HFO before stopping is proper to as short as possible, less than 5 min.

1.12 Recommended lubricating oil

System oil .....API service grade CD SAE30 TBN30～40
Governor oil .....same as system oil

Supplier	Oil brand
BP	BP ENERGOL IC-HF303
CALTEX	RPM DELO 3000 Marine Oil SAE30
CASTROL	CASTROL TLX 303
CHEVRON	DELO 3000 Marine Oil SAE30
ELF	AURELIA 3030
ESSO	EXXMAR 30TP30 or EXXMAR 30TP30
MOBIL	MOBILGARD 324
PETROBRAS	MARBRAX CCD330
SHELL	ARGINA T30
TEXACO	TARO DP SAE30
TOTAL	HAM SAE30

1.13 Fluid holdings in engine

Lubricating oil .... LO cooler 140 lit. + LO tank 2500 lit. = initial filling quantity about 2640 lit.
(engine in running condition 84 lit.)
Governor oil..... 1.3 lit.
Jacket CW ..... engine 275 lit.
Cooler CW..... air cooler 38 lit. + LO cooler130 lit.

2. PRINCIPAL PARTICULARS

2.1 Type of Engine ..... vertical in-line 4-stroke single-acting non-reversible direct injection trunk piston type with exhaust turbocharger and air cooler

2.2 Type of Generator ..... three-phase synchronous generator, totally enclosed splash-proof type (IP44) air circuit machine with fresh water cooled air cooler, self ventilation, revolving field, salient pole with damper winding, horizontal shaft

Supplier: Daihatsu
Maker: Nishishiba Electric Co.,Ltd.

2.3 Direction of rotation..... clockwise as viewed from generator end

2.4 Control ..... manual start/stop :remote and engine-side
automatic start :managed by switchboard
automatic stop :caused by engine emergency shutdown
synchronization :manual/auto on switchboard and engine-side

2.5 Engine starting method..... compressed air start

2.6 Engine cooling system..... central cooling with 36℃ LT-FW

2.7 Location of Turbocharger..... opposite side to generator

2.8 Camshaft..... built-up type

2.9 Diesel generator data

Engine model	8DK–28
Quantity of cylinders	8
Cylinder bore x Piston stroke	280 mm x 390 mm
Engine rated output	2550 kW
Engine speed	720 min^{-1}
Mean effective pressure	2.21 MPa
Mean piston speed	9.36 m/s
Maximum pressure	≦17.0 MPa
Overload capacity	110% for an hour every 12 hours
Lube oil consumption	0.8g/Kwh (estimate at full load)
Fuel oil consumption *1)	196 g/kWh +5%

Generator capacity	3000 kVA
Generator rated output	2400 kW
Power factor	0.8 lagging
No. of poles	10
Voltage Phase Frequency	AC 690 V 3-phase 60 Hz

Quantity of DG set	Four(4) sets/ship
Parallel running	Fellow Diesel-Generators, Not worked with general service generators

*1)Fuel oil consumption is based on the engine output (kW) at crankshaft-end using fuel lower calorie of 42700kJ/kg, under 100% generator load, on condition that the engine drives each one (1) of LO pump and CW pump.

3. SPEED GOVERNING SYSTEM

3.1 Engine fitting (each 1 set/engine)

Governor .....Electric control mechanical-hydraulic type
Woodward made model UG-25+

3.2 Separate accessory (installed on hull part by shipyard): NONE

3.3 Reference data for External system

Sudden load steps .....0→38→69→100%: 3 steps
Sudden off-load step .....100→0%
Speed variations .....within 10% momentary and within 5% permanently
Speed stabilized time .....within 5 seconds

When a four-stroke diesel engine with high supercharge is used as the prime mover for driving generator, application of electrical load in more than 2 load steps can be permitted in its governing characteristics by classification society. In this case, it is considered in the designing stage that where the electric station being automatically switched on after blackout and to the sequence in which it is connected, the load value is not to exceed the value of specified in 1st load step.
This also applies analogously for generators to be operated in parallel and where the power has to be transferred from one generator to another in event of any one generator has to be switched off.

4. CHARGE AIR / EXHAUST SYSTEM

4.1 Engine fitting (each 1 set/engine)

Exhaust turbo-charger.....Mitsubishi Heavy Industries, Ltd. made
model MET30SR
with cleaning device of compressor and turbine side
Air cooler.....tube with fin type fresh water cooled

4.2 Separate accessory (installed on hull part by shipyard)

Exhaust expansion joint.....for exhaust gas turbocharger outlet
stainless steel bellows with both end flanges
size 450A x 550A
(1 pc./engine)

Exhaust silencer .....vertically installed, expansional attenuation type
with spark arrestor
connection size 550A, attenuation Δ 15dB(A)
(1 pc./engine)
Exhaust noise level O.A.125dB(A)+2dB(A) tolerance

4.3 Reference data for External system

Fresh air outlet from ventilator.....to be located near the turbocharger air inlet
Required combustion air.....17400 m^3 at 25℃ per one(1) engine
Charge air temp. before cylinders .....operation 45 - 55℃
Exhaust gas volume .....16800 m^3 normal/h per one(1) engine
Exhaust gas temp. at T/C outlet.....approx.380℃
Permissible exhaust gas back press. .max.300 mmAq

5. FUEL OIL SYSTEM

5.1 Engine fitting (each 1 set/engine)

MDO feed pump	engine driven trochoid type 1.3 m^3/h x 0.7MPa	
Fuel oil final filter	notch wire duplex type with manual blow off device 200 mesh	
Press. relief valve	at oil return pipe end	Δp=0.1 - 0.2 MPa
Pressure damper	on oil inlet and outlet pipe	

5.2 Separate accessories (installed on hull part by shipyard): NONE

5.3 Reference data for External system

MDO service tank height	low alarm level is to be higher than the cylinder cover top of engine	
HFO pre-treatment with centrifugal separators	Aluminum content: $<$10 mg/kg Water content: $<$0.2 % by volume Sodium content: $<$50 mg/kg	
HFO pre-boost (supply) pump	$\geqq$0.71 m^3/h per one(1) engine discharge: 0.5 MPa suction: static	
HFO booster (circulation) pump	$\geqq$1.95 m^3/h per one(1) engine discharge: 1.0 MPa suction: 0.4 MPa	
HFO pre-boost press.	nominal	0.4 MPa
HFO press. before engine	nominal	0.7 MPa
HFO press. before fuel inj. pump	operation	0.5 - 0.6 MPa
	low alarm	0.35 MPa
HFO press. after engine	nominal	0.4 MPa
MDO press. before feed pump	nominal	static
MDO bypass-line relief valve	nominal	set 0.7 MPa
MDO press. after bypass-line relief valve	nominal	static
MDO press. after engine	nominal	0.4 MPa
Fuel viscosity before fuel inj. pump	operation	14$\pm$1.5 mm^2/s(cSt)
Pump suction strainer	absolute	60 - 100 mesh (0.22 – 0.14 mm)
Automatic backwash filter	nominal	10 micron (absolute 25 micron)
Bypass strainer	absolute	350 mesh (absolute 40 micron)
Engine built-on filter	absolute	200 mesh (absolute 75 micron)

6. NOZZLE COOLING MDO SYSTEM

Jacket C.W. branching system

7. COMPRESSED AIR SYSTEM

7.1 Engine fitting (each 1 set/engine)

Starting operation valve	for manual start at engine-side
Main starting air valve	starting air control to engine
Starting air rotary valve	for the pilot air distribution to starting valve

7.2 Separate accessories (installed on hull part by shipyard):

Auxiliary air reservoir capacity	400 lit. x 3.0MPa two(2)sets/ one(1) ship

7.3 Reference data for External system

Starting air source	nominal	3.0 MPa
	operation	1.5 – 3.0 MPa
	minimum	1.2 MPa

Starting air consumption.....remote start 1.4 m^3 normal/one(1) time
Control air pressure .....operation 0.6 - 0.9 MPa
Control air consumption.....negligible small
Control air for initial engine start.....air of 0.6 – 0.9 MPa is indispensable for control system.

8. LUBRICATING SYSTEM

8.1 Engine fitting (each 1 set/engine)

L.O. suction strainer.....punching board type of 3 mm holes built in L.O. tank
L.O. pump.....engine driven gear type
41 m^3 /h x 0.65 Mpa
L.O. cooler.....multi-tubular type fresh water cooled
L.O. thermostatic valve.....wax type with hand operating bypass device
L.O. relief valve.....bearing line setting pressure 0.40 - 0.55 Mpa
L.O. filter .....notch wire duplex type with manual blow off device
200 mesh
L.O. tank.....incorporated in common bed capacity 2500 lit.
continuous purification
Turbocharger L.O. filter .....notch wire duplex type with manual blow off device
280 mesh
L.O. bypass filter.....self-rotating glacier type
FM200 x 2
L.O. priming pump motor driven gear rotary type
electric source : AC690V 60Hz 3-phase, to be fed from general service source due to continuously priming during engine rest.
motor enclosure : IP44(TEFC)
motor insulation : class F
pump : 5 m^3 /h x 0.4 Mpa
motor : 2.2 kW

8.2 Separate accessories (installed on hull part by shipyard): NONE

8.3 Reference data for External system

Bearing L.O. pressure	operation	0.40 - 0.55 MPa
	low alarm	0.25 MPa
	safety stop	0.20 MPa
Turbocharger L.O. pressure.....	operation	0.06 - 0.15 MPa
	low alarm	0.06 MPa
L.O. temperature of engine inlet	operation	50 - 60℃
L.O. centrifugal separator for batch purification	actual flow ≧ 5100 lit./h per ship treatment temp. 95 ℃	
Overflow tank capacity	6.0 m^3/ship	

9. COOLING WATER SYSTEM

9.1 Engine fitting (each 1 set/engine)

Cylinder CFW pump .....engine driven centrifugal type
80 m^3/h × 25 m TH
Engine pre-heating piping
at engine inlet.....screw-down non-return valve for external heating system

Cylinder CFW temp. control valve ....set 70℃ at engine inlet

9.2 Separate accessories (installed on hull part by shipyard)

Engine pre-heating water unit	Electric FW heater (48kW) with thermostat setting 75℃ Pre-heating FW Pump (10.8 m^3/h x 14mTH) Electric source AC690V to be fed from general service due to continuously priming during engine rest for prolong engine parts life (2 sets/ship)

9.3 Reference data for External system

FW expansion tank height	tank bottom higher 3 – 10 m than crankshaft center	
FW expansion tank net capacity	min. 1700 lit. per one(1) ship	
Cooler CFW required flow	90 m^3/h per one(1) engine 26.4 m^3/h per one(1) generator	
Cooler CFW pressure	operation	max. 0.2 MPa
Engine coolers flow resistance	approx. 10 mAq	
Cooler CFW temp. of engine inlet	control	36℃
Cylinder CFW pressure of cyl. inlet	operation	0.25 - 0.35 MPa
	low alarm	0.15 MPa
Cylinder CFW flow resistance	approx. 7 mAq	
Cylinder CFW temp. of engine inlet	control	70℃
Cylinder CFW temp. of engine outlet	high alarm	85℃
	safety stop	90℃

10. SAFETY DEVICE

10.1 Engine fitting (each 1 set/engine)

Cylinder safety valve	equipped on each cylinder head with Max. pressure gauge connection
Crankcase relief valve	equipped properly on the side-cover
Rupture disc and non-return valve	toward back fire in starting air system

11. SUNDRY

11.1 Engine fitting (each 1 set/engine)

Step	on FO injection pump side
Flywheel turning device	reduction gear type with electric motor drive motor output 0.4kW, AC690V 60Hz 3-phase
Shaft-coupling	flexible coupling with flywheel, isolation rubbers and inertia plate
Flywheel guard	steel plate fabrication
Exhaust manifold cover	steel plate fabrication with inside lagging
Common bed	welded steel plate fabrication
Rubber mounting	conical type
Jack bolts	screwed into the common bed
Flexible hose	for each connection between engine and hull side

11.2 Separate accessories (installed on hull part by shipyard)

Turning motor starter	wall hung panel with wired switch box power source of AC690V 60Hz 3-phase to be fed from general service (1 set/engine)

12. ENGINE GAUGE BOARD Engine fitting consists of following indicators

Engine tachometer .....direct measuring mechanical type
Pressure gauge.....direct measuring bourdon tube type, glycerin filled
graduation : MPa
each one(1) of; Charge air
Fuel oil
LO
T/C LO
Cylinder CFW
Cooler CFW

13. LOCAL THERMOMETER Engine fitting of direct measuring liquid filled glass stem type

Charge air..... intake manifold
Exhaust gas..... each cylinder outlet
turbo-charger outlet
Fuel oil ..... engine inlet
Lube oil..... engine inlet
L.O. cooler inlet
Cylinder CFW.... engine inlet
engine common outlet
Nozzle CFW..... engine outlet
Cooler CFW..... air cooler inlet
L.O. cooler inlet
L.O. cooler outlet

14. CONTROL SYSTEM

14.1 Engine fitting (each 1 set/engine)

Remote start magnetic valve.....DC24V 15W
Fuel shutdown device.....DC24V 15W
for fuel control in process of starting
Remote stop magnetic valve.....DC24V 15W
for the fuel shutdown device of control
and safety system
FO injection pump fuel-cut magnetic valve DC24V 15W
for cylinder fuel cut device of safety system
Handle switch .....for remote start stand-by
Turning safety switch.....for remote start stand-by
Engine speed sensor.....pulse sensing type
Engine speed switch unit.....signal output for Low-speed and Over-speed
(installed into Engine local control panel)
Turbo-charger revolution indicator unit.....pulse sensing type with amplifier indicator
signal output for Over-speed
(installed into Engine local control panel)
Exhaust gas temp (automatic stop) *1.....over 530℃ at each cylinder outlet
over 100℃ deviation from average B
LO press. switch(automatic stop).....0.20MPa
Over-speed switch(automatic stop).....112 – 115% by Speed switch
Cylinder CFW temp. switch(automatic stop) ....90℃
Crankcase oil-mist detector(automatic stop)....mist concentration too-high

FO inj. pipe leakage level switch(H. alarm).....high level alarm in the leakage box
LO sump tank level switch(L. alarm) .....too low
LO T/C press. switch(L. alarm) 0.06MPa
Crankcase oil-mist detector .....mist concentration high
Turbo-charger revolution(H. alarm) .....29400 min^{-1}

*1 : Shut down signal for exhaust gas each cylinder outlet temp. and deviation from average(Normal open) are to be provided from alarm monitoring panel to Engine local control panel(Daihatsu supply) by shipyard. B
Please consider that shut down signal should be canceled when the sensor malfunction or wire-break occur.
Deviation alarm/shut-down signals are to be canceled when the average temp. is below 250℃.

14.2 Separate accessories (installed on hull part by shipyard)
Engine local control panel .....on-deck mounted/wall supported type enclosure of IP44
Engine start/stop control circuit
Power source : AC230V/DC24V
this panel is to be installed near engine
AVR for generator and Turbo-charger revolution unit is installed.
2 sets/ship (1 panel/2 engines)

15. MONITORING SYSTEM

15.1 Engine fitting

15.1.1 Pressure transmitter DC 24V output 4 - 20mA in proportion to the scale range

measuring point	scale range	Normal operation	alarm setting	Q'ty/eng
LO engine inlet	0 – 1.0 MPa	0.40 – 0.55 MPa	0.25 MPa low	1
High temp.FW engine inlet	0 – 0.6 MPa	0.25 – 0.35 MPa	0.15 MPa low	1

15.1.2 Thermo-resistance bulb Pt100 R100/R0=1.3850

measuring point	scale range	Normal operation	alarm setting	Q'ty/eng
LO engine inlet	max. 200℃	50 – 60℃	65℃ high	1
High temp. FW engine outlet	max. 200℃	70 – 80℃	85℃ high	1
Exh. gas T/C outlet	max. 700℃	<480℃	500℃ high	1
Exh. gas each cly. outlet	max. 700℃	<480℃	500℃ high	8
	Deviation alarm from average : Over 50℃ *2			

*2 : Deviation alarm is to be canceled when the average temp.is below 250℃.

15.4 Separate accessories (installed on hull part by shipyard): NONE

Analog signal extension shall be led directly to ship's monitoring system.

16. SPARE PARTS & TOOLS

16.1.1 Spare parts according to the class recommendation

Item	Spare parts	Spare qty/ship
Main bearing	Bearing shell	1 bearing
	Bolts and Nuts	
Thrust bearing	Bearing metal	1 bearing
Cylinder valves	Exhaust valve complete	2 cylinders
	Air intake valve complete	1 cylinder
	Starting air valve complete	1 cylinder
	Relief valve	1 cylinders
	Fuel injection valve complete	1/2 engine

Connecting rod bearings	Crankpin bearing shell	1 bearing
	Crankpin bearing bolts	
	Piston pin	
	Piston pin bush	
Piston rings	Piston rings	1 cylinder
	Oil rings	
Fuel injection pump	Fuel injection pump complete	1 cylinder
Fuel injection piping	High pressure pipe with joint	1 cylinder
Gaskets and Packings	Special gaskets and packings of each size and type fitted for cylinder cover and cylinder liner	1 cylinder

16.1.2 Daihatsu's standard spare parts, added to the class recommendation

Item	Spare parts	Spare qty/ship
Thermometer	Glass stem type of each size	1 pc.
Oil seal and Mechanical seal	each size	1 pc.
Special gaskets and O ring	each size	1 cyl. or 1 pc.
Ball bearing	each size	1 pc.
Spring except above	each size	1 cyl. or 1 pc.
Exhaust gas turbocharger	maker standard spare parts	1 engine

16.2 Tools

Item	qty/ship
Insert guide for piston	1
Remover/Setter for cylinder liner	1
Remover for valve spring	1
FO nozzle spanner	1
Remover/Setter pin for main bearing shell	1
Hanging bolt for cylinder head	1
Remover for FO nozzle holder	1
Injection test connector for FO nozzle holder	1
Remover for FO nozzle	1
Setter for valve stem seal	1
Jig for cooling valve seat	1
Oil press. ram for main bearing cap	1
Valve seat rubbing tool	1
Oil pressure jack for hydraulic tightening bolt	1
Oil pressure pump for hydraulic tightening bolt	1
Remover for protect ring	1
Hanging bolt for piston	1
Special spanner	1
Nozzle cleaning tool	1
Maximum pressure gauge	1
Cylinder bore gauge & measure-position gauge	1
Nozzle test pump	1
Crank web deflection gauge	1
Turbocharger blower syringe	1
Turbocharger turbine cleaning device	1
Exhaust gas turbocharger standard tools	1

17. SHOP TRIAL

The shop trial should be performed in accordance with requirements of classification society. The diesel generator engine should be run to couple up a generator unless particular reasons, and to use Marine Diesel Oil for fuel. The load facility is of water resistance.
Details will be described in "SHOP TRIAL PROCEDURE".

17.1 Test & inspection items

17.1.01 Measurement of Crank deflection
Crank deflection should be measured in cold condition before running.

17.1.02 Starting test
The number of starting times and the minimum starting air pressure will be recorded by using of an accessory air reservoir or shop's one, testing from cold condition.

17.1.03 Load test
Under each load rate described afterward, engine data such as fuel consumption, pressure, temperature should be measured and recorded.

17.1.04 Measurement of Bearing temperature
After running, Main bearing and Crankpin bearing should be taken temperature.

17.1.05 Working test for protecting device
In case that the remote control panel is in our supply scope, its working should also be demonstrated.

17.1.06 Generating characteristic test
Voltage and frequency should be measured and recorded when generator output (kW) is changed in order of 100%, 75%, 50%, 25%, 50%, 75%, 100%, 110% and 100%.

17.1.07 Governor test
Momentary and permanent speed variations and the speed recovery time to steady speed should be confirmed to be controlled within requirements of classification and recorded, when full load is suddenly taken off or, when load is suddenly applied with loading steps approved by classification society. Speed variations are measured by the frequency meter.

17.1.08 Parallel running test
After setting the load (kW) of each generator to 75%, each generator output (kW) will be measured and recorded when total combined load is changed in order of 75%, 100%, 80%, 60%, 40%, 20%, 40%, 60%, 80%, 100% and 75%.
Load sharing is to be such that the load on any generator does not normally differ from its proportionate share of the total load by more than 15% of the rated output (kW) of the largest machine or 25% of the rated output (kW) of the individual machine, whichever is less.
Parallel running test should be done at least with 2 (two) engines.

17.1.09 Manual voltage change test
Using the voltage control rheostat which is supplied by generator maker, the range of voltage control will be recorded.

17.1.10 Frequency change with governor motor
Frequency change speed will be confirmed to be 8 – 12 s/Hz and recorded.

17.1.11 Remote starting test
In case that the remote control panel is in our supply scope, remote starting should be demonstrated.

17.1.12 Measurement of torsional vibration

The previous measured data of the same diesel generator installation will be submitted. If it were not for such data, torsional vibration should be measured only on one (1) engine of the first ship.

17.2 Open-up inspection

One(1) cylinder per ship will be opened up and items of its cylinder should be inspected as below.

-Cylinder cover
-Intake & Exhaust valve
-Piston (Piston rings will be fitted as it stands.)
-Connecting rod
-Crankpin bearing
-Crankpin bolt

One(1) main bearing per ship will be opened up and inspected.

17.3 Attendant schedule

X: attend

Test & Inspection items		Customer witness	Manufacturer
1) Measure of Crank deflection			X
2) Starting test			X
3) Generator load (kW) test including fuel consumption measurement at each load	25% x 20 min.		X
	50% x 20 min.		X
	75% x 20 min.		X
	100% x 60 min.	X	X
	110% x 20 min.		X
4) Measure of Bearing temperature			X
5) Working test of Protect device	Emergency trip	X	X
	pre-alarm		X
6) Generator characteristic test			X
7) Governor test			X
8) Parallel running test			X
9) Manual voltage change test			X
10) Frequency change test with governor motor			X
11) Remote starting test with remote control panel			X
12) Open-up inspection		X	X
13) Measure of Torsional vibration			X
All of above data should be submitted to customer.			