

SECTION 1 GENERAL DESCRIPTION

1.1 **GENERAL**

The vessel shall be arranged for single screw propulsion with directly coupled diesel propelling machinery located in the engine room aft.

The main propulsion unit shall consist of one (1) set marine diesel engine, driving a propeller through a line of shafting.

The main engine shall be able to use the heavy fuel oil of 600 cSt at 50°C . The aux. boiler shall be able to use the heavy fuel oil of 380 cSt at 50°C .

The main diesel generator engine shall be able to use the heavy fuel oil of 600 cSt at 50°C. Fuel oil is able to be used at starting, stopping, low load condition and furious load change condition of diesel gene. engine in accordance with the engine operation manual.

The steam generating plant shall consist of one (1) aux. boiler.

The electric generating plant shall consist of three (3) diesel generator sets.

1.2 MACHINERY PARTICULAR

	Rule		ABS/CR (ACCU)					
	Kind of Ship	o	M.T. D/W TYPE BULK CARRIER					
H			1 - 1					
	Dimension		m	Lpp 195.00	B 32.24	D 19.15	d (Ext. 13.010	
	Tonnage		Ton	G.T.	35,826	D.V	V. 63	3,374 M.T.
	Speed		knot	Sea Trial	15.687	Ser	ab vice	ot. 14.5
M	ain Engine							
	Type & No.	of Set			crosshead	type diesel	lengine	ingle acting, direct with 3×1 set
	Output	Maximum Rating	kW× min ⁻¹	7	,560 × 99)		
	× Speed	Normal Rating	kW× min ⁻¹		,425 × 93			Turbocharger TCA55
	Brake Mean Press. at Ma		MPa	1.76				\times 1 set
	Mean Pistor Max. Rating		m/s	7.31				
	Cylinder No. & Size		mm	$6 \times \phi 500 \times 2,214$				
	Turning Motor		kW× min ⁻¹	2.2 × 1,200				
				MITSUI ENGINEERING & SHIPBUILDING CO.,LTD.				
Sh	afting		_					
	Thrust Shaft	t	No.× mm	Attached t	o Main Eng	gine		
	Intermediate	e Shaft	No.× mm	1	× φ 415	× 5,9	50	
	Propeller Sh	naft	No.× mm	1	× φ 500	× 6,5	50	
	Stern Tube S	Seal		KEMEL AX-530				
Pr	opeller							,
	Type & No.	of Set			Solid Type $3r$) \times 1 se	et		
	Diameter × Pitch mm		mm	4,561.6 (0.7R) φ 6,300 × 4,488.3 (MEAN)			_	
	Exp. Area Ratio × Boss Ratio -			0.4700×0.1524				
	Skew Angle deg		deg.	25				
	NAKASHIMA PROPELLER CO., I					O., LTD		

Type & No. of Set		Composite sy GK-2032-12	ystem vertical typ 00/680		× 1 set
Steam Pressure & Temperature	- X	(Design)	0.8 MPa× Sat	urated iturated	
Heating Surface	m	(Oil burning 33.2		h. gas side) 198.4	
Evaporation	kg	(Oil burning 1,200		h. gas side) 80 (M/E 85	5 % Load
Feed Water Temp.	°C		abt. 60		
Burner Type		Forced Draft	Type Pressure A	tomizing Burne	er
		MIURA CO.	, LTD.		
Service	No.of Set	Туре	Capacity $(m^3/h \times MPa)$	Motor (kW×min ⁻¹)	
Main		4-Cycle			YANMA
Diesel Generator Engine	3	Diesel Engine Brushless	745 kW	900 min ⁻¹	6EY18A 450V
Main Generator	3	A.C. Generator	862.5 kVA	690×900	× 60 H
Emergency Generator Engine	1	4-Cycle Diesel Engine	99 kW	1,800 min ⁻¹	MITSUI ZO TD914L0
Emergency Generator	1	Brushless A.C. Generator	90 kVA	72×1,800	450V × 60 H
		i .			
		MD Vertical	(F A)		TANAD
Main Air Compressor Emergency	2	MD Vertical 2-Stage MD Vertical	(F.A.) 155 × 2.9 (F.A.)	37×1800	TANAB H-73 MATSUBA

	(K ** / ` 111111)	
		NANIMA BUMB
Sea Water Pump 1 MD. V. Cent. $600 \times 20 \text{ m}$	55×1800	NANIWA PUMP FEV-250-2D
<u> </u>		
		Do.
Sea Water Pump 1 MD. V. Cent. $600 \times 20 \text{ m}$	55×1800	FEV-250-2D
MGO Cooling (T.H.)		Do.
Fresh Water pump 1 MD. H. Cent. $5.0 \times 25 \text{ m}$	1.5×3600	BHR-40
Jacket Cooling (T.H.)		Do.
Fresh Water Pump 2 MD. V. Cent. 104×40 m	22×1800	FEV-125-2D
Main Lubricating Oil (D.P.)		Do.
Pump $2 \text{ MD.V. Cent.} 220 \times 0.42$	60×1800	TOM-200E
Fuel Oil (D.P.)		TAIKO KIKAI
Booster Pump 2 MD. H. Screw 2.9×0.4	2.2×3600	MSDK-3MA
		l
Main Engine Fuel Oil (D.P.)		Do.
Circulating Pump 2 MD. H. Screw 4.2 × 1.0	3.7×3600	MSDK-5HMA
Fuel Oil (D.P.)		Do.
Transfer Pump 1 MD. H. Gear 15 \times 0.3	5.5×1200	NHG-15MA
M.G.O. (D.P.)		Do.
Transfer Pump 1 MD. H. Screw 4×0.3	5.5×3600	MSDK-4MA
Lubricating Oil (D.P.)		Do.
Transfer Pump 1 MD. H. Gear 4×0.3	1.5×1200	NHG-4MT
Diesel Gene. Fuel Oil (D.P.)		TAIKO KIKAI
Circulating Pump 2 MD. H. Screw 1.6×0.9	1.5×3600	
ε 1		MSDK-2HMA
Diesel Gene. M.G.O. (D.P.)		Do.
Booster Pump 2 MD. H. Screw 1.6×0.75	1.5×3600	MSDK-2HMA
Emergency Air operate (D.P.)		Do.
M.G.O. Pump 1 H. Screw 1.6×0.75	1.5×1200	MSDK-3HMN
Stern Tube (D.P.)		Do.
Lubricating Oil Pump $\begin{vmatrix} 2 \end{vmatrix}$ MD. H. Gear $\begin{vmatrix} 0.5 \times 0.2 \end{vmatrix}$	0.4×1200	NHG-0.5M
Diesel Gene. Lub. Oil (D.P.)		
Priming Pump 3 MD. H. Gear 2.5×0.2	0.94×3600	*
L.O. Purifier (D.P.)		TAIKO KIKAI
Supply Pump 1 MD. H. Gear 2.1×0.3	1.5×1200	NHG-2MT
D/G L.O. Purifier (D.P.)		Do.
Supply Pump 1 MD. H. Gear 0.6×0.3	0.4×1200	NHG-1MT
Suppry Lump	0.4 \ 1200	11110-11/11
		ļ
		NANIWA PUMP
Bilge & Ballast Pump 1 MD. V. Cent. $ 220/90 \times 20/70 $ r		FE2V-200E
Self Priming (T.H.)		Do.
Fire & G.S. Pump 1 MD. V. Cent. $ 220/90 \times 20/70 \text{ r} $		FE2V-200E
(T.H.)		Do.
Ballast Pump 2 MD. V. Cent. 1000 × 25 m	100×1800	FEWV-350D
MD. H. (T.H.)		TAIKO KIKAI
Bilge Pump 1 Recipro. $5 \times 30 \text{ m}$	1.5×1800	LD-5NS
		Do.
Sludge Pump 1 Monros $2.5 \times 41 \text{ m}$	1.5×1200	HNP-301
		1
Ref. Mach. Cooling Sea Water Pump 1 MD. H. Cent. 45× 55 m	15×3600	NANIWA PUMP BHR-100

Service	No.of	Туре	Capacity	Motor	
1	Set		$(m^3/h \times MPa)$	$(kW \times min^{-1})$	
Drinking Water Pump	1	MD. V. Cent.	(T.H.) 5× 50 m	3.7×3600	NANIWA PUMP BHR-40
Fresh Water Pump	2	MD. V. Cent.	(T.H.) 5× 50 m	3.7×3600	Do. BHR-40
Hot Water Circulating Pump	2	MD. H. Cent.	(T.H.) 2× 10 m	0.4×3600	Do. BHR-32
			(T.H.)		Do.
D/G Pre-Heating Pump	1	MD. H. Cent.	3× 20 m	0.75×3600	BHR-32
Boiler HFO/MGO		MD.	(D.P.)		
Burning Pump	1	H. Trochoid	268 @ /h×1.8	0.75×3600	*
Boiler Pilot Burner Pump	1	MD. H. Trochoid	(D.P.) 40 & /h×0.8	0.09×3600	*
Boiler Forced Draft Fan	1	MD. Turbo	23 m ³ /min ×2.94 kPa	2.2×3600	*
Boiler Feed Water Pump	2	MD. H. Cent.	(T.H.) 4× 100 m	7.5×3600	NANIWA PUMP EB2H-32D
•					
Fuel Oil Purifier	2	MD. V. Centrifuge	2,700 l/h (600 cSt at 50°C)	5.5×1800	MITSUBISHI KAKOKI SJ35H
Lubricating Oil Purifier	1	MD. V. Centrifuge	2,400 ½/h	5.5×1800	Do. SJ25H
D/G Lubricating Oil Purifier	1	MD. V. Centrifuge	1,300 ½/h	3.7×1800	Do. SJ15H
D/G Lubricating Oil By-pass Filter	3		*		*
Engine Room		Reversible	650 m ³ /min		TAIYO ELECT.
Ventilating Fan Engine Room	2	MD. V. Axial	\times 0.29 kPa 650 m ³ /min	7.5×1200	FA-B-90-3 Do.
Ventilating Fan	1	MD. V. Axial	× 0.29 kPa	7.5×1200	FA-B-90-3
Workshop Space Exhaust Fan	1	MD.	33 m³/min	0.065×1800	
Auxiliary Blower	2	MD. Turbo		45×3600	Attach to M/E
Motor for M/E hydraulic system	2	MD.		65×1800	Attach to M/E
Shaft Power Meter	1				SHOYO
Bilge Separator	1	with Content meter	5 m ³ /h		TAIKO KIKAI USH-50
M.G.P.S.	1	Cl ion type			NIPPON CORROSION
Shaft Grounding Equipment	1	with mV-Meter			Do.
Ballast Water Treatment System	1	Electrolysis	ECS1000B×2		TECHCROSS

Service	No.of	Type	Capacity	Motor	
Overhead Travelling Crane	Set 1	MD.	$(m^3/\hat{h} \times MPa)$ 4 ton	$ \begin{array}{c c} (kW \times min^{-1}) \\ \hline 3 \times 900 \\ 0.2 \times 1800 \\ 0.2 \times 1800 \\ \end{array} $	SEKIGAHARA MAB-040059
Lathe	1	MD.	Center distance 1,000 mm	0.75×1800 2.2×1800	KUSAKABE KL36B-100
Drilling Machine	1	MD.	φ 38	1.5×1800	Do. KD-38
Grinding Machine	1	MD. 2 – Wheels	$\begin{array}{cccc} \text{AC440V 3} & \phi & 60 \text{Hz} \\ \phi & 255 & \times & 25 \text{t} \end{array}$	0.75×1800	Do. KGL-10
Electric Welder	2	A.C. Arc Type	300 Amp		
Gas Cutting Machine	1	Acetylene Type	Oxygen B.×2 Acetylene B. ×1	Hose: Each 25 m×4	Foreign made
Chain Block	1 2 3		3 ton 1 ton 0.5 ton		
Control Room Air Conditioner	1	With E. heater Packaged Type (R404A)	11.3 kW	2.2×3600	USHIO REINETSU UAP-2HS4PL4-1
Water sterilizer	1		3,000 ℓ/h		
Water-based Local Fire Fighting System	1	Low Press. Type			KASHIWA
Sewage Treatment Unit	1				TAIKO KIKAI SBH-25
Ballast Eductor	1		100 m ³ /h		
Bilge Eductor	1		50 m ³ /h		
F.O. Tank Pre-heating Unit	1				HOKUSHIN ENGINEERING
F.O. Shifter Pump	1	MD. H. Gear	(D.P.) 7.2×0.49	3.7×1800	% 100%Capa.
Fresh Water Generator	1		15 T/D		SASAKURA XM-15
Distillate Pump	1	MD. H. Cent.	(T.H.) 1.2× 30 m	0.75×3600	*
Ejector Pump	1	MD. H. Cent.	(T.H.) 18× 39 m	5.5×3600	*
Waste Oil Incinerator	1		349 kW		MIURA BGW-30N
Waste Oil Pump	1	MD. H Trochoid	160 ℓ/h × 0.2 MPa	0.1×1800	*
Exhaust & Cooling Fan	1	MD.	95 m ³ /min × 2.65 kPa	7.5×3600	*
Burning Fan	1	MD.	11.4 m ³ /min × 1.18 kPa	1.5×3600	*

Service	No.of Set	Type	Capacity (m ²)	Motor (kW×min ⁻¹)	
Jacket Cooling Fresh Water Cooler	1	Plate	11.40		HISAKA WORKS LX-125B-NPM-59
Main Lubricating Oil Cooler	1	Plate	103.75		Do. LX-595B-NPM-127
Diesel Gene. Cooling F.W. Cooler	2	Plate	20.60		Do. UX-195B-NPM-105
MGO Cooling F.W. Cooler	1	Plate	1.40		Do. UX-195B-NJM-9
Main Engine MGO Cooler	1	Plate	2.20		Do. UX-116B-NJM-13
Diesel Generator MGO Cooler	1	Plate	1.00		Do. UX-116B-NJM-7
M/E F.O. 2nd Filter	1		ABS.50μ 4.2m3/h		KANAGAWA KIKI K8FE33VAZS-W50
D/G F.O. 2nd Filter	1		E.F.10µ 1.6m3/h		Do. K8FE3VAZS-W10
Auxiliary Condenser	1	H. Shell & Tube	10		SHOWA 300U-2F
Shifter Fuel Oil Heater	1	Steam Heat	STM 0.55MPa 55 → 85°C		KAJIWARA B150/40×15-20
Purifier Lub. Oil Heater	1	Steam Heat	STM 0.55 MPa $45 \rightarrow 90^{\circ}$ C		Do. XLV90-150
D/G Purifier Lub. Oil Heater	1	Steam Heat	STM 0.55 MPa $45 \rightarrow 90^{\circ}$ C		Do. XLV90-50
Purifier Fuel Oil Heater	2	Steam Heat	$\begin{array}{c} \text{STM } 0.55\text{MPa} \\ 55 \rightarrow 98^{\circ}\text{C} \end{array}$		Do. B125/40×15-14
Main Engine Fuel Oil Heater Boiler	2	Steam Heat	STM 0.55MPa 105 →150°C		Do. B150/100×15-20
Fuel Oil Heater Diesel Gene.	1	Electric Heat	STM 0.55MPa	7 kW	X KAJIWARA
Fuel Oil Heater	1	Steam Heat	$105 \rightarrow 150^{\circ}\text{C}$ STM 0.3MPa		$B100/80 \times 15-9$ HARISON SANGYO
Calorifier Unit Main Engine	1	Steam Heat	$\begin{array}{c} 10 \rightarrow 70^{\circ}C \\ \hline 2 \end{array}$		CFT-300XX-S SHOWA
Warm-up Heater	1	Steam Heat Steam Heat	STM 0.55MPa STM 0.55MPa		300A-P HARISON
D/G Pre-Heater	1	Plate type	$65 \rightarrow 73^{\circ}C$		HSF16-FG-S
M/E Fuel Oil Viscosity Controller	1				
Main Air Reservoir	2	Cylindrical	$\begin{array}{c} 5.0 \text{ m}^3 \times \\ 2.9 \text{ MPa} \end{array}$		IMABARI SHIPBUILDING AR-5.0V
Emergency Air Reservoir	1	Cylindrical	1500 × 2.9 MPa		*
Control Air Dryer	2	Refrigerate type	50 Nm ³ /h		NIHON SEIKI NH-F50NA-T110

Service	No.of Set	Туре	Full Capacity (m ³)	Heat. Ratio (m ² /m ³)	
Heavy Fuel Oil Settling Tank	1		18.684	0.3	Integrated
Heavy Fuel Oil Service Tank	1		18.945	0.3	Integrated
Low Sulphur Fuel Oil Settling Tank	1		10.661	0.3	Integrated
Low Sulphur Fuel Oil Service Tank	1		10.810	0.3	Integrated
M.G.O. Service Tank	2		10.770		Integrated
M.G.O. Settling Tank	1		10.770		Integrated
F.O. Sludge Tank	1		1.395(1.39)	0.1	
L.O. Sludge Tank	1		1.395(1.39)	0.1	X 75 11
Fuel Oil Drain Tank	1		3.340(3.34)	0.1	In Double Bottom
Fuel Oil Overflow Tank	1		15.370	0.03	In Double Bottom
Waste Oil Tank	2		1.400(1.22)	0.5	
Main Engine Lub. Oil Storage Tank	1		21.274		Integrated
Main Engine Lub. Oil Settling Tank	1		17.404	0.2	Integrated
Main Engine Lub. Oil Sump Tank	1		17.790		In Double Bottom
Diesel Gene.					
Lub. Oil Storage Tank	1		6.893		
Diesel Gene. Lub. Oil Settling Tank	2		No.1 2.900 No.2 2.877	0.2	
Diesel Gene. Lub. Oil Sump Tank	Each 1		1.000		In Common Bed
Cylinder Oil Alarm Chamber	1		0.02		
Cylinder Oil Storage Tank	2		No.1 15.159 No.2 30.694		Integrated
			() Consoite	::	OPP supplement

⁾ Capacity is written on IOPP supplement

Service	No.of Set	Туре	Full Capacity (m ³)	Heat. Ratio (m ² /m ³)	
Stern Tube Lub. Oil Tank Unit	1		0.212	,	
Stern Tube FWD Seal Lub. Oil Tank	1		0.010		*
Stern Tube Drain Collect. Unit	1		0.010		*
Stern Tube Lub. Oil Collect Tank	1		1.420		In Double Bottom
Scavenging Box Drain Tank	1		0.478(0.47)	0.1	
Gray Water Collect Tank	1		17.930		In Double Bottom
Gray Water holding Tank	1		111.59		Integrated
MGO Cooling F.W. Expansion Tank	1		0.372		
Jacket Cool. F.W. Expansion Tank	1		2.016		
Deaeration Tank	1		0.050		*
Fresh Water					
Pressure Tank	1	Cylindrical	1.081		
Drinking water Pressure Tank	1	Cylindrical	1.081		
Cascade Tank	1		2.898		With Inspect. Section
Bilge Primary Tank	1		2.646	0.01	
Bilge Tank	1		23.820(23.82)		In Double Bottom
Bilge Sludge Tank	1		20.360(20.36)	0.01	In Double Bottom
Clean Drain Tank	1		12.580		In Double Bottom OPP supplemen

^() Capacity is written on IOPP supplement



Abbreviation:

abt. About D. Driven

MD. Motor Driven
Cent. Centrifugal

* Pending
Vert. Vertical
Hor. Horizontal
F.A. Free Air

D.P. Discharge Pressure



1.3 **SHOP TEST**

As regards under said machinery installed in the engine room, the under said running test shall be executed at the Maker's shop to demonstrate workmanship, proper working order and performance in accordance with the shop test projects.

In case electric current of 60 Hz shall not be available, auxiliaries driven by electric motors shall be tested by supplying available electric current and results on performance shall be converted into these for 60 Hz by proper calculation.

Necessary data shall be recorded during these tests and the results shall be submitted to the Owner.

For main engine

(1) Ahead running load test

1/2 load	1/2 hour
3/4 load	1/2 hour
Normal rating	1 hour
Maximum rating	1/2 hour
25%, 10% load	(Data only)

At normal rating load the fuel oil consumption test shall be conducted.

- (2) Governor test
- (3) Minimum revolution test
- (4) Starting test and astern confirmation test
- (5) Emergency trip test
- (6) Overhaul inspection

During the shop test, the diesel oil shall be used and the lub. oil shall be used in accordance with Maker's standard.



For diesel generator engine

(1) Ahead running load test

1/2 load (Data only)
Maximum rating 1 hour
10% over load 1/3 hour

- (2) Governor test
- (3) Starting test (Data only)
- (4) Parallel running test
- (5) Emergency trip test
- (6) Fuel oil consumption measuring

These shop tests shall be carried out after coupling the engine with generator at the engine Maker's shop. The said load shall mean the generator load.

For pump and air compressor

(1) Performance test

Performance test shall be carried out for each set but in case two or more than two sets of same kind and capacity are installed, performance test shall be carried out only for one set.

(2) Continuous running test

Continuous running test at full load for each set shall be carried out.

The said tests shall be executed according to the Maker's usual practice by using available facilities in the Maker's shop.

For oil purifier

The shop test shall be carried out according to the Maker's standard and usual practice.

For fresh water generator

The shop test shall not be carried out.

The operating test shall be carried out onboard during sea trial.



1.4 FUEL OIL CONSUMPTION OF MAIN ENGINE

The fuel oil consumption of main engine shall be measured at shop test burning diesel oil.

The figure shall be 160.5 g/kW·h at normal rating on the basis of fuel net calorific value of 42,700 kJ/kg and ISO Standard Reference Conditions (Complying with MARPOL 73/78 ANNEX VI Reg.13 - Tier II restriction). This consumption figure shall be subject to a tolerance of 5 %

ISO condition

Suction air temperature 25° C
Sea water temperature 25° C
Barometric pressure 1000 hPa



SECTION 2 MAIN PROPULSION UNIT

2.1 GENERAL

The main propulsion unit shall consist of MAN B&W marine diesel engine, 2-stroke, single acting, direct reversible crosshead diesel engine with exhaust turbocharger (model 6S50ME-B9.3).

2.2 CONSTRUCTION AND MATERIAL

The materials and dimensions for diesel engine and its equipment shall be in accordance with Japanese Industrial Standard (JIS) and Maker's standard.

2.2.1 Bedplate and main bearing

The bedplate consists of high, welded, longitudinal girders and welded cross girders with bearing supports.

For fitting to the engine seating, long, elastic holding down bolts tightened by hydraulic tools are to be used.

The oil pan, which is integrated in the bedplate, collects the return oil from the forced lubricating and cooling oil system.

The main bearings consist of Tin-aluminium shells. The bottom shell can, by means of special tools and hydraulic tools for lifting the crankshaft, be rotated out and in. The shells are kept in position by a bearing cap and are fixed by long elastic studs, with nuts tightened by hydraulic tools

2.2.2 Frame box

The frame box is of welded design. On the exhaust side, it is provided with a relief valve for each cylinder while, on the camshaft side, it is provided with a large door for each cylinder. The crosshead guides are welded to the frame box.

For each cylinder, a slotted pipe for collecting part of the cooling oil outlet from the piston is bolted into the frame box.

The frame box, bedplate and cylinder frame are tightened by twin stay bolts. The stay bolts are tightened hydraulically with use of jacks.



2.2.3 Cylinder frame, cylinder liner and stuffing box

The cylinder frame unit is of welded type or cast iron (depending on production facility) with integrated camshaft frame. Together with the cylinder liner, they form the scavenge air space. At the chain drive, the upper part of the chain wheel frame is fitted. On the camshaft side of the engine, the cylinder frame units are provided with covers for cleaning the scavenge air space and for inspection of the scavenge ports and piston rings.

The gallery brackets are bolted onto the cylinder frame. Furthermore, the outer part of the telescopic pipe is fitted for the supply of piston cooling oil.

A piston rod stuffing box for each cylinder unit is fitted at the bottom of the cylinder frame. The stuffing box is provided with sealing rings for scavenge air, and with oil scraper rings to prevent oil from entering the scavenge air space.

The cylinder liner is made of boron cast iron alloy. The upper part of the liner is surrounded by a cooling jacket. The cylinder liner has scavenge ports and drilled holes for cylinder lubrication.

2.2.4 Cylinder cover

The cylinder cover is of cast or forged steel (depending on production facility), made in one piece, and has bores for cooling water. It has a central bore for the exhaust valve and bores for fuel valves, safety valve, starting valve and indicator valve.

The cylinder cover is tightened to the cylinder frame with studs and nuts by hydraulic jacks.

2.2.5 Crankshaft

The crankshaft is of the semi-built type, made of forged steel throws.

The crankshaft is built integral with the thrust shaft and is, on the aft end, provided with a flange for the turning wheel and for coupling to the intermediate shaft. At the fore end, the crankshaft can be provided, if needed, with a flange for a counterweights and/or a tuning wheel with additional price.

2.2.6 Axial vibration damper

The engine is fitted with an axial vibration damper, which is mounted on the fore end of the crankshaft.

The damper consists of a piston and a split-type housing located forward of the foremost main bearing. The piston is made as an integral collar on the main journal, and the housing is fixed to the main bearing support.



2.2.7 Thrust bearing

The thrust bearing is of the B&W-Michell type, and consists of a thrust collar on the crankshaft, a bearing support, and segments with white metal.

The propeller thrust is transferred through the thrust collar, the segments, and the bedplate to engine seating and end chocks.

The thrust bearing is lubricated by the engine's main lubricating oil system.

2.2.8 Connecting rod

The connecting rod is made of cast or forged steel (depending on production facility) and provided with bearing caps for the crosshead and crankpin bearings.

The crosshead and crankpin bearing caps are secured to the connecting rod by studs and nuts which are tightened by hydraulic jacks.

The crosshead bearing consists of a set of Tin-aluminium shells. The crosshead bearing cap has an angular cut-out for the piston rod.

The crankpin bearing consists of Tin-aluminium shells.

Lubricating oil is supplied through ducts in the crosshead and connecting rod.

2.2.9 Piston, piston rod and crosshead

The piston consists of piston crown and piston skirt. The piston crown is made of heat-resistant steel and has four ring grooves which are hard-chrome plated on both the upper and lower surfaces of the grooves. The piston skirt is of cast iron and provided with bronze bands.

The piston rod is of forged steel and is surface-hardened on the running surface for the stuffing box. The piston rod is connected to the crosshead with four screws. The piston rod has a central bore which, in conjunction with a cooling oil pipe, forms inlet and outlet for cooling oil.

The crosshead is of forged steel and is provided with guide shoes with white metal on the running surface.

The telescopic pipe for oil inlet and the pipe for oil outlet are mounted on the top of the guide shoes.

2.2.10 Exhaust valve and valve gear

The exhaust valve consists of a housing with gas channel and spindle guide. The housing is water cooled and made of cast iron. Between the cylinder cover and the housing, there is a bottom piece.

The bottom piece is water cooled on its outer surface.

The valve spindle is of heat resistant steel with "hard metal" welded onto the seat, and is provided with small vane wheel on which the exhaust gas acts during operation, thus making spindle rotate slightly.



The hydraulic system consists of an actuator, activated by a cam on the camshaft, a high-pressure pipe, and an oil cylinder for the exhaust valve spindle, mounted on top of the housing. The hydraulic system opens the exhaust valve, while the closing force is provided by an air spring. The closing of the exhaust valve is damped by means of an oil cushion on top of the spindle.

2.2.11 Fuel valve, starting air valve, safety valve and indicator valve

Each cylinder cover is equipped with two fuel valves, one starting valve, one safety valve, and one indicator valve. The opening of the fuel valve is controlled by the fuel oil high pressure created by the fuel pumps, and the valve is closed by a spring.

The fuel valves are equipped with a slide and circulating bore, to ensure an adequate flow of heated oil through the fuel pump housing and fuel valves at all loads including stopped engine. By means of the "built-in" circulation of preheated fuel oil, the fuel pumps and fuel valves can be maintained at service temperature, also while the engine is stopped. Consequently, it is not necessary to change to diesel oil when entering harbour, provided that the circulating pump is kept running and preheating of the circulated fuel oil is maintained.

The starting valve is opened by control air from the starting air distributor and closed by a spring.

The safety valve is spring-loaded.

The engine is fitted with an indicator valve to which the PMI pressure transducer can be connected.

2.2.12 Fuel oil pressure booster and fuel oil high pressure pipe

The engine is provided with one hydraulically activated fuel oil pressure booster for each cylinder. The fuel oil pressure booster consists of a pump housing, a hydraulic piston and plunger. In order to prevent fuel oil from being mixed with the servo oil, the fuel oil pressure booster is provided with a sealing device.

The Fuel oil Injection is controlled by electronic valve (ELFI valve), which is electronically controlled by the Cylinder Control Units of Engine Control System.

The fuel oil high-pressure pipes are equipped with protective hoses and are neither heated nor insulated.



2.2.13 <u>Hydraulic cylinder unit (HCU)</u>

The HCU consists of a base plate on which a distributor block is mounted.

The distributor block is fitted with one accumulator to ensure that the necessary hydraulic oil peak flow is available for the electronic fuel injection.

The distributor block serves as a mechanical support for the hydraulically activated fuel oil pressure booster and Alpha lubricator.

There is one HCU per two cylinders. The HCU is equipped with two fuel oil pressure boosters, two ELFI valves and two Alpha Lubricators. Thereby, one HCU is operating two cylinders.

2.2.14 Chain drive

The chain drive is integrated with the thrust bearing in the aft end of the engine. The camshaft is driven from the crankshaft by chain drive. The chain drive is provided with chain tightener. The long free lengths of chain are supported by guidebars.

The starting air distributor is driven by the camshaft.

2.2.15 Hydraulic power supply (HPS)

The HPS is installed in the front end of the engine. The HPS is electrically driven and consists of two electric motors each driving a hydraulic pump.

The pressure for the hydraulic oil is approx. 30.0 MPa. Each of the pumps has a capacity corresponding to min. 55% of the engine power. In case of malfunction of one of the pumps, it is still possible to operate the engine with 55% engine power corresponding to 85% speed.

2.2.16 Reversing

Reversing of the engine is performed electronically and pneumatically, by changing the timing of the Fuel Injection and the starting air valves.

The exhaust gear is not reversible.

2.2.17 Engine maneuvering system

The engine is provided with an electric-pneumatic manoeuvring system. The system transmits orders from the manoeuvring console to the engine.

The regulating system makes it possible to start, stop and reverse the engine and to control the engine. The speed control dial on the manoeuvring console gives a speed-setting signal to the Engine Control System.



2.2.18 Main operating panel (MOP)

In the engine control room a MOP is located, which is a Personal Computer (PC) with a touch screen as well as a trackball from where the operator can carry out engine commands, adjust the engine parameters, select the running modes, and observe the status of the control system.

2.2.19 Engine Side Console (ESC)

In normal operating the engine is controlled from engine control room.

Alternatively, the ESC can be activated. This redundant control is to be considered as a substitute for the previous engine side control console mounted directly onto the MC engine. The ESC is place on the engine.

From the ESC, the basic functions are available, such as starting, engine speed control, stopping, reversing, and the most important engine data are displayed.

2.2.20 Governor system

The governor functions equivalents to the conventional governor system are included in the engine Control System.

2.2.21 Starting air system

The starting air system comprises a main starting valve, a non-return valve, a bursting disc for the branch pipe to each cylinder, a starting air distributor, and starting valves on each cylinder. The main starting valve is connected with the main manoeuvring system, which controls the start of the engine.

The starting air distributor regulates the supply of control air to the starting valves so that they supply the engine cylinders with starting air in the correct firing order.

2.2.22 Scavenging air system

The air intake to the turbocharger takes place direct from the engine room through the intake silencer of the turbocharger. From the turbocharger, the air is led via the charging air pipe, air cooler and scavenging air receiver to the scavenging ports of the cylinder liners. The charging air pipe between turbocharger and air cooler is provided with a compensator and is heat insulated on the outside.

2.2.23 Exhaust turbocharger and air cooler

The engine is fitted with turbocharger arranged on the aft end of the engine. The turbocharger can alternatively be located on the side of the engine.

The turbine side is provided with cleaning device.



The engine is fitted with air cooler mono-block type so arranged for easy cleaning with chemicals at the engine standstill. The air cooler consists of tube plates of rolled brass, cooling tubes with cuprous fins and cast iron covers coated with resin.

After the air cooler, a water mist catcher is mounted.

2.2.24 Auxiliary blower

The engine is provided with two electrically-driven auxiliary blowers. The suction sides of the blowers is connected to the scavenge air space after the air cooler.

Between the air cooler and the scavenge air receiver, flap valves are fitted with automatically close when the auxiliary blowers supply the air.

Both auxiliary blowers will start operating before the engine is started and will ensure sufficient scavenge air pressure to obtain a safe start.

During operation of the engine, both auxiliary blowers will start automatically each time the engine load is reduced to about 30–40%, and they will continue operating until the load again exceeds approximately 40–50%.

In cases where one of the auxiliary blowers is out of service, the other auxiliary blower will automatically compensate without any manual readjustment of the valves, thus avoiding any engine load reduction. This is achieved by the automatically working non-return valves in the suction pipe of the blowers.

2.2.25 Exhaust gas system

From the exhaust valves, the gas is led to the exhaust gas receiver where the fluctuating pressure from the individual cylinders is equalised, and the total volume of gas led further on to the turbochargers at a constant pressure. After the turbocharger, the gas is led to the exhaust pipe system.

Compensators are fitted between the exhaust valves and the receiver, and between the receiver and the turbocharger.

The exhaust gas receiver and exhaust pipes are provided with insulation, covered by galvanised steel plating.

2.2.26 <u>Turning wheel and turning gear</u>

The turning wheel has cylindrical teeth and is fitted to the thrust shaft. The turning wheel is driven by a pinion on the terminal shaft of the turning gear, which is mounted on the bedplate.

The turning gear is driven by an electric motor with built-in gear and brake. The turning gear is equipped with a blocking device that prevents the main engine from starting when the turning gear is engaged. Engagement and disengagement of the turning gear is effected manually by an axial movement of the pinion.



2.2.27 Gallery arrangement

The engine is provided with gallery brackets, stanchions, railing and platforms (exclusive of ladders). The brackets are placed at such a height that the best possible overhauling and inspection conditions are achieved. Some main pipes of the engine are suspended from the gallery brackets.

2.2.28 Cylinder lubricators (Alpha lubricator system ALS)

The cylinder lubricator units, one per engine cylinders, are mounted. The oil is led to the lubricator unit, through a pipe system from an elevated tank (Shipbuilder's supply). The ALS is electronically controlled by the Cylinder Control Units of Engine Control System.

The setting of Alpha lubricator system can be performed by MOP.

2.2.29 <u>Piping arrangements</u>

The lubricating oil, cylinder cooling fresh water and air coolers are cooled by means of sea water. The pipes for the lubricating oil system and for the fresh water on the engine are of steel, the sea water pipes are of galvanized steel.

a) Forced lubrication and oil cooling:

The main forced lubrication is led to each main bearing through branches from the main lubrication pipe located along the engine. Cooling oil is led to the telescopic pipe through branches from the cooling oil main pipe located along the cooling jackets on the exhaust side of the engine, through which the oil is led to the crossheads. From there, some of the oil is branched off for lubrication of the crosshead shoes and crosshead bearings and is led through the bored connecting rod to the crank bearing.

Some of the oil is led through a pipe in the bore of the piston rod for cooling of the piston. The oil returns from here through the piston rod and let out through a duct in the crosshead.

The camshaft bearing lubricating oil and the exhaust valve driving gear oil are supplied from cooling oil system.

b) Cooling water system:

Cylinders and exhaust valves are fresh water cooled.

The fresh water is led from the main piping along the engine through branches to the each cylinder liner. The fresh water is led from the cylinder liner up through the cylinder cover and exhaust valve housing and from there to a manifold through which it is carried back to the fresh water cooler.



2.3 FITTING AND ACCESSORY

The following accessories shall be supplied together with main engine.

- 1 set of exhaust gas turbocharger
- 1 set of air cooler
- 1 set of flywheel
- 1 set of turning gear
- 1 set of thrust bearing
- 2 sets of auxiliary blower
- 1 set of main starting valve with non-return valve
- 1 sets of ALPHA lubricator system
- 1 set of grating for engine
- 1 set of piping attached to the engine
- 1 set of maneuvering device
- 1 set of pressure gauge
- 1 set of thermometer
- 1 set of manometer
- 1 set of fuel oil 2nd filter
- 1 set of oil mist detector
- 1 set of hydraulic power supply unit (HPS)
- 1 set of hydraulic cylinder unit (HCU)
- 2 sets of main operating panel (MOP)
- 1 set of local operating panel (LOP)



SECTION 3 SHAFTING AND PROPELLER

3.1 GENERAL

The entire rotating system including main engine, shafting and propeller shall be designed so that the serious torsional vibration requiring barred range shall not occur between 85% and 100% of revolution corresponding to the maximum rating of main engine.

The calculation sheets regarding the torsional vibration shall be submitted to the Owner and the Classification Society for approval.

3.2 SHAFTING

The shafting shall be one (1) line which consist of one (1) intermediate shaft and one (1) propeller shaft.

The shafting shall be of solid type and machined smooth all over except journals and coupled face which shall be finely finished.

The coupling flanges shall be integrated with the shaft and protected by sheet steel guards. The shafting shall be bolted together with straight reamer bolts.

The diameter of intermediate shaft shall be determined in accordance with the requirement of the Classification Society.

The diameter of shaft at intermediate shaft bearing shall be added 5mm to the determined shaft diameter.

The diameter of propeller shaft shall be in accordance with the requirement of the Classification Society.

The aft part of propeller shaft shall be machined with 1/20 taper and threaded at end for fitting the propeller with a steel nut.

The propeller shaft shall be withdrawn inboard by removing intermediate shaft, and the eye plate for withdrawing shall be provided.

I-beam shall be provided for propeller shaft and intermediate shaft drawing.

Special requirement for Postponement Survey of propeller shaft kind 1C (Survey intervals 10 years) shall be adopted.

3.3 <u>INTERMEDIATE SHAFT BEARING</u>

One (1) intermediate shaft bearing of removable bearing shell type shall be fitted for proper support of the intermediate shaft.

Intermediate shaft bearing shall be provided bearing metal at upper and lower part.



The bearing shall be filled with lub. oil from the pipes of branched main engine lub. oil line.

Lub. oil shall flow into the bearing clearance from the side of shaft center line through the clearance between housing bore and outside of bearing metal and lubricate the bearing. Lub. oil shall drain off through the both end of bearing metal and flow to the returning main engine lub. oil sump tank.

3.4 STERN TUBE BEARING AND SEAL

The stern tube shall accommodate one (1) stern tube bearing shell and two (2) stern tube oil sealing devices.

The stern tube sealing device at aft side shall be provided air seal type and distance piece.

The wear down measuring apparatus shall be provided to measure clearance at the aft side bushing of the stern tube.

The rope guard fabricated steel with anode shall be provided between aft end of stern frame boss and propeller boss.

The wire net guard (propeller boss grooved type) and NET STOPPER shall be provided.

3.5 PROPELLER

There shall be provided one solid type propeller. The diameter and pitch of propeller shall be suitable for the power and speed. The propeller shall rotate clockwise, seen from aft when going ahead. The propeller shall be of key-less type and fitted on the taper end of propeller shaft and secured by a nut.

The forward end of boss shall be counterbored and fitted with a sealing gland.

The propeller surface shall be ground smooth. A propeller cap shall be bolted to the boss and its interior shall be filled with grease.

The performance of propeller shall be designed under the following conditions.

Main engine output

Main engine revolution

Draught

Sea condition

6, 425 kW

Normal output (6,785 kW)

abt. 97.5 rpm (abt. 4% up)

Designed loaded draught

Calm sea

The propeller shall be swung on a mandril and statically balanced.



3.6 MATERIAL

Shafting:

Intermediate shaft Forged steel
Propeller shaft Forged steel
Nut for propeller shaft Forged steel
Coupling bolt Forged steel

Stern tube bearing and seal:

Stern tube bearing Cast iron with white metal (WJ2)

Sealing ring Fluoro rubber (FPM)

Intermediate shaft bearing:

Upper and lower shells Cast iron

Bearing metal White metal (WJ2)

Propeller:

Propeller Nickel aluminum bronze

Propeller cap Bronze

Rope guard Mild steel plate



SECTION 4 STEAM GENERATING PLANT

4.1 **GENERAL**

The steam generating plant shall be in accordance with the following descriptions and particulars described in Subsection 1.2 MACHINERY PARTICULAR.

4.2 **AUXILIARY BOILER**

4.2.1 Construction

The boiler shall consist of the doughnut shaped steam drum and water drum which are connected by two rows of water tubes.

The flame of oil burning side shall transfer heat to water in inside water tubes by radiation. It shall become the combustion gas and be branched into two rows of water tubes and meet at the exit and be discharged from the funnel.

Contact heat transfer shall be made when water passes in water tubes and heat be transferred to water efficiently.

The exhaust gas side shall be provided with a group of a water tubes reasonably arranged circumferentially on upper and lower drums to transfer heat efficiently.

The exhaust gas inflowed through the flue shall be separated in two directions of left-hand and right-hand to effect heat exchange and discharged through the outlet funnel as low temperature exhaust gas.

Inner and outer casings shall be available. Heat insulating material shall be placed between inner and outer casings to check radiation of heat.

Insulating fire clay shall be placed in the lower part of the furnace and narrowed part of gas shorting.

4.2.2 Material

End plate Boiler steel plate
Furnace Boiler steel plate

Water tube Boiler tube

Shell plate Boiler steel plate



4.2.3 Fitting and accessory

- 1 pressure gauge root valve
- 2 sets of water gauge

(including water level controller)

- 1 set of oil burning unit
- 3 sets of soot blower (Compressed air type)
- 2 safety valve
- 1 main steam stop valve
- Each 1 main and aux. feed check valve
- Each 1 main and aux. feed stop valve
- 1 surface blow-off valve
- 1 bottom blow-off valve
- 4 water level gauge root valve
- 1 boiler water sampling valve



SECTION 5 ELECTRIC GENERATING PLANT

5.1 GENERAL

There shall be provided three (3) sets of main diesel generators.

Regarding the electric generator, refer to PART IV ELECTRIC PART.

5.2 MAIN DIESEL GENERATOR ENGINE

5.2.1 General

The main diesel generator engine shall be vertical single acting, 4-cycle direct injection, air cooled turbocharged diesel engine with air cooler.

5.2.2 Construction and material

(1) Crankshaft

The crankshaft shall be made of high grade forged steel one piece type.

(2) Main bearing shell

The main bearing shell shall be made of aluminum alloy metal lined, split in two (2) pieces type mild steel. It shall be completed thin-shell type, and provided with complete interchangeability.

(3) Engine frame

Engine frame shall be made of special cast iron, of under sling bearing structure, which is sufficiently rigid for high explosion pressure.

The engine frame shall have big inspection holes on the both side in order to be taken out the main and crank pin bearing shells, and other main moving parts.

The intake air passage shall be provided at the upper part of engine frame on the exhaust manifold side providing a double wall structure, thus substantially enclosing sound insulation.

Also passages of cooling water inlet/outlet and Lub. oil inlet shall be built into this engine frame to minimize external piping.

The main bearing cap shall be secured rigidly to the engine frame by hydraulically tightening two mounting bolts and two side bolts.



(4) Cylinder head

The cylinder head shall be made thick with special cast iron. It has a fuel injection nozzle on its center, and each 2 pieces of intake and exhaust valves and rocker arms are arranged around the fuel injection nozzle.

(5) Cylinder liner

The cylinder liner shall be made of high grade cast iron against abnormal wear, and its inside is precisely hone-finished.

The cylinder liner cooled by freshwater shall be made thick with ample rigidly so that it is sufficiently endurable even under high combustion pressure and the thermal stress.

(6) Piston, piston pin and piston ring

The piston shall be made of ductile cast iron as mono-block type and cooled by crankcase lubricating oil through the connecting rod and piston pin inside.

1st and 2nd piston ring grooves of piston shall be surface-hardened to have resistance against wear down.

The piston pin shall be made of carbonizing-hardening chromium-molybdenum steel. A full floating method shall be adopted in fitting the piston pin.

The three piston rings and one oil ring shall be made of cast iron, and piston rings and oil rings shall be chromium plated.

(7) Connecting rod and crank pin bearing shell

The connecting rod shall be made of forged steel, and it is constructed so that the forging is divided into 3 parts and the large end part is horizontally divided. The piston pin bush shall be of cylindrical steel lined with lead bronze. The crank pin bearing shell shall be of aluminum alloy metal lined completed thin shell type.

(8) Fuel injection pump and fuel nozzle holder

Both the pump with a tappet and the nozzle of Bosch type shall be attached to each cylinder.

The circulation type fuel injection pump shall be adopted.



(9) Intake and exhaust valve

Both intake and exhaust valves shall mushroom type of heat resistance steel, and provided with the valve rotators and removable seat rings respectively.

The exhaust valve shall be made of heat resistance steel.

The seat of exhaust valve shall be plated with stellite.

The exhaust valve seat shall be cooled by fresh water and the treatment of anticorrosion shall be applied for gas passage.

5.2.3 Piping

(1) Cooling system

Cooler line (LT-FW)

The engine driven LT-FW pump shall run cooling water from the external freshwater cooler into the secondary L.O. cooler and air cooler.

Under low load condition, charge air inverse warming would be carried out automatically by means of cutting off cooling water from the secondary air cooler.

Cylinder jacket line (HT-FW)

The engine driven HT-FW pump shall be circulated cooling water, which is controlled by the attached thermostat, in the primary air cooler, cylinder jacket and cylinder heads.

(2) Lub. oil system

A gear pump shall be driven by the auxiliary machinery driving gear of engine.

Lub. oil sucked up from the oil sump shall be sent out into cooler and oil filter, and lubricates main bearings, crank pin metals, piston pin metal, camshaft bearings, swing arm, valve rocker arm, timing gear train and turbocharger, while some oil cools pistons and drops back to the oil sump.

For the priming of the lubrication system during engine is in rest, electric motor driven pre-priming pump of continuous priming system shall be provided.

To safeguard the oil cooler and oil piping against excessive oil pressure, a relief valve shall be attached.



5.2.4 Fitting and accessory

The following accessories shall be supplied with the engine.

- 1 turbocharger
- 1 air cooler
- 1 flywheel
- 1 maneuvering gear
- 1 governor
- 1 exhaust gas manifold
- 1 mechanical tachometer
- 1 set of pressure gauge
- 1 set of thermometer
- 1 lub. oil filter
- 1 lub. oil by-pass filter (centrifugal type)
- 1 lub. oil pump (gear)
- 1 lub. oil cooler
- 2 cooling fresh water pump (centrifugal)
- 1 turning bar
- 1 common bed
- 1 set of fuel oil shut-off device for emergency trip



SECTION 6 PUMP

6.1 **GENERAL**

The particulars of pumping equipment shall be in accordance with Subsection 1.2 MACHINERY PARTICULAR.

The continuous running pumps for propulsive use shall be provided with two (2) sets, each one of them shall be as stand-by in principle.

6.2 <u>CENTRIFUGAL PUMP</u>

Connection between pump shaft and motor shaft shall be of the pin and buffer type flexible coupling or rigid coupling according to the Maker's standard.

Pump casing except for horizontal pumps, specially constructed type pumps and small vertical pumps shall be split or removed upward only so that the rotating members may be overhauled for inspection or replacement without disturbing the pipe connections.

The pumps which self-priming is necessary shall be provided with self-priming unit.

The materials of main parts of centrifugal pumps shall be as follows:

Name	Casing	Impeller	Shaft	Shaft seal
Cool. S.W. pump	Bronze	Ni-Al-Bronze	SUS316	Mechanical seal
Jacket cool. F.W. pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal
Fire & G.S. pump (Bilge & ballast pump)	Bronze	Ni-Al-Bronze	SUS316	Mechanical seal
Ballast pump	Bronze	Ni-Al-Bronze	SUS316	Mechanical seal
Ref. machine cool. S.W. pump	Bronze	Ni-Al-Bronze	SUS316	Mechanical seal



Name	Casing	Impeller	Shaft	Shaft seal
Drinking water pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal
Fresh water pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal
Hot water circulating pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal
Boiler feed water pump	Ductile cast iron	Stainless steel	SUS304	Mechanical seal
MGO Cooling Fresh Water pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal
D/G pre-heating pump	Cast iron	Ni-Al-Bronze	SUS304	Mechanical seal

The fittings and accessories shall be as follows:

- 1 set of coupling bolt, nut and rubber ring, if fitted
- 1 coupling cover for horizontal type pump, if fitted
- 1 drain plug
- 1 gauge board fitted with suction and discharge pressure gauges
- Each 1 root cock or valve for pressure gauge
- 1 air ejector, if fitted
- 1 common bed for horizontal type pump, if fitted

Main lub. oil pump

The material of main L.O. pump shall be accordance with maker standard.

The specified capacity and motor of main L.O. pump shall be designed on the following viscosity.

Name	Capacity	Motor output	Impeller	Shaft
Main lub. oil pump	26 cSt	260 cSt	Ni-Al-Bronze	Cr-Mo-steel



6.3 ROTARY PUMP

Rotary pumps shall develop rated capacity and discharge pressure when operating with the under-said suction conditions.

Name	Suction vacuum (MPa)	Viscosity (cSt)	Shaft seal
Fuel oil transfer pump	-0.05	26 - 1,000	Mechanical seal
L.O. transfer pump	-0.05	26 - 1,000	Mechanical seal
Stern tube L.O. pump	-0.05	26 - 1,000	Mechanical seal
L.O. puri. supply pump	-0.05	26 - 260	Mechanical seal
D/G L.O. puri. supply pump	-0.05	26 - 260	Mechanical seal

The materials of main parts of the gear pumps shall be as follows:

Casing Cast iron
Gear Carbon steel
Shaft Carbon steel

The fittings and accessories shall be as follows:

1 — set of coupling bolt, nut and rubber ring or coupling bush

1 — coupling cover for horizontal type pump

1 - relief valve

1 — gauge board fitted with suction and discharge pressure gauges

Each 1 — root cock or valve for pressure gauge

1 — common bed for horizontal type pump



6.4 SCREW PUMP

Screw pumps shall develop rated capacity and discharge pressure when operating with the under-said suction conditions.

	Name	Suction vacuum (MPa)	Viscosity (cSt)	Shaft seal
◬	Diesel oil transfer pump	-0.05	1.5 - 1,000	Mechanical seal
	Fuel oil booster pump	-0.05	1.5 - 260	Mechanical seal
	M/E fuel oil circulating pump	+0.40	1.5 - 260	Mechanical seal
	D/G fuel oil circulating pump	+0.40	1.5 - 260	Mechanical seal
	D/G dreset of booster pump	-0.05	1.5 - 260	Mechanical seal
	Emergency M.D.O . Pump	-0.05	1.5 - 260	Mechanical seal

The materials of main parts of the screw pumps shall be as follows:

Casing Cast iron
Casing cover Cast iron
Power rotor Carbon steel
Idle rotor Ductile steel

The fittings and accessories shall be as follows:

- 1 set of coupling bolt, nut and rubber ring or coupling bush
- 1 coupling cover for horizontal type pump
- 1 relief valve
- 1 gauge board fitted with suction and discharge pressure gauges
- Each 1 root cock or valve for pressure gauge
- 1 air vent plug
- 1 common bed for horizontal type pump



6.5 <u>RECIPROCATING PUMP</u>

Reciprocating type bilge pump shall be provided with conventional packing type gland seals and develop rated capacity and discharge pressure when operating with suction vacuum of -0.05MPa and viscosity of $1\sim1000$ cSt.

The materials of main parts of reciprocating pump shall be as follows:

Cylinder cover Cast iron
Cylinder liner Brass casting

Piston Brass Valve Rubber

Piston rod Stainless steel

The fittings and accessories shall be as follows:

1 — safety valve

1 - air vent plug

1 — drain plug

2 - V belt

Each 1 — V pulley

1 - safety cover

1 — gauge board fitted with suction and discharge pressure gauges

2 – gauge cock

6.6 MONROS PUMP

Monros pump shall be one kind of displacement type screw pump and provided with conventional packing type gland seals.

Monros type sludge pump shall develop rated capacity and discharge pressure when operating with suction vacuum of -0.05MPa and viscosity of $1\sim1000$ cSt.

The materials of main parts of monros pump shall be as follows:

Stator Rubber

Shaft, rotor and con-rod Stainless steel
Pump stand Cast iron



The fittings and accessories shall be as follows:

- 1 safety valve
- 2 V belt

Each 1 — V pulley

- 1 safety cover
- 1 gauge board fitted with suction and discharge pressure gauges
- 1 common bed

6.7 OTHER PUMP

The construction, materials and design of pumps attached to the main engine, main diesel generator engines, aux. boiler, oil purifiers, air compressors, waste oil incinerator, fresh water generator and etc. shall be in accordance with Maker's standard.



SECTION 7 AIR COMPRESSOR AND FAN

7.1 MAIN AIR COMPRESSOR

There shall be provided two (2) sets of main air compressor for main engine and main diesel generator engine starting and for control air and general air service.

Control air and general air service shall be supplied through the air reducing valve from main air reservoir.

The main air compressor shall be of electric motor driven two stage compression, reciprocating type and shall be completed with self contained lubricating oil system including lub. oil pump, air coolers and unloader.

The cylinders, cylinder covers and air coolers shall be cooled by fresh water.

The materials shall be as follows:

Cylinder Cast iron
Piston Aluminum
Connecting rod Forged steel
Crank shaft Forged steel
Crank case Cast iron

The fittings and accessories shall be as follows:

- 1 coupling with bolts and nuts
- 1 coupling cover
- 1 set air cooler after each stage
- 1 gauge board with pressure gauge after each stage
- 1 relief valve after each stage
- 1 set of drain valve
- 1 unloader
- 1 suction air filter
- 1 oil level indicator or sounding rod
- 1 oil drain plug for crank case
- 1 common bed for compressor
- 1 cooling fresh water pump
- 1 oil pump driven crank shaft
- 1 oil pressure regulating valve
- 1 oil filter



7.2 <u>EMERGENCY AIR COMPRESSOR</u>

The emergency air compressor shall be of electric motor driven.

The materials of emergency air compressor shall be in accordance with Maker's standard.

7.3 MAIN AIR RESERVOIR

The main air reservoir shall be made of cylindrical welded steel construction. The capacity of each air reservoir shall be sufficient to ensure six (6) starts of the main engine from rest in either direction without replenishment.

The fittings and accessories shall be as follows:

- 1 safety valve
- 1 charging valve
- 1 main stop valve
- 1 aux. stop valve
- 1 drain valve of double shut type
- 1 manhole
- 1 pressure gauge

7.4 EMERGENCY AIR RESERVOIR

The emergency air reservoir shall be made of cylindrical welded steel construction.

The fittings and accessories shall be as follows:

- 1 safety valve
- 1 charging valve
- 1 stop valve
- 1 pressure gauge

7.5 ENGINE ROOM VENTILATING FAN

The engine room ventilating fan shall be of motor driven vertical axial flow split type and motor shall be incorporated in the fan casing.

At the reverse rotation, the capacity and head shall reduced.

The materials shall be as follows:

Casing Steel plate

Impeller Aluminum alloy



SECTION 8 HEAT EXCHANGER

8.1 <u>COOLER AND CONDENSER</u>

8.1.1 Shell and tube type heat exchanger

One (1) auxiliary condenser shall have a sufficient capacity to condense excess steam from the exhaust gas section of aux. boiler.

This heat exchanger shall be of horizontal shell and tube type. Tube shall be straight, and tube end of sea water inlet side shall be expanded into tube plates.

The materials shall be as follows:

Shell Steel plate or steel pipe

Shell cover Cast iron (inside epoxy paint)

Tube plate Naval brass
Tube Aluminum brass

The fittings and accessories shall be as follows:

4 — thermometers (3 — for condenser)

1 — compound gauge for condenser

1 — peep hole for shell except small size cooler

Necessary number — air cock and drain cock for shell and shell cover

1 - set of protecting anode (Zn) for each water chest of sea water

1 — set of chemical clean. flange for both tube and shell side except small size cooler

8.1.2 Plate type heat exchanger

Each one (1) set of jacket cool. F.W. cooler and main L.O. cooler respectively shall have a sufficient capacity to meet max. output requirement of main engine.

Two (2) sets of D/G cool. F.W. cooler shall have a sufficient capacity to meet max. output requirement of three (3) sets of main diesel generator engine and two (2) sets of main air compressor.

The materials shall be as follows:

Frame plate Mild steel

Plate Titanium (in case of sea water cooling)

Stainless steel (in case of fresh water cooling)



The heat exchangers attached to main engine, main diesel generator engines and other machinery shall be in accordance with Maker's standard.

The design conditions for heat exchangers shall be as following table.

HEAT EXCHANGER CALCULATION SHEET

SHELL AND TUBE TYPE HEAT EXCHANGER

	Design condition						
	Tube side (S.W.)			Clean.			
Name	Quantity	-		Quantity Temperature (°C)		factor (%)	
	(m^3/h)	Inlet	Outlet	(m^3/h)	Inlet	Outlet	
				1,100			
Aux. condenser	40	32	49.2	kg/h	100	60	85

Remarks:

- 1) Out diameter of tube shall be 16 mm and thickness shall be 1.0 mm.
- 2) As a result of particular calculation, above said value may be altered.

PLATE TYPE HEAT EXCHANGER

e	Clean.
	factor
Temperature ($^{\circ}$ C)	
Outlet	
45.0	85
<u>79. 2</u>	
******	85
38.0	85
36.0	85
40.0	85
40.0	85
	rature (°C) Outlet 45.0 79.2 79.3 38.0 36.0 40.0

Remarks:

1) As a result of particular calculation, above said value may be altered.





8.2 OIL HEATER

There shall be provided two (2) main engine fuel oil heater, two (2) purifier fuel oil heaters, one (1) purifier lub. oil heater, one (1) diesel gene. purifier lub. oil heater, one (1) diesel gene. fuel oil heater and one (1) shifter fuel oil heater.

Boiler fuel oil heater shall be in accordance with Maker's standard.

The design conditions for there heaters shall be as following table.

		Heating		
Name	Quantity	Tempera	ture (°C)	steam press.
	(Lit/h)	Inlet	Outlet	(MPa)
Main engine				
F.O. heater	4,200	105	<mark>150</mark>	0.55
Purifier				
F.O. heater	2,300	55	98	0.55
Purifier				
L.O. heater	2,400	45	90	0.55
Diesel gene.				
F.O. heater	1,600	105	<mark>150</mark>	0.55
Shifter				
F.O. heater	3,400	55	85	0.55
D/G purifier				
L.O. heater	600	45	90	0.55

The materials of oil heaters shall be as follows:

Shell Steel tube

Tube Steel tube with rod or coil tube

The fittings and accessories shall be as follows:

1 — drain plug

1 - air vent cock

1 - relief valve

2 – thermometer



SECTION 9 FRESH WATER GENERATOR

9.1 **GENERAL**

There shall be installed one fresh water generator, utilizing the waste heat in the jacket water from the main engine.

The fresh water generator shall produce fresh water of salinity not exceeding 10 P.P.M of salt at abt. 90°C main engine jacket water temperature and 32°C cooling sea water temperature.

The distilling cycle shall be as follows:

Jacket water from the main engine cooling F.W. outlet shall be led to the evaporator. Sea water branched from condenser cooling sea water outlet shall be led to the evaporator and heated by the fresh water from the main engine cooling system.

Sea water shall be evaporated in separator shell at a comparatively low temperature due to the vacuum produced by means of the water ejector.

The vapour shall be led into the condenser through the deflector and demister and then condensed by the cooling sea water.

The brine, concentrated sea water, shall be constantly taken out from the evaporator and discharged to over board.

The ejector pump shall supply sea water to water ejector. The distillate pump shall take the fresh water produce from the condenser of the fresh water generator and transfer it to the fresh water tank.

9.2 FITTING AND ACCESSORY

- 1 ejector
- 1 set of distillate pump
- 1 set of ejector pump
- 1 set of salinity alarm device
- 1 solenoid valve
- 1 vacuum gauge
- 1 set of pressure gauge
- 1 flow meter
- 1 chemical injection unit

Other necessary fittings

The construction and materials shall be in accordance with Maker's standard.



SECTION 10 PIPING GENERAL

10.1 GENERAL

Consideration shall be given in design so that the piping shall be led as directly as practicable with a minimum of bends.

Care shall be taken to avoid as far as possible pockets in pipe lines. Where pockets do occur, they shall be fitted with bosses having valves or screwed plugs or other means for draining if necessary. The drain plugs shall not be fitted in way of cofferdams or voids. The lines which necessitate draining frequently shall be fitted with valves or traps, or both.

The radius of bends in steel pipe shall be about two times the nominal diameter except for bend elbow. But in case it is difficult to make good piping arrangement with two times, bend elbow may be used. Welding fittings may be employed in place of pipe bends.

In case that the bend elbows are used, the radius of bends shall be one or one and half times of nominal diameter.

The system shall be designed to allow for all stresses due to thermal expansions and deflections of ship's structure.

Except where otherwise noted, expansion shall be compensated by using bends.

Expansion joints in exhaust gas pipes shall be of bellows type.

The pipes shall be supported suitably against excessive vibration.

The oil piping shall be kept as far as away from hot surface as practicable. The pipe shall, as far as possible, not be arranged directly above or in front of or behind the switch board. If unavoidable, suitable protection shall be provided.

Where piping passes through water or oil tight bulkheads and decks, the connection shall be made tight by means of three spool flanges or direct welded pipes.

Connections through insulated bulkheads shall be of sufficient length to permit access to flanged connection without disturbing the insulation.

The directly welded pipes shall be employed for piping penetrated through tank walls constructed with hull, such as sounding pipes, pump suction pipes and vent pipes.

Where galvanized piping is specified, the galvanizing shall be done after the pipe is fabricated and flanges are attached thereon in shop, except for screwed ends which may be attached after galvanizing.



Where it is impracticable or welding has destroyed galvanization the surface shall be touched up with coat of zinc rich paint.

Unions joints, screw joints or bite joints may be used for connecting the small pipes, valves and cocks.

After fabrication in shop for subsequent assembly, the lubricating oil pipes of main engine forced circulation system shall be pickled before installation. After fitting out onboard, they shall be cleaned by flushing with the lubricating oil which is prepared as system oil.

Packing used for all pipe lines, in general, shall be of multipurpose type or reinforced rubber sheet type.

10.2 SEA CHEST

The number of sea chest shall be kept to a minimum by combining the system. The suction sea chest shall be of welded steel construction and fitted with sea valve of angle, globe and butterfly type.

The distance piece for overboard and sea suction connection shall be of extra heavy steel pipe or fabricated steel construction. The thickness of distance piece shall be determined according to the requirement of the Classification Society.

In general, suction sea chest shall be fitted with grid type strainer which shall be fabricated from flat steel bars and galvanized after fabrication. For small suction sea chest, perforated strainer plates of galvanized steel may be used.

Strainer grids or plates shall have a clear area not less than two times cross sectional area of the connected pipe, and shall be secured so that no part extends beyond the shell. The bolts or studs and nuts for securing strainer grid or plates shall be of stainless steel. The studs and nuts for securing sea valve shall be of stainless steel.

Steam blow valve with coupling and air vent shall be fitted to each suction sea chest.



10.3 <u>VALVE AND COCK</u>

In general, the valves and cocks of marine use which are specified in accordance with Japanese Industrial Standard (JIS) or equivalent standard shall be used except that the valves and cocks for control system which have special construction and shape shall be in accordance with Maker's standard.

Generally, globe and angle valve shall be used on engine room piping system, but as to fresh water and sea water lines of pipe diameter 80 mm and above, butterfly valve shall be adopted.

Pipe line	Material of valve body	Joint	Nominal
Bilge, ballast and			
sea water line		Steel slip on	
50 mm & above	Cast iron	welded flange	5K STD
40 mm & below	Bronze	or sleeve	
Fire line		Steel slip on	
50 mm & above	Cast iron	welded flange	10K STD
40 mm & below	Bronze	or sleeve	
Fresh, drinking and			
cooling F.W. line		Steel slip on	
50 mm & above	Cast iron	welded flange	5K STD
40 mm & below	Bronze	or sleeve	
M/E F.O. circulating pump			
discharge line	Special	Steel slip on	
50 mm & above	cast iron	welded flange	16K STD
40 mm & below	Bronze		
D/G F.O. circulating pump			
discharge line	Special	Steel slip on	
50 mm & above	cast iron	welded flange	16K STD
40 mm & below	Bronze		
F.O. and L.O. line		Steel slip on	
50 mm & above	Cast iron	welded flange	5K STD
40 mm & below	Bronze	or sleeve	
F.O. purified line	Special	Steel slip on	
50 mm & above	cast iron	welded flange	5K STD
40 mm & below	Bronze	or sleeve	



Pipe line	Material of valve body	Joint	Nominal
Steam (0.7MPa) line 50 mm & above 40 mm & below	Cast iron Bronze	Steel slip on welded flange or sleeve (Note:4)	10K STD
Steam (0.4MPa) line 50 mm & above 40 mm & below	Cast iron Bronze	Steel slip on welded flange or sleeve	5K STD
Feed water line	Bronze	Steel slip on welded flange	16K STD
Compressed air (2.9MPa) line 32 mm & above 25 mm & below	Cast steel Forged steel	Steel slip on welded flange	20K STD
Compressed air (0.8MPa) line	Bronze	Steel slip on welded flange or sleeve	10K STD

Note:

- 1) Valves on hull construction of 40 mm bore and below shall be of cast bronze and those of 50 mm and above shall be of cast steel.
- 2) Main suction valves fitted on outside walls of fuel oil and lub. oil tanks except double bottom tanks shall be of special cast iron except those of 40 mm bore and below of cast bronze.
- 3) Valves and pipe fittings in the piping system of group Π except steam line shall be of casting with on elongation of 12% and over.
- 4) Sleeve welded joint is not to be used for steel pipes having a nominal diameter for more than 80A for steam line.
- 5) Mechanical joints shall be of NK-approved type and the construction and type shall be in accordance with Table D12.8 and Table D12.9 (12.3.3, Part D of the Rules).



10.4 PIPING SCHEDULE

(1) LIST OF MATERIAL (PIPE LIST)

			Des	sign	Test p	ressure		
	Pipe line	Kind of pipe	Press (MPa)	Temp. (°C)	Shop (MPa)	After inst.	Remarks	
	Bilge line \triangle 65 mm & above 50 mm & below	SGP STPG370E (Sch.80)	0.32	Ambi-	-	Work.	To be poly-lining To be galvanized	
	Ballast line \triangle 65 mm & above 50 mm & below	SGP STPG370E (Sch.80)	0.30	Ambi-	-	Work.	To be galvanized	
	Fire line \triangle 65 mm & above 50 mm & below	SGP - STPG370E (Sch.80)	0.75	Ambi-	-	Work.	To be poly-lining To be galvanized	
	Cooling S.W. & S.W. service line 65 mm & above 50 mm & below	SGP STPG370E (Sch.80)	0.45	Below 55	-	Work. Cond.	To be poly-lining To be galvanized	
<u>}</u>	Cooling F.W. line 125 mm & above 100 mm & below	SGP-E SGP-B	0.45	92	-	Work. Cond.	To be parker i z	zing
	F.O. sett. tank to F.O. purifier		0.30	60	-	0.45		
	F.O. puri. to tank	STPG370E	0.30	98	0.45	0.45	1	
	F.O. boost. pump to M/E F.O. circ.pump	(Sch.40)	0.30	90	0.45	0.45	-	
	M/E F.O. circ. pump to main engine	KSTPG38S (Sch.40)	1.40	150	2.10	2.10	To be pickled &	
	Main engine to mix. tube	STPG370E (Sch.40)	0.40	150	0.60	0.60	to be insulated	
	D/G F.O. circ. pump to diesel generator	KSTPG38S (Sch.40)	1.40	140	2.10	2.10		
	Boiler F.O. serv. line	STPG370E (Sch.40)	0.30	98	0.45	0.45		
	Boiler F.O. burning pump to burner	KSTPG38S (Sch.40)	1.80	130	2.70	2.70		
	F.O. transfer line 125 mm & above 100 mm & below	SGP-E SGP-B	0.32	50	-	0.48	-	
	L.O. line 125 mm & above 100 mm & below	SGP-E SGP-B	0.42	55	-	Work. Cond.	To be pick. (except trans. line)	
	L.O. purified line 125 mm & above 100 mm & below	SGP-E SGP-B	0.35	90	0.53	Work. Cond.	To be pickled	



			Des	sign	Test p	ressure	
Pipe line	e	Kind of	Press	Temp.	Shop	After	Remarks
		pipe	(MPa)	$(^{\circ}C)$	(MPa)	inst.	
			0.80	175	1.20	Work.	To be
Steam line		SGP-B	0.45	155	0.68	Cond.	insulated
		STPG370E				Work.	To be
Boiler blow lin	e	(Sch.40)	1.00	175	1.50	Cond.	insulated
Tank heating p	ipe	STPG370S					
(In engine roon	-	(Sch.80)	0.8	175	1.20	1.2	-
Exh. steam			Below	Below		Work.	To be
& drain		SGP-B	0.10	100	-	Cond.	insulated
		KSTPG38S		Ambi-			To be
C1-:	. 1:	(Sch.40)	2.99	ence	4.49	Work.	galvanized
Compressed air	line	STPG-370E		Ambi-		Cond.	for
		(Sch.40)	0.90	ence	1.35		main pipe
	Suc.	STPG-370E	Below				
Feed water	line	(Sch.40)	0.10	60	-	Work.	
line	Dis.	STPG370S				Cond.	-
	line	(Sch.40)	1.10	60	1.65		
		SUS304-A		Ambi-		Work.	
Drinking water	line	(Sch.20S)	0.55	ence	-	Cond.	-
Fresh water ser	vice			Ambi-		Work.	To be
line		SGP-B	0.55	ence	-	Cond.	galvanized
F.W. gene. dist	illate	SUS304-A				Work.	
water line		(Sch.20S)	-	-	-	Cond.	-
						Work.	
Gauge pipe line	e	Copper	-	-	-	Cond.	-
Oily drain,							
deck scupper &	5	SGP-B	-	-	-	-	-
open ended pip	e						
		SGP-E					
Exhaust gas pipe		STPY-400	-	-	-	-	-
		SS400					
				100			
	\triangle					VX.5 1.50	and a second
M. G. P. S.	1 :	SGP	_			Work.	To be
distribution	Tine	Jul	14550	0 , 1 8	0. - 0	Cond.	poly-lining

Pipe line	Bore	Kind of pipe	Remarks
Overflow pipe, sounding pipe	40mm, 50mm	STPG370E (Sch.80)	
and vent. pipe fitted to	65mm & above	SGP	_
the hull constructed tank			



(2) THICKNESS OF STEEL PIPE

Unit: mm

Nominal	Outside	Steel pipe		SGP-E
diameter	diameter	Sch.40	Sch.80	SGP-B
	ł			
10	17.3	2.3	3.2	2.3
15	21.7	2.8	3.7	2.8
20	27.2	2.9	3.9	2.8
25	34.0	3.4	4.5	3.2
32	42.7	3.6	4.9	3.5
40	48.6	3.7	5.1	3.5
50	60.5	3.9	5.5	3.8
65	76.3	5.2	7.0	4.2
80	89.1	5.5	7.6	4.2
100	114.3	6.0	8.6	4.5
125	139.8	6.6	9.5	4.5
150	165.2	7.1	11.0	5.0
200	216.3	8.2	12.7	5.8
250	267.4	9.3	*12.7	6.6
300	318.5	*9.5	*12.7	6.9
350	355.6	*9.5	*12.7	7.9
400	406.4	*9.5	*12.7	7.9
	I.	l .	1	

Unit: mm

	Exhaust gas pipe	Thickness of copper pipe		
Nominal dia.	Thickness	Material	Outside dia.	Thickness
650 & above	6.0	SS 400	6	1.0
400 to 600	6.4	STPY-400	10	1.0
350 & below	-	SGP-E	12	1.2
			16	1.2

Note:

- 1) 10 mm and below pipes in nominal diameter shall be of seamless copper pipe.
- 2) STPY-400 shall be adopted for marked * size pipe.
- 3) The material of M/E exh. gas pipe above one (1) meter under the funnel top plate shall be anti-corrosive steel.



10.5 STRAINER

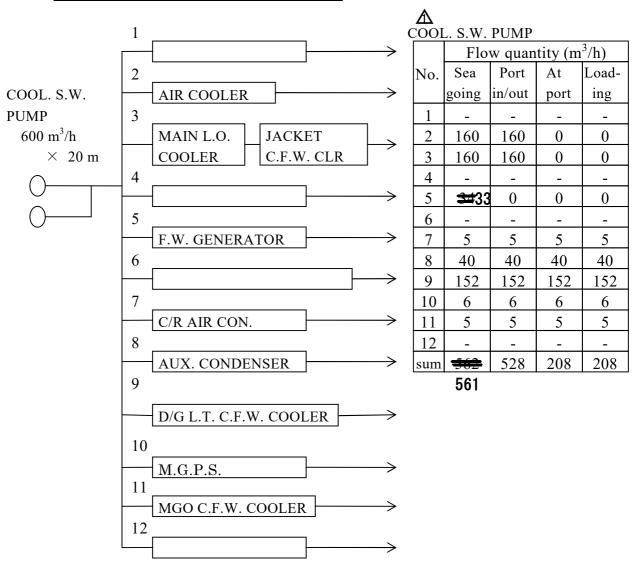
		No.×Mesh		
Line	Item	Inlet	Outlet	Remarks
	Cool. S.W. pump	2× 8 mm	-	Simplex type The element to be
Sea water	Ref. mach. cool. S.W. pump	1× 8 mm	<u> </u>	SUS316, Casing to be lidest steel and inner
line				surface to be of poly lining Epoxy paint
		1×		Inner strainer
	Main L.O. cooler	abt. 4 mm		(Maker supply)
	D/G low temp.	$2\times$		
	F.W. cooler	abt. 4 mm		
	Bilge &			Simplex type
	ballast pump	1× 8 mm	-	The element to be
				stainless, and inner
Bilge &	Fire & G.S. pump	1× 8 mm	-	surface to be of epoxy
ballast line	\triangle	4		paint
	Ballast pump	2× 8 mm	-	
	Bilge pump	1×32	-	Simplex type
	Sludge pump	1×10	-	
	Bilge separator	1×100	-	
Fresh water	Drinking water tank	_	1×10 mm	Rose box
line				
	Fresh water tank	-	1×10 mm	
D . 1:	D : 4			Y type strainer
Drain line	Drain trap	Each 1	-	XX
Steam line	Reducing valve & temp. cont. valve (direct type)	Each 1	-	Y type strainer

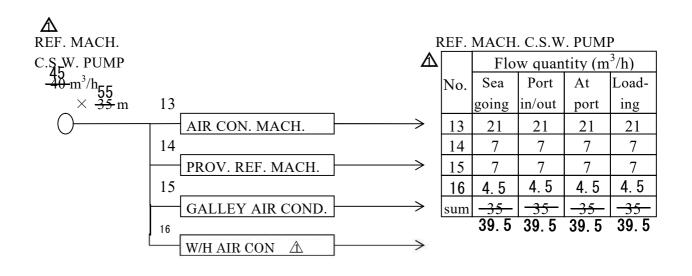


		No.×Mesh		
Line	Item	Inlet	Outlet	Remarks
	F.O. transfer pump	1× 16	-	Simplex
		_		
	D.O. transfer pump	1× <mark>60</mark>	-	Simplex
		1× 60	-	Duplex (F.O. side)
	F.O. purifier	1× 60	-	Simplex (D.O. side)
	F.O. hooster numn	1×100		Dunlay
	F.O. booster pump Main engine	1 ^ 100	1×	Duplex Auto. back wash
	F.O. circ. pump		ABS.50 μ	
	r.O. circ. pump	-	ΑΒ3.30 μ	with by-pass filter (Maker supply)
Fuel oil line	Diagal gamanatan			(Maker suppry)
ruel oil line	Diesel generator D.O. booster pump	1×100		Duplex
	Diesel generator	1 × 100	1×	Auto. back wash
	F.O. circ. pump		E.F.10 μ	with by-pass line
	r.o. circ. pump	-	$3\times$	Notch wire
			ABS.75 μ	(Maker supply)
}		<u>-</u>	ΑΒ3.73 μ	
	Dailar F.O. mumn	1 ∨ 100		Simplex (Melver symply)
	Boiler F.O. pump	1×100	-	(Maker supply)
	F.O. shifter pump	1× 32	_	Duplex
	Trot smitter pump	1111 32		Duplen
	Waste oil incinerator	1× 60	-	Simplex
	L.O. transfer pump	1× 32	-	Simplex
	Stern tube	2 × 100		
 	L.O. pump	2× 100	-	Simplex with magnet
	L.O. purifier	1× 60	_	Duplex
1	Main engine	17. 00	1×	Duplex
	L.O. pump	_	ABS.40 μ	Manual back wash
Lub. oil line	L.O. pump		πυσ. το μ	Wandar odek wash
	Sludge collector	1×150	_	(Maker supply)
				Y type strainer
	Cylinder lubricator	1	_	(Maker supply)
	Diesel generator			Simplex
	L.O. pump	3	_	(Maker supply)
		-	3×	Continuous back wash
			ABS.30 μ	(Maker supply)



10.6 SEA WATER DISTRIBUTION CHART







10.7 PIPING SYSTEM

Schematic diagrams of piping system shall be shown as follow.

FIG. 1	BILGE LINE	M10 - 12
FIG. 2	COOLING SEA WATER LINE	M10 - 13
FIG. 3a	COOLING FRESH WATER LINE	M10 - 14a
FIG. 3b	MGO COOLING FRESH WATER LINE	M10 - 14b
FIG. 4	FRESH WATER SERVICE LINE	M10 - 15
FIG. 5	FUEL OIL TRANSFER LINE	M10 - 16
FIG. 6	FUEL OIL PURIFYING LINE	M10 - 17
FIG. 7	M/E AND BOILER FUEL OIL SERVICE LINE	M10 - 18
FIG. 8	DIESEL GENERATOR FUEL OIL SERVICE LINE	M10 - 19
FIG. 9	LUB. OIL TRANSFER & FURIFYING LINE	M10 - 20
FIG. 10	LUB. OIL SERVICE LINE	M10 - 21
FIG. 11	STERN TUBE LUB. OIL LINE	M10 - 22
FIG. 12	STEAM LINE	M10 - 23
FIG. 13	COMPRESSED AIR LINE	M10 - 24
FIG. 14	EXHAUST GAS LINE	M10 - 25



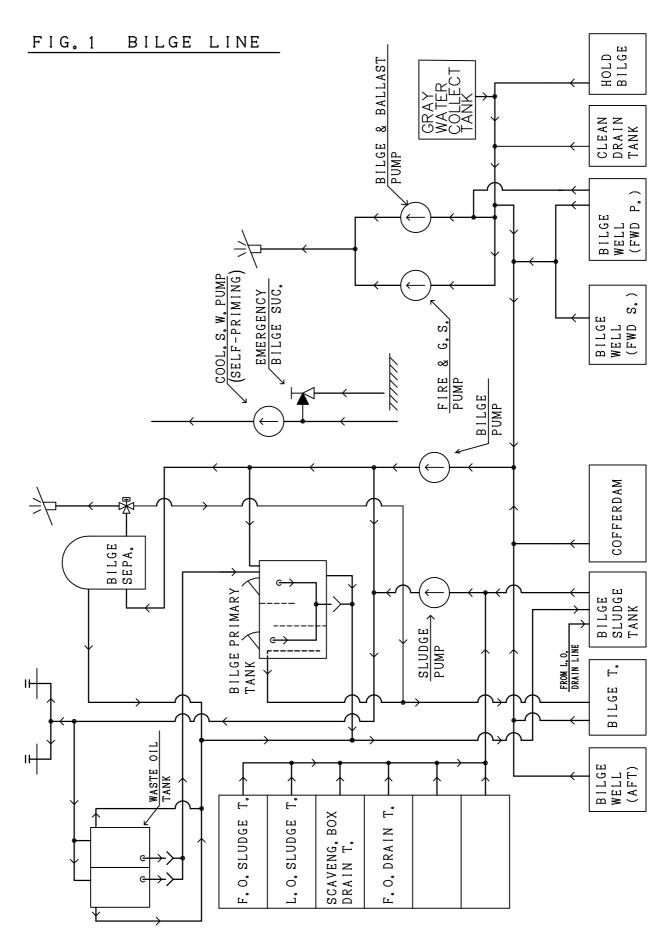




FIG. 2 COOL. S. W. LINE

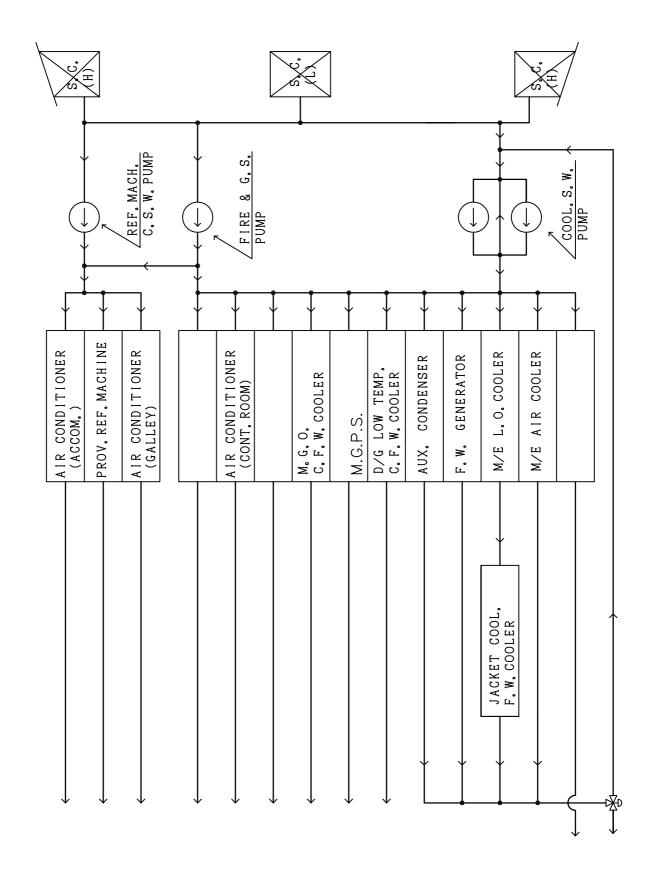




FIG. 3a COOL. F. W. LINE

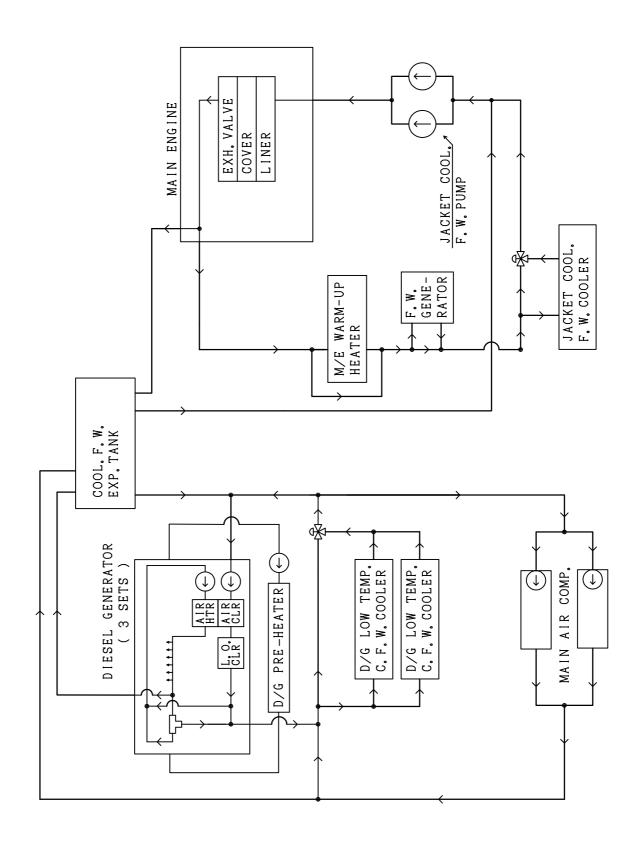




FIG. 3b M. G. O. COOL. F. W. LINE

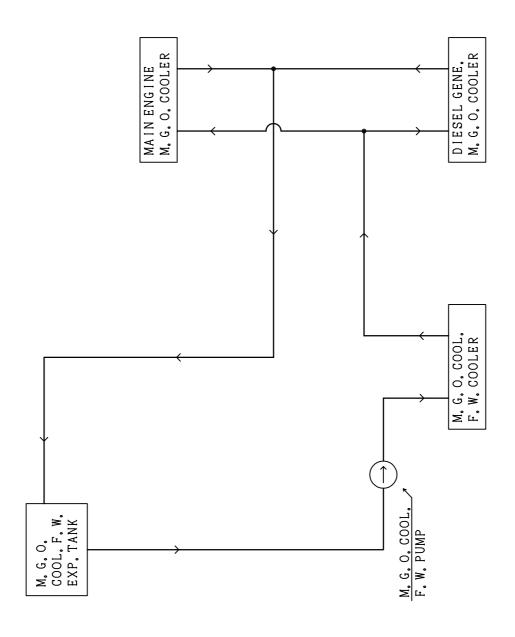




FIG. 4 FRESH W. SERVICE LINE

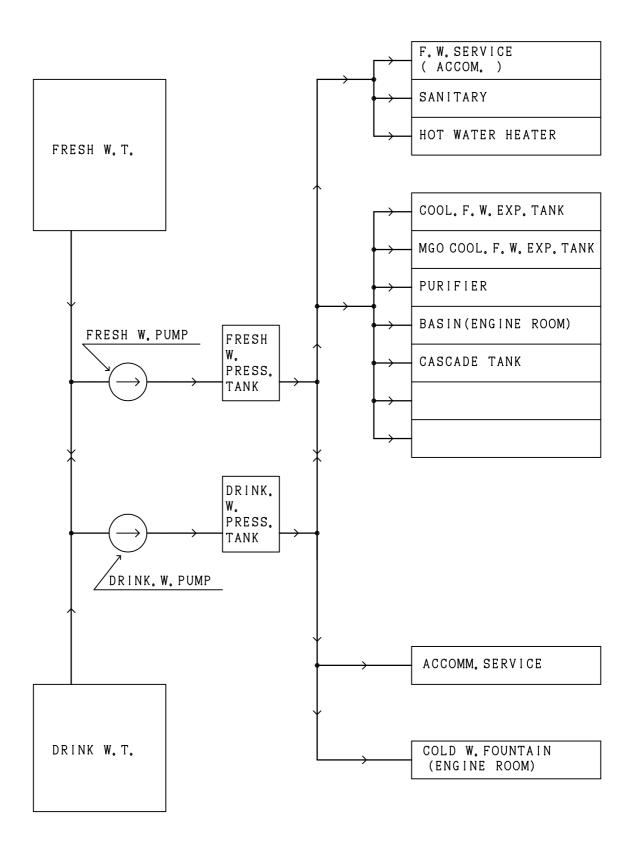




FIG. 5 F. O. TRANSFER LINE

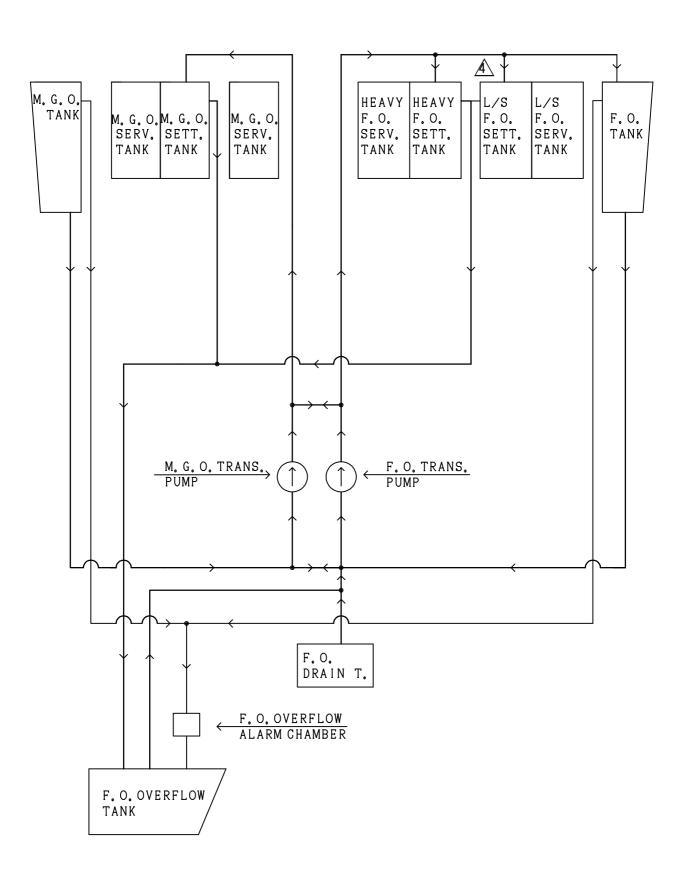




FIG. 6 F.O. PURIFYING LINE

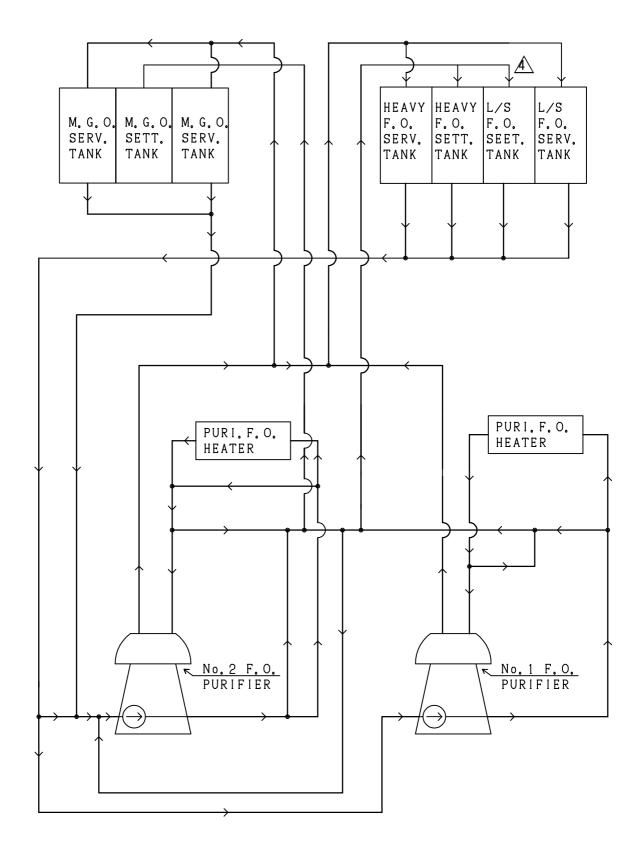




FIG. 7 M/E & BOILER F. O. SERVICE LINE 🛆

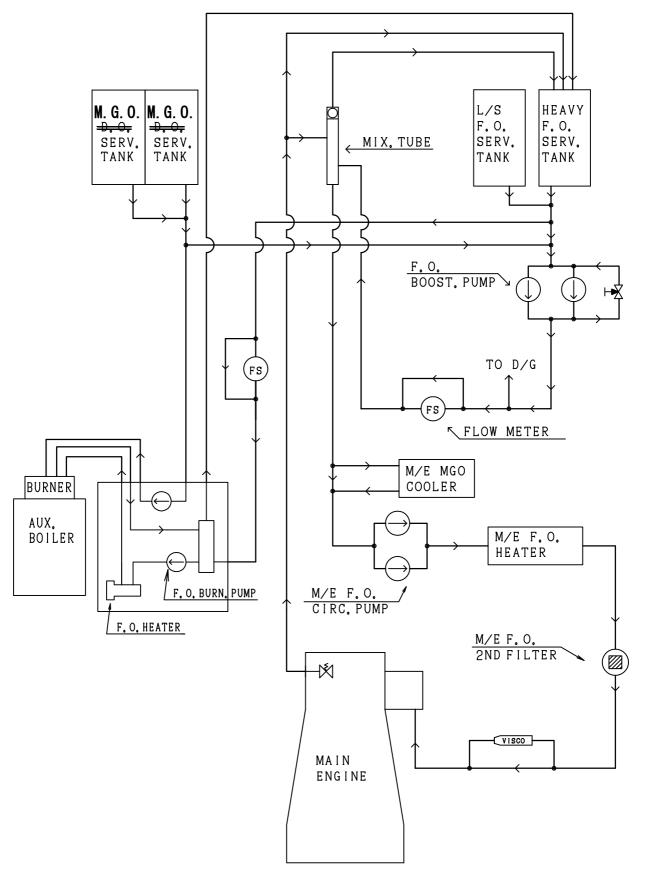




FIG. 8 D/G F.O. SERVICE LINE A

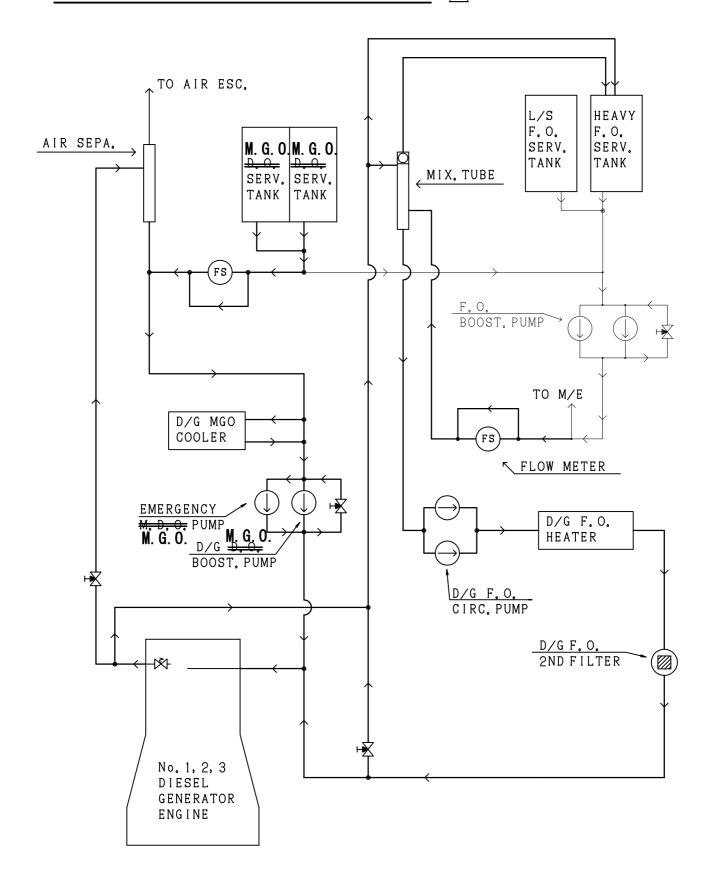




FIG. 9 L.O. TRANS. & PURI. LINE

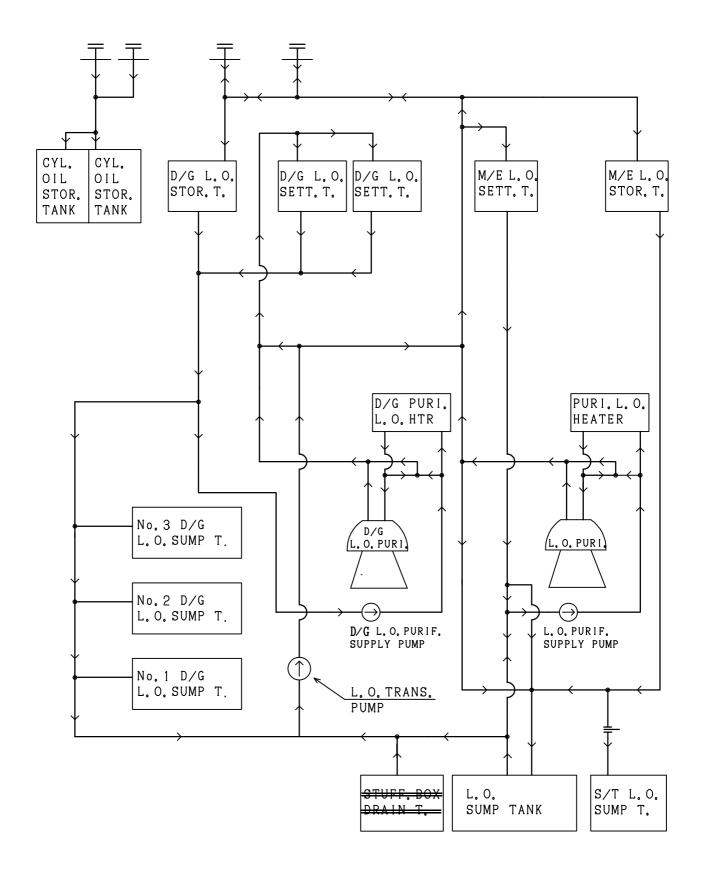




FIG. 10 L.O. SERVICE LINE

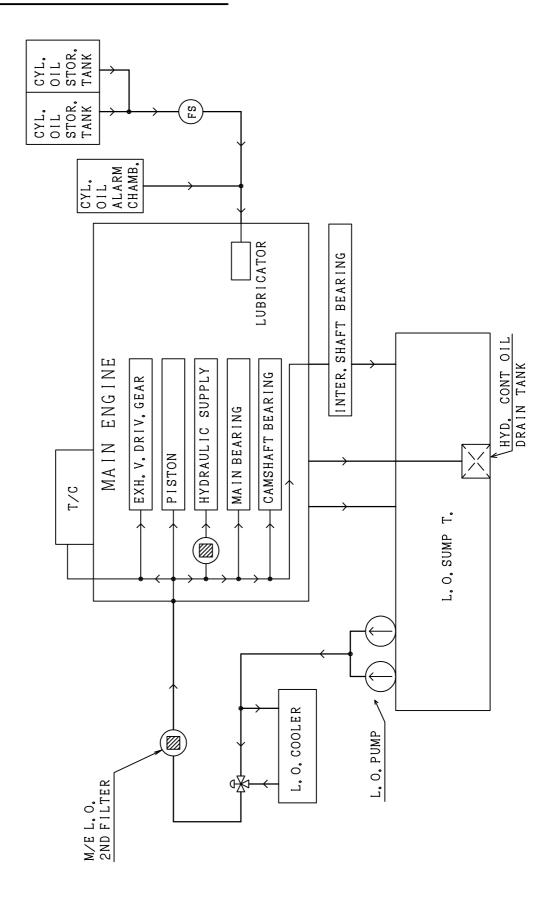




FIG. 11 STERN TUBE L.O. LINE A

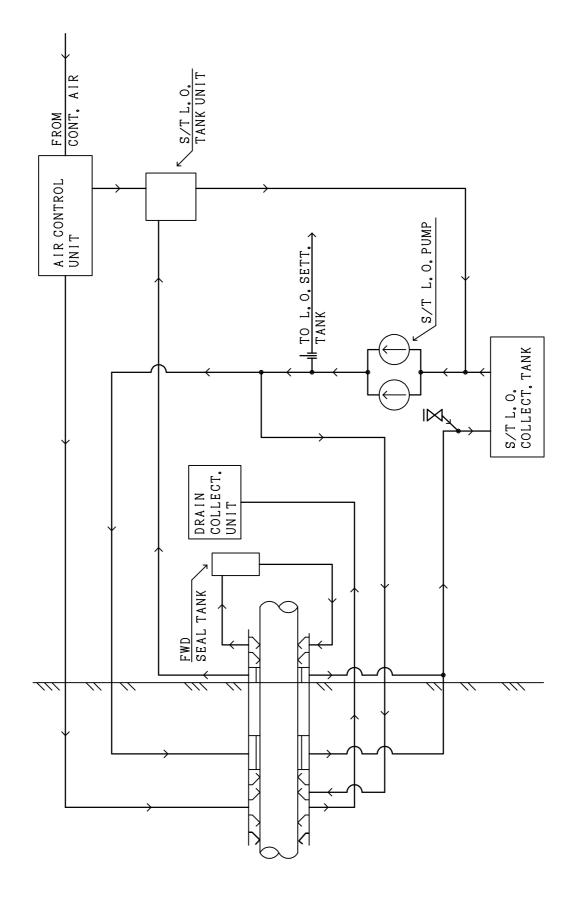




FIG. 12 STEAM LINE

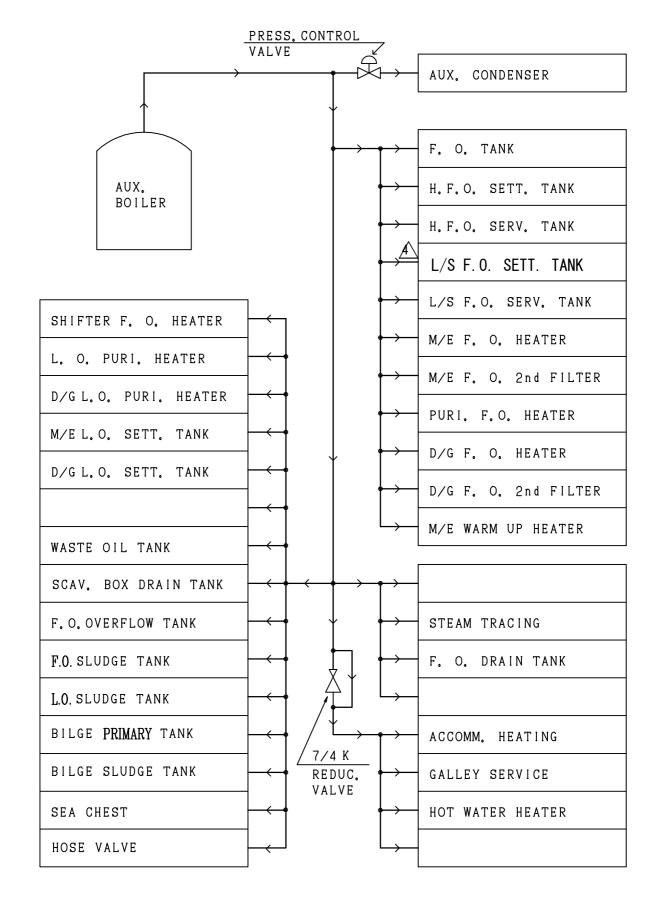




FIG. 13 COMPRESSED AIR LINE

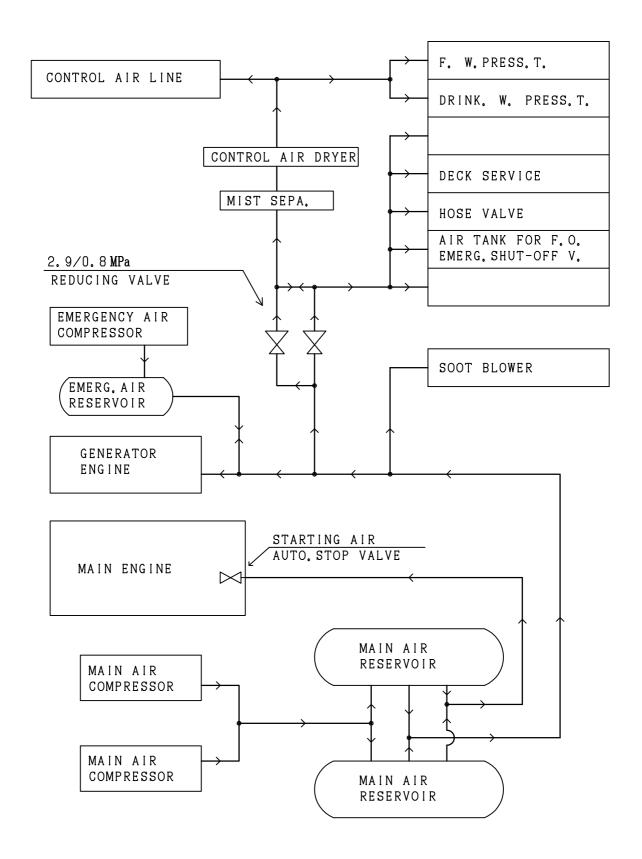
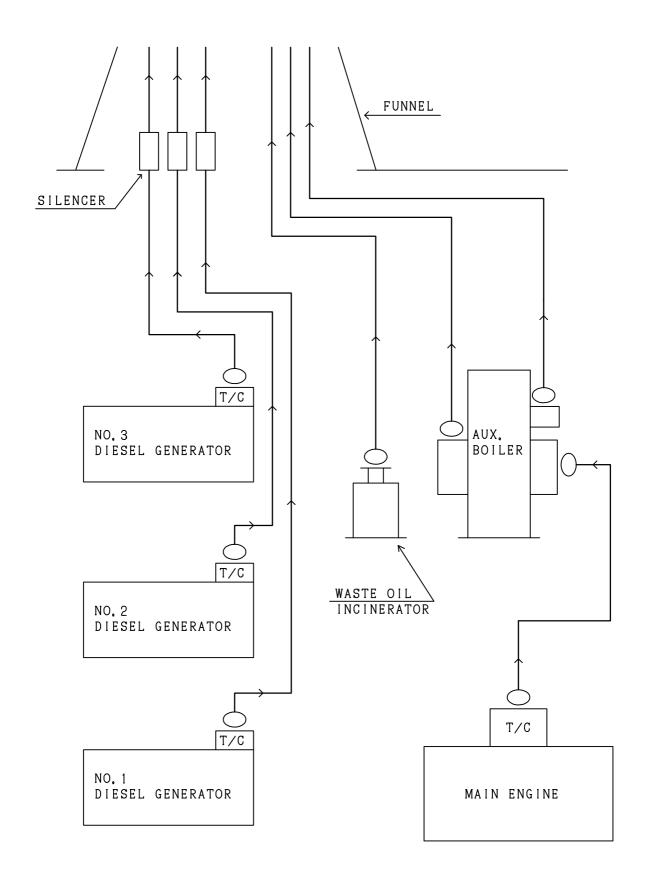




FIG. 14 EXH. GAS LINE





SECTION 11 INSULATION AND PAINTING

11.1 <u>INSULATION</u>

11.1.1 General

The external surface of the equipment and tanks which shall treat or contain the fluid having temperature above 55°C, except for the jacket cooling fresh water system, lub. oil system and boiler feed water line, shall be insulated as described below. Jacket cooling F.W. pipes in the location where people can easily touch shall be insulated.

The insulation materials such as glass wool, rock wool, etc. shall be suitably served according to the internal temperature of equipment and tanks concerned.

Where it is necessary to fit removable and replaceable insulation on flanges, valves, fittings, etc., glass wool mattress shall be used. Where glass wool mattress are used, they shall be secured with steel wires, steel bands and clips.

A-60 insulation shall be provided for engine room fore side bulkhead.

11.1.2 Application for equipment and tank

Main engine, main diesel generator engines, incinerator and aux. boiler shall be insulated according to Maker's standard.

Pumps, coolers, condenser and oil heaters shall not be insulated, however oil heaters shall be provided with metal cover for protection.

The external surface of under said tanks which are exposed to the engine room except rear wall and bottom of the tanks shall be insulated in accordance with the following table.

		Insulation		
	Tank	Material	Thickness in	Covering
			mm	
	Heavy fuel oil settling tank			Galvanized
	Heavy fuel oil service tank	Glass wool or		steel plate
	L/S fuel oil service tank	rock wool	25	(abt. 0.2mm) or
	Waste oil tank			aluminized glass
7	L/S fuel oil sett. tank			cloth

4

The tanks attached to machinery or equipment, insulation of which are required, shall be insulated in accordance with Maker's standard.

Other tanks shall not be insulated.



11.1.3 Application for piping

The materials and thickness of insulation for piping except for exhaust gas system, jacket cooling fresh water system and lub. oil system shall be in accordance with the following table.

Tamanamatana manaa	Nomina	Nominal pipe diameter in mm		
Temperature range of internal fluid	Up to 20	25 to 150	200 & above	Material
of internal fluid	Thickness of insulation in mm			
Up to 100℃	6	20	20	Glass wool,
101°C to 183°C	6	20	20	glass mat or
184°C and above	6	40	40	glass wool mattress

The exposed parts of the following pipes which is a danger to the crew shall be insulated with glass cloth irrespective of pipe diameter and internal temperature.

- ·Boiler blow pipe
- Drain pipe after drain valves, drain traps and safety valves of aux. boiler.

The external surface of insulation material shall be covered with glass cloth or aluminum foil for protection.

The exhaust gas pipes after turbocharger of main engine, main generator diesel engines, incinerator and uptake of aux. boiler shall be insulated up to two (2) meters height from the funnel bottom in accordance with the following table and covered with galvanized steel plate.

Name	Material	Nominal pipe diameter in mm	Thickness of insulation in mm
Main engine Diesel gene. engine Aux. Boiler Incinerator	Rock wool	All sizes	50

In all cases where pipe insulation abut on flanges and fittings the end of insulation shall be suitably terminated to permit free removable of bolts and to allow for movement of pipes at hangers.



11.2 PAINTING

Machinery and piping in engine room shall be painted expect following parts.

- 1. Working surface of machinery, brass surface, and other parts which are finished bright.
- 2. Surface of insulation which are not covered with steel plates.
- 3. Internal surface of machinery, piping and tanks except otherwise mentioned.

The colour of finished coat for external surface shall be in accordance with the following table.

Name of machinery or equipment	Colour
Diesel engine	
Main air compressor	
Cooler	
Aux. condenser	Light blue green
Main air reservoir	(Munsel notation : 7.5BG7/2)
Fresh water generator	
Intermediate shaft bearing	
Turbocharger	Silver
	Silver
C/R packaged air conditioner	Light blue green
	(Munsel notation : 7.5BG7/2)
Aux. boiler	
Incinerator	Maker's standard
Tank	
Pipe (Not insulated)	White
Air trunk	(Munsel notation : N-9.5)
Main air reservoir <u>∧</u>	

Other machinery and equipment shall be painted in accordance with Maker's standard.

The piping system shall be discriminated with colour bands.



SECTION 12 MISCELLANEOUS EQUIPMENT

12.1 OIL PURIFYING DEVICE

12.1.1 <u>Fuel oil purifier</u>

Two (2) fuel oil purifiers shall be disc bowl type.

One (1) of these purifiers shall be able to use as diesel oil purifier.

The materials of main parts shall be as follows:

Bowl disc Stainless steel

Bowl body Special stainless steel

Frame Cast iron

Vertical shaft Special alloy steel

The fittings and accessories shall be as follows:

1 — oil level gauge

1 — multi monitor

1 - set of disc

1 - oil feed pump

As to automatic system, refer to Subsection 13.5 <u>INSTRUMENTATION AND</u> <u>CONTROL IN ENGINE CONTROL ROOM</u>.

12.1.2 <u>Lubricating oil purifier</u>

One (1) lubricating oil purifier and one (1) D/G lubricating oil purifier shall be disc bowl type.

The materials of main parts shall be as follows:

Bowl disc Stainless steel

Bowl body Special stainless steel

Frame Cast iron

Vertical shaft Special alloy steel



The fittings and accessories shall be as follows:

- 1 oil level gauge
- 1 multi monitor
- 1 set of disc

As to automatic system, refer to Subsection 13.5 <u>INSTRUMENTATION AND</u> <u>CONTROL IN ENGINE CONTROL ROOM</u>.

12.2 BILGE SEPARATOR

One (1) bilge separator shall be provided in engine room.

The materials of main parts shall be as follows:

Casing Steel plate

The fittings and accessories shall be as follows:

- 1 solenoid valve
- 1 relief valve
- 2 drain plug
- 2 test cock
- 2 sets of pressure gauge with cock
- 1 set of bilge alarm device
- 1 set of automatic 3-way valve



12.3 ENGINEER'S WORKSHOP AND STORE ROOM

The engineer's workshop shall be provided at suitable location in engine room and shall be provided with the machine tools as listed in the Subsection 1.2 MACHINERY PARTICULAR, a work table combined with vice, suspended tool board, fire proof curtain near welding space and etc. as Builder's practice. Tool cabinet shall be provided two (2) sets in the workshop.

Metal shelves shall be provided in the store room to hold small spare parts and tools.

Oxygen & acetylene bottles shall be located on outside of engine room and it's shall be led to engineer's workshop by means of fixed piping.

12.4 <u>LIFTING GEAR AND TOOL</u>

One (1) overhead traveling crane, having as electrically hoist shall be installed over the main engine for overhauling cylinder cover, cylinder liner and piston.

Hoisting and longitudinal travelling shall be electrically performed, and transverse travelling shall be performed by hands by means of link chain pulley and reduction gear.

Plane trolleys and I beams shall be provided for overhauling diesel generator engine and purifiers respectively.

Eye plate shall be suitably fitted for overhauling pumps, heat exchangers and strainers of heavy weight.

12.5 TANK IN ENGINE ROOM

Tanks as listed in the Subsection 1.2 <u>MACHINERY PARTICULAR</u> shall be provided in the engine room.

All tanks shall be made of welded steel plate.

Regarding the insulation and painting of tanks, refer to **SECTION 11 INSULATION AND PAINTING**.

All tanks shall be fitted with necessary connections and fittings as following table.



					Fit	ting			
	Name of tank	Emerg. Shut- off valve	Self closing valve	Air vent	Level gauge	Heat.	Heat. coil ratio (m²/m³)	connec	Remarks (Thermo -meter)
	Heavy fuel oil settling tank	О	О	O	F	О	0.3	0*	О
	Heavy fuel oil service tank	О	О	O	F	О	0.3	o*	О
7	L/S fuel oil sett. tank	0	0	0	F	0	0.3	0*	0
	L/S fuel oil service tank	О	О	О	F	О	0.3	o*	О
	Diesel oil service tank 🖄	О	О	O	F	-	<u>-</u>	0*	
).	Diesel oil settling tank	O	O	O	F F	<u>-</u>	<u> </u>	o*	
	F.O. sludge tank	_	О	О	F F	О	0.1	o*	
	L.O. sludge tank	-	О	О	F	О	0.1	0*	
	Fuel oil drain tank	-	-	О	S	О	0.1	0*	
	Fuel oil overflow tank	-	-	О	F	О	0.03	0*	
	M/E lub. oil sump tank	-	-	О	F&S	-	-	-	
	M/E lub. oil storage tank	-	-	O	F	-	-	-	
	M/E lub. oil settling tank	О	О	O	F	О	0.2	o*	О
	D/G lub. oil storage tank	-	-	O	F	-	-	-	
	D/G lub. oil settling tank	О	О	О	F	0	0.2	o*	О
	S/T lub. oil collect tank	_	_	O	F	_	<u>-</u>	_	
	S/T FWD seal L.O. tank	<u>-</u>	-	O	G*	<u>-</u>	<u> </u>	<u>-</u>	
	S/T lub. oil tank unit	<u>-</u>	<mark>-</mark>	O	G*	<mark>-</mark>	<u> </u>		
	Cylinder oil storage tank	0	_	О	F	_	_	_	
	Cylinder oil alarm chamber	-	-	О	-	-	-	-	
	,								
	Scavenging box drain tank	-	-	О	S	О	0.1	0*	
	MGO C.F.W. expansion tanks	-	_	-	- G	_	_	_	
	Cool. F.W. expansion tank	-	-	-	G	-	-	-	Open
	Deaeration tank	-	-	О	-	-	-	-	
	Cascade tank (Inspect. tank)	-	-	-	SG	-	-	-	Open
	Fresh water pressure tank	_	-	_	G	_	_	_	
	Drinking water press. tank	-	-	-	G	_	-	-	

<u></u>

M. G. O.

M. G. O.



				Fit	ting			
Name of tank	Emerg Shut- off valve	Self closing valve	Air vent	Level gauge	Heat. Coil	Heat. coil ratio (m²/m³)	_	Remarks (Thermo -meter)
Waste oil tank	О	-	О	F	О	0.5	o*	О
Bilge primary tank	-	-	-	-	O	0.01	_	Open
Bilge tank	-	-	О	S	-	-	o*	
Bilge sludge tank	_	_	0	S	О	0.01	o*	
Clean drain tank	_	-	0	S	-	-	-	
Gray water collect tank	-	_	O	F&S	_	_	_	

Note: Abbreviation

 $F: Float gauge \qquad G: Glass gauge \qquad G^*: Flat type glass gauge$

SG: Sight glass S: Sounding pipe o*: Seat only

O: To be fitted



12.6 FLOOR, LADDER AND GRATING

The engine room floor and operation platform shall be of 4.5 mm checkered pattern steel plate, supported on suitable angle.

Removable sections shall be provided as required for proper access for handling and inspection of the equipment located under floor and manholes.

Engine room gratings shall be provided at the place where are required for proper access to the equipment.

The gratings shall have steel bars of Maker's standard pattern and which shall be suitably spaced and properly fitted in flat steel bar counterframes.

Ladders shall be fitted as required for convenient access to various grating levels. Main ladders shall have foot grating and the vertical ladders shall have steps of round section steel bars. The inclination of main ladders shall be about 55° where applicable. The width of main ladders shall be 600 mm and that of sub-ladders shall be 500 mm. Vertical ladders shall be used only for unimportant, access to provisionally.

Handrails shall be fitted at gratings, ladders and floors where are necessary for the safety and convenience of operating personnel. Handrails shall be of steel pipe carried in steel pipe stanchions and shall be fitted with portable sections where required or overhauling machinery. Double handrails shall be fitted only at the main engine top and middle grating and above upper deck level in engine room. M/E overhauling platform arrangement shall be provided as Maker's standard.

12.7 <u>VENTILATION FOR ENGINE ROOM</u>

Mechanical supply ventilating system shall be provided for the engine room. The fresh air for each ventilating fan shall be taken from separate ventilating air inlets and shall be distributed to the engine room through ducts.

Total supply capacity of ventilating fans shall be determined based on the amount of air consumed by the main engine running at maximum output, taking the air consumption of diesel generator engine.

As to detail of ventilating fan, refer to Subsection 7.5 **ENGINE ROOM VENTILATING FAN**.



12.8 FIRE FIGHTING SYSTEM IN ENGINE ROOM

The ship shall be provided with fire fighting system in accordance with the rule requirement.

There shall be provided two (2) fire pumps (Bilge & ballast pump and Fire & G.S. pump), fire valve and hose the suitable place in engine room.

Portable foam fire extinguisher and removal foam fire extinguisher etc. shall be provided in accordance with the rule requirement.

Details of fire fighting system, refer to PART II HULL PART.

Fixed water-based local fire fighting system shall be provided in accordance with the rule requirement.

The emergency stop switch shall be provided outside of engine room. Details of the emergency stop switch, refer to **PARTIV ELECTRIC PART**.

The emergency shut off valve device shall be provided outside engine room for fuel oil and lub. oil tanks which air described on Subsection 12.5 TANK IN ENGINE ROOM.

12.9 <u>INCINERATOR</u>

There shall be installed one (1) set of waste oil incinerator for dispose of sludge and waste oil.

The construction, materials and accessories shall be in accordance with Maker's standard.

12.10 NAME PLATE AND CAUTION PLATE

Name plate for machinery shall be in English and in SI unit.

Caution plate for machinery shall be in English and Chinese.

In principle, name plate written in English shall be fitted to each valve which nominal diameter 15A and above.

Tanks in engine room shall be fitted with name plate.



SECTION 13 AUTOMATION AND REMOTE CONTROL

13.1 GENERAL

The control and monitoring system specified in this specification shall be designed to comply with the requirement of the Rule applicable, so as to operate the ship with unattended machinery space for period of proper hours under all sailing condition including maneuvering.

There shall be provided an engine control room in the engine room.

The main engine shall be remotely controlled from either bridge or engine control room.

The control and monitoring equipment for propulsion plant and associated ship service system shall be assembled and installed in the engine control room in order to obtain same effect on the handling which could be done at normal control and local monitoring.

Emergency running shall be also be able to do at local by means of control device of necessary minimum number.

As to communication equipment etc., refer to PART IV ELECTRIC PART.

13.2 MAIN ENGINE REMOTE CONTROL SYSTEM

The main engine remote control system shall be provided performance of reversing, starting, stopping and speed setting of the main engine, electrically-pneumatically with a micro-computer from the bridge by operating a single telegraph transmitter, and electrically-pneumatically with a micro computer from the engine control room by operating the telegraph receiver and maneuvering dial for reversing, speed setting and starting.

When the main engine control is carried out from the engine control room or local, the telegraph handle on bridge control console shall be used as conventional type engine telegraph.

The local control system shall be provided on the main engine for the case of emergency in failure of the remote control system or the governor.



13.3 ENGINE CONTROL ROOM

The independent engine control room well-illuminated, air conditioned and of soundproof, shall be located suitable place in engine room, and shall serve various purposes, such as centralized controls, supervision and date collecting, and improving the circumstance for crew and the reliability on instruments.

The engine control room shall have a sufficient space to install the following.

 Control console 	1 set
· Air conditioning unit	1 set
 White board 	1
• Chair	2
· Drawing locker	1 set
· Main switch board	1 set
• Group starter panel	1 set
 Meeting table and bench 	1 set
• Level gauge for FO bunker to	ank 1

Ventilation of the engine control room shall be of semi-forced ventilating system. A branch duct from the engine room ventilating air supply duct shall be led to the engine control room.

The exhaust air from the engine control room shall be released to engine room by means of natural ventilation.

The engine control room shall have two (2) sound-proof doors with a fixed glass window, and one (1) glass window.

13.4 <u>ALARM SYSTEM</u>

Alarm of machinery located in engine room shall be able to recognize by indicating lamps or display in engine control room.

As for details of the alarming and other instruments, refer to Subsection 13.5 **INSTRUMENTATION AND CONTROL IN ENGINE CONTROL ROOM**.

When the abnormal condition happen in engine room during "Unattended machinery spaces" running, indicating of group shall be done with alarm at following places.



1) Alarm indicating place

Bridge

· Ship's office

· Officer's mess room

Saloon

• Chief engineer's room

• 1st engineer's room

• 2nd engineer's room

• 3rd engineer's room

Alarm for 1st, 2nd and 3rd engineer's room shall be selected only for the duty engineer's room by select switch, provided in engine control room.

Extension alarm panel shall be of identification of group "A", "B", "C", "D" and "E".

2) Group of indicating

"A" group : Main engine emergency shut down

"B" group : Main engine slow down

"C" group : Main engine and propulsion auxiliaries trouble

except "A" and "B" group

"D" group : Electric and steam generating plants trouble

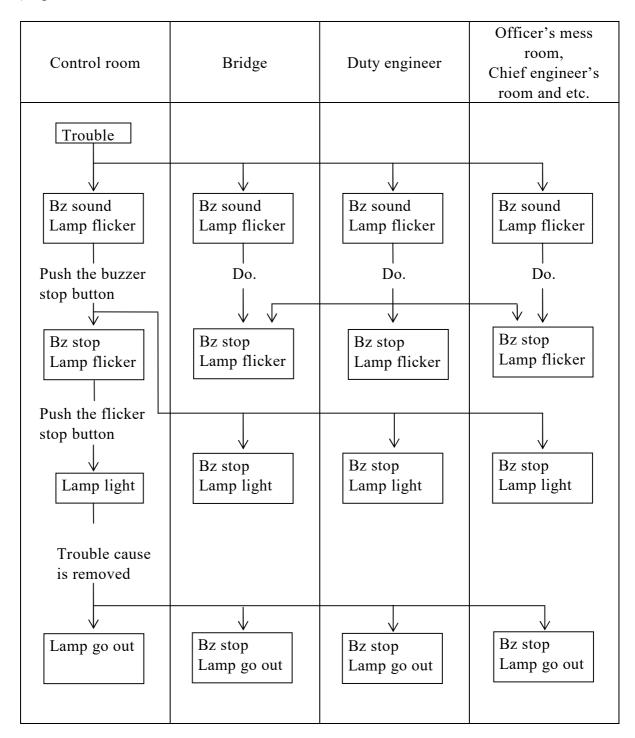
"E" group : Other trouble

The smoke type or temperature type fire detector shall be fitted in the engine room, and sectionalized into proper groups to cover specified zone of engine room which shall be identified in the fire alarm panel provided in bridge.

The audible fire alarm shall be provided to engine room, engine control room, bridge and each storey passage of accommodation quarter.



3) Operation of extension alarm





4) Operation of alarm lamp and buzzer in engine control room

	Alarm	Running i		-	mp., level er alarm
Condition		Lamp	Buzzer	Lamp	Buzzer
	Stopping	Go out	Silence	•	
Normal	Running	Light (Green)	Silence	Go out	Silence
		Flickering		Flickering	
Abnormal		(Red)	Sound	(Red)	Sound
Push the b	uzzer stop	Flickering		Flickering	
button		(Red)	Silence	(Red)	Silence
Push the f	licker stop	Light		Light	
button		(Red)	1	(Red)	_
Push the re	eset				
button at		Go out	_	_	_
starter pan	el				
Return to 1	normal	_	_	Go out	Silence

13.5 <u>INSTRUMENTATION AND CONTROL IN ENGINE CONTROL ROOM</u>

Abbreviation:

① ······ Item to be provided

 $\begin{array}{cccc} H & \cdots \cdots & High \ alarm \\ L & \cdots \cdots & Low \ alarm \\ \triangle & \cdots \cdots & Monitor \end{array}$

Note:

(1) Details of Display shall be as follows:

Size of display : 19 inches (Color)

Number of set : 2 sets Operating panel : 2 sets Log printer (log & alarm) : 1 set

Indicating pattern shall be in accordance with Maker's standard.

					LOC	CAL		С	ENT	RAL	CO	NTR	ROL	STA	TIO	N		BF	RIDO	ЗE			
									INI	DICA	ΛT.	LA	MP	A]	LAR	M							
Di [*]		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Start & stop		0				0									1)						1) Common control lever
		Reversing															1)						with engine telegraph
		Speed control		0				0									1)						2) Due to follows• Over speed
		Load limitation	0					0				3) ①					0		1				 L.O. press. drop Manual emergency trip (E/S, C/R, W/H)
	_	Upper speed limit										3) ①							1				3) On LCD display4) Due to follows
INE	system																						· Crank case high oil mist
ENGINE	ng sy	Emergency trip	2)									3) 4											Scavenging box firePiston cool. oil non-flowL.O. low press.
Z	Maneuvering	Manual emerg. trip		0		1	1)	0				3)			1)	1	0		1	1)		A	 Jacket C.F.W. low press Jacket C.F.W. out. H.T.
MAIN	Mane	Emergency trip reset		\circ				\circ															Piston cool.oil out. H.T.Exh.gas cyl. out. H.T.
																							 Thrust pad high temp. Slow down from EICU
		Auto. slow down	4)				1					3) ①1	<u>5)</u>		5) ②	2				5)		В	• S/T bearing H.T. 5)"Pre-warning"
		Auto. slow down reset						\bigcirc									0						& "Slow down"
		Auto. slow down cancel				1		\circ				3)					0		1				6) In case of E/S maneuv.
		Slow down request													6) ①	1				1)		В	
		Increase limit			\bigcirc			\bigcirc				3) ①					\bigcirc						

					LC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BI	RIDO	ъE			
						l d			IN	DICA	AT.	LA	MP	A]	LAR	M			þ				
Di sie		Item	V it constitution	Automation	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Control position		1	· .	1)		2)				3)					4)		3)				1) Engine side – Remote
																							2) C/R — W/H
																							3) "E/S","C/R","W/H"
		Imperfect Bridge control condition													(1)	1				1)		С	4) Confirmation
		Engine telegraph			5)			10)	5)						Ü		10)	5)	8)		7)		5)
		Sub-telegraph						0				6) ③					0)	6) ③		7)		A NAV.FULL H FULL
NE	system	Handle matching										9) ①							1				E HALF A SLOW
ENGINE		BUCS power source /	3									9) ①			11) ①	1						С	D D. SLOW STOP A D. SLOW
Z	uveri	BUCS failure	3												1	1						С	S SLOW T HALF
MAIN	Maneuvering	Turning gear "Engage" Disengage"				(1)																	E FULL R E. FULL
		Starting air valve																					N
		ME cont system													1)	1						С	6) "F/E","S/B","R/U"
		Main engine revolutio	n		1				Â	Â	1							4					7) Recording the order and time
		Main engine revolution counter							1														8) Telegraph repeater
		Turbocharger revolution							Â	<u> </u>	1												9) On the LCD display
		Fuel index							Â	<u> </u>	1												10) Lever type 11) Source failure 🖄

					LOC	CAL		С	ENT	RAI	L CO	NTR	ROL	STA	TIO	N		BI	RIDG	βE			
						0.			INI	DICA	AT.	LA	MP	A	LAR	M			Ċ				
Di ^s		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Starting failure													1)	1)				1)		С	1) Critical speed
		Start block													1	1						С	continuous running
		Wrong way												2) ①	1)	1)						С	2) On the LCD display
														2)	1)					1)			3) Source failure
		Critical speed RCS power source	0									2)		(1)	3) ①	1				<u> </u>		C C	4) Auto. start & stop by scavenging air press.
		RCS failure													1)	(1)				8)		С	5) " Mi" " "UNMANNED" 🛕
INE	system	EPS power source										2) ①			3) ①	1)				Ĺ		С	6) "MAN-1/E-2/E-3/E"
ENGINE	ing sy	EPS failure													1)	<u>(l)</u>						С	7) "1/E","2/E","3/E"
	Maneuvering	AC/DC power source													3)	2						С	8) "System failure"
MAIN	Iane																						9) "Auto. position request"
	N	ETS power source										2) ①			3) ①	1)						С	
		ETS failure													1	1				1		С	
		LOP power failure													1	1)						С	
		Auxiliary blower	4)	0				0				2		9)	1 2	1 2						С	
		Unattended machinery space						6)				5) ①							5) ①				
		Duty engineer						Ó				7) ③							7) ③				

			1		LOC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BF	RIDG	ъE			
						þ			IN	DICA	AT.	LA	MP	A	LAR	M			þ				
	vi- on	Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Fuel oil inlet			1) ①				Â	Â	1			<u>/2</u>	⊥H	Q						C	1) To be fitted with strainer
		Lub. oil inlet			1				Â	\triangle	1				L A	1						В	outlet
		Piston cooling oil inlet			1										L ①	1)						С	2) System failure
		Turbocharger lub. oil inlet			1					Â	1				L A	1)						С	
NE		Jacket cooling F.W. inlet			1					Â	1				L A	1)						В	
ENGINE	ure	Air cooler sea water inlet								<u></u>	1)				L A	1)						С	
	Pressure	Exhaust valve spring air													L	1)						С	
MAIN		Scavenging air			1				Â	Â	1				0	0							
		Starting air main valve inlet			1				Â	\triangle	1				L A	1)		1		L		С	
		Maneuvering air			1				713	Â	1				L A	1)		•		2)		С	
		manea terring are								713													

			1		LOC	CAL		С	ENT	RAI	CO	NTF	ROL	STA	TIO	N		BI	RIDO	ъE			
						b			IN	DICA	AT.	LA	MP	A	LAR	M			þ				
	vi- on	Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Fuel oil 2nd filter difference	0		0										Н ①	1)						С	1) U tube type
		Lub. oil 2nd filter difference			0										H	1						С	1) & tube type
		Turbocharger air filter difference			1)																		
		Air cooler in/out difference			1)																		
ENGINE	0)																						
	Pressure																						
MAIN		HPS filter													Н								
		difference HPS by-pass filter difference													① H	1)						C	
		difference <u>A</u>													1	1							

					LOC	CAL		С	ENT	RAI	CO	NTF	ROL	STA	TIO	N		BI	RIDO	ъE			
						0.			IN	DICA	AT.	LA	MP	A]	LAR	M			Ć.				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Fuel oil inlet	1)		1					Â	1			<u>^</u> 2	<mark>∺</mark> ∰	② ●						С	1) By the pneumatic type
		Lub. oil inlet	1)		1					\triangle	1				H	1						С	temp. control valve
		Piston cooling oil each cylinder outlet			6					Â	6				H 📤	6						В	
		Turbocharger lub. oil outlet			1					Â	1				H Â	1						С	
		Jacket cooling F.W. inlet			1					Â	1												
NE	e	Jacket cooling F.W. each cylinder outlet	1)												H 🚖	6						С	
ENGINE	Temperature	Jacket cooling F.W. each cylinder outlet(SD)	Ó							<u> </u>	6				H 📤	6						В	
Z	empe	Thrust pad			1					\triangle	1				H A	1						В	
MAIN	T	Air cooler air inlet			1																		
		Air cooler air outlet			1																		
		Scavenging air			1					Â	1												
		Air cooler sea water inlet			1					<u>^</u>													
		Air cooler sea water outlet			1																		
	ı																						

					LO	CAL		С	ENT	RAI	L CC	NTF	ROL	STA	TIO	N		BI	RIDO	ЭE			
						þ			IN	DIC	AT.	LA	MP	A]	LAR	M			þ				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Exhaust gas each cylinder outlet								Â	6				H &	6						В	
		Exhaust gas each cylinder outlet deviation								<u> </u>					H &	6						С	
	ture	Exhaust gas turbocharger inlet								Â	1				H <u>A</u>	1						С	
	Temperature	Exhaust gas turbocharger outlet								Â	1				H Â	1						С	
	Теп	Scavenging box fire								Â	6				H &	6						В	
		Fuel oil flow meter inlet			1																		
INE		Cylinder oil flow meter inlet			1																		
ENGINE		Lub. oil sump tank			1										L	1						С	
Z		Jacket cool. F.W. expansion tank			1										L ①	1						С	
MAIN																							
	vel	Cylinder oil alarm chamber													L	1						С	
	Tank level	Fuel oil leakage tank													H ①	1						С	
	Та	Mist catcher drain													H ①	1						С	
		Scav. box drain tank													H ①	1						С	
	<u> </u>	Stuff. box drain tank	_	<u> </u>											H	(1)							
		Stuff. OOA ufain tank													H	(1)						С	
		HCU													1	1						С	

			1		LOC	CAL		С	ENT	RAI	. CO	NTR	ROL	STA	TIO	N	<u> </u>	BI	RIDO	ъE			
									INI	DICA	λT.	LA	MP	A]	LAR	M)			ĺ	
Di si		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		M/E axial vibration 🖄			~					✓	1				2) H	1						В	1) Abnormal
		Piston cooling oil non-flow													6	6						В	2)Slow down request 🖄
		Crank case oil mist							7						H ①	1						В	
		Crank case oil mist deviation													H ①	1						C	
		Oil mist detector													1)	1						С	
		A-C oil change-over																					
INE		M/E axial vibration <u>A</u>													1	1						С	
ENGINE	Etc.	Fuel oil flow meter			1																		
	E1	Cylinder oil flow meter			1																		
MAIN		Deaeration tank													1	1						С	
		M/E F.O. viscosity/temp. controller						\bigcirc	\bigcirc						1) ①	1						C	
		M/E F.O. viscosity													HL ②	2						<mark>C</mark>	
	Δ	, _,	0	0				0					2		1) ②	2						С	
		M/E PSU AC power failure													2	2						С	
		M/E PSU UPS controller abnormal													2	2						С	
	· ·	M/E PSU 24V DC battery mode													2	2						С	

					LOC	CAL		C						STA	TIO	N		BI	RIDC	ъE			
						d d				DICA	AT.	LA	MP		LAR	M			ď				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Intermediate shaft bearing			1					Â	1				H A	1						С	
	ture	Stern tube bearing lub. oil outlet			1																		
	Temperature	Stern tube bearing								<u> </u>	2				H 2	2						В	
	Teı																						
		Stern tube													TT								
		Drain collect tank													H ①	1						С	
G	vel	Stern tube lub. oil collect tank			1										#	#					:	=	
J.L.	Tank level	Stern tube L.O. tank unit			1										HL ②	2						С	
SHAFTING	Та	Stern tube FWD seal lub. oil tank			1										HL ②	2						С	
		Stern tube lub. oil non-flow													1	1						С	
		Stern tube AFT seal Air press.													L	1						С	
	Etc.	Stern tube L.O. tank unit press.			1										##	*						#	
	Eı	Spare seal ring "use"						0				1)											
		Shaft horse power						<u></u>		<u>O</u>					1)	1						E	

					LOC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N	1	BI	RIDO	ъE			
						l d			IN	DICA	λT.	LA	MP	A	LAR	M			d				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Start	1)	0				\circ				2) ③			3)	3						D	1) Due to follows
		Stop		0				\circ															· Over current · High voltage
		Change-over		0				4)															· Low voltage · Low frequency
		Ready for start										5) ③											• D/G emerg. trip 2) Running lamp
IG PLANT		Emergency trip	6)												9	9						D	3) Due to start failure 4) AutoManual
GENERATING	Diesel engine											7)											• 5) Due to follows • F.O. handle "Run" position
GEN	Diese	A-C oil change-over		0								6											6) Due to follows
IC		Fuel oil flow meter			1																		· Over speed · L.O. press. drop
ELECTRIC		Diesel oil flow meter			1																		• F.W. high temp.
ELE		Fuel oil leakage tank													H ③	3						D	7) Due to DO use- FO use
		Speed relay abnormal													3	3						D	
		D/G LO sump tank													L 3	3						D	

					LOC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BI	RIDO	ЭE			
						þ			INI	DIC <i>A</i>	λT.	LA	MP	Al	LAR	M			d				
Di sie	vi- on	Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Lub. oil inlet			3					Â	3				L ŝ	3						D	1) By the wax type temp.
		High temp. cooling F.W. inlet			3					Â	3				L Á	3						D	control valve
		Low temp. cooling F.W. inlet			3					Â	3				L <u>\$</u>	3						D	2) By the pneumatic type temp. control valve
	pressure	Turbocharger lub. oil inlet			3										L ③	3						D	
PLANT		Starting air inlet													L ③	3						D	
	D/G	Control air inlet													L ③	3						D	
GENERATING		Fuel oil inlet	7		3									<u> </u>	LH	⑥ ≇						D	
ERAT		Fuel oil 2nd filter difference	0												H ①	1						D	
GENI		Lub. oil filter difference	0												Н 3	3						D	
		Lub. oil inlet	1)		3					Â	3				H <u>\$\hat{3}\tag{3}\tag{2}</u>	3						D	
ELECTRIC	e	High temp. cooling F.W. outlet	1)		3					<u> </u>	3				H <u>3</u>	3						D	
ELE	ratur	Exhaust gas each cylinder outlet			18																		
	temperature	Exhaust gas turbocharger inlet			6					Â	6				H &	6						D	
	D/G t	Fuel oil inlet	2)		3					Â	3				HL &	6						D	
		Low temp. cooling F.W. inlet	2)		1					Â	1				HL 2	2						D	
		Boost air inlet			3										Ш								

					LOC	CAL		C	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BI	RIDO	θE			
						l d			INI	DICA	AT.	LA	MP	A)	LAR	M			d				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Current							3						Н ③	3						D	1) "Stand-by" & "Run"
		Voltage	2)						3						HL ②	2						D	2) "MSB & FORE" & "ESB"
		Frequency	3)						2						HL ②	2						D	
		Electric power	4)						3						L 3	3						D	3) Due to auto synchronize
NT		Electric power							0						<u> </u>	<u> </u>						ט	4) Due to auto load shift
PLANT		MSB control source failure													1	1						D	
ING		MSB circ. breaker trip source failure													1)	1						D	
GENERATING	Generator	MSB control system failure													1)	1						D	
GENI	Gene																						
		ACB non-close													3	3						D	
ELECTRIC		ACB abnormal													3	3						D	
ELE		Preferential trip													1)	1						D	
		AC440V insulation													1	1						Е	
		AC110V insulation													2)	2						Е	
		Emergency generator engine abnormal										1)			1	1						D	

					LOC	CAL		С	ENT	'RAI	L CO	NTR	ROL	STA	TIO	N		BI	RIDO	Έ			
										DICA		LA			LAR								
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Running		\bigcirc		1							1										1) Due to follows
	General	Emergency trip	1)												2) ①	1						D	Miss fire & flame failureF.D. fan stop
	Gen																						Drum level lowestF.O. temp. drop
	•																						• F.O. press. drop • Source failure
		F.O. burning pump		0																			• Exh. gas high temp.
^K	gı	Forced draft fan	3)	0											1	1)						D	2) Common alarm 3) Controlled by "ON-OFF"
BOILER	Running	Feed water pump	4)	0																			system
	Rı																						4) Auto. start & stop by detect. the drum water level
AUXILIARY		Drum steam	3)		1				Â	Â	1				L A	1						D	5) By the thermostat
A	Pressure	Burner F.O. inlet			1										L <u> </u>							D	
	\mathbf{P}_{i}																						
	.du	F.O. heater outlet	5)		1										HL ②	2						D	
	Temp.																						

					LO	CAL		С					ROL	STA	TIO	N		BI	RIDO	ъE			
						d d				DIC/	AT.	LA	MP		LAR	M			ď				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Drum	0		0		HL 2		1						HL ②	2						D	1) By the float valve
	Level	Cascade tank	1)												L	1						D	2) By the pneumatic type press. control valve
	T																						1
			2)																				
		Excess steam dumping	0	0																			
ER		Soot blower		\circ																			
BOILER																							
	:	Fuel oil flow meter			1																		
AUXILIARY																							
IXU.	Etc.																						
	E																						

				1	LOG	CAL		C	ENT	RAI	. CO	NTR	ROL	STA	TIO	N	1	BI	RIDO	ъE			
									INI	DICA	AT.	LA	MP	A]	LAR	M							
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
	i.	Fuel oil purifier	1)	0		2							2		2)	2						Е	1) Auto. sludge discharge system
	Running	Fuel oil shifter	5)	0		2									1	1						Е	2) Due to follows Oil leakage
	Rur																						3) By the direct type temp. control valve
M M	ñ																						4) By the pneumatic type temp. control valve
SYSTEM		Heavy fuel oil settling tank	\bigcirc		1										H ①	1						Е	5) Auto. start & stop by detecting fuel oil trans.
		Heavy fuel oil service tank			1										H ①	1)						Е	pump running
OIL		L/S fuel oil sett. tank	3)		1										1	1						Е	6) By the electric type temp. control valve
FUEL	e.	L/S fuel oil service tank			1										H ①	1						Е	•
F	eratuı																						
	Temperature	Purifier fuel oil inlet	<mark>6)</mark>		2					<u>/2\</u>	2				H	2						Е	
	Г	Shifter fuel oil heater outlet	4)		1										H ①	1						Е	
															Н								
		Waste oil tank			2										2	2						Е	

					LOC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BI	RIDO	ъE			
						0			INI	DIC <i>A</i>	ΛT.	LA	MP	Al	LAR	M			C				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Heavy fuel oil settling tank	1)		1										HL ②	2						Е	1) By auto. start & stop of
		Heavy fuel oil service tank	2)		1										L ①	1						Е	F.O. transfer pump
		L/S fuel oil sett. tank L/S fuel oil	1)		(I)										1	(1)						Е	2) Over flow system 2 3) By auto. start & stop of
		L/S fuel oil service tank	2)		1										L ①	1						Е	D.O. transfer pump M. G. O.
		M. G. O. Diesel oil service tank <u>∕</u>	3) 4)	2									L ②	##) ()	2						Е	4) Overflow
EM	evel	M.G.O. settling tank 🖄	3) O												H@	2						E	5) Due to high level and high high level
SYSTEM	Tank level	Waste oil tank			2										HL 4	4						Е	anga anga 10 vo.
	Τ	F.O. tank													H 6	<u>6</u>						E	
T OIT		M. G. O. D.O. tank													5)	<u>6</u>						E	
FUEL																							
		Fuel oil drain tank			1										H ①	1						Е	
		Fuel oil overflow tank			1										H ①	1						Е	
	Etc.	Fuel oil overflow line													4) ①	1						Е	

					LOC	CAL		С				NTF						ВІ	RIDO	ЗE			
						d			INI	DICA	<u>AT.</u>	LA	MP	A]	LAR	M			b				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Lub. oil purifier	1)	\circ		1							1		2) ①	1						Е	1) Auto. sludge discharge
	ning	D/G Lub. oil purifier	1)			1							1		2) ①	1						Е	system
	Running																						2) Due to follows • Oil leakage
ļ																							3) By the eletric type temp. control valve
	e	Purifier lub. oil inlet	3)		1					<u> </u>	1				H <u> </u>	1						Е	temp. control valve
2	ratur	D/G Purifier lub. oil inlet	3)		1					<u> </u>	2				H A							Е	
SYSTEM	Temperature																					1	
SY	Те																						
OIL																							
LUB.																							
T1																							
	Level																						
	Le																						

					LOC	CAL		C	ENT	`RAI	. CO	NTR	ROL	STA	TIO	N		BI	RIDO	iΕ			
						þ			IN	DICA	AT.	LA	MP	A]	LAR	M			þ				
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
	gı	Main air compressor	1)	0				2)				2	2		3) ②	2						Е	1) Auto. start & stop
M	Running	Emergency air compressor		0																			2) Auto Manual ,
SYSTEM	R																						start - stop <mark>and lead-follow</mark>
		Main air reservoir 4			2					À	2			<u></u>	LH T	⊕						Е	3) Abnormal stop • L.O. low press.
AIR	Pressure	Control air			1					<u> </u>	3				L Â	1						Е	· Compress. air outlet high temp.
SED	Pres	Emergency shut off valve operating air			1										L ①	1						Е	nigh temp.
RESS																							
COMPRESSED	ture	Main air compressor cooling F.W. inlet			2																		
5	Temperature	Main air compressor cooling F.W. outlet			2																		
	Ten																						
		Bilge well													Н ③	3				H ①		Е	
SYSTEM		Bilge tank													H ①	1						Е	
SYS	Level	Bilge sludge tank													H ①	1						Е	
GE	Le	F.O. Sludge tank													H ①	1						Е	
BILGE		L.O. Sludge tank													H ①	1						Е	
		Clean drain tank													H ①	1						Е	

					LO	CAL		C	ENT	RAI	CO	NTR	ROL	STA	TIO	N		Bl	RIDO	ъE			
									INI	DICA	AT.	LA	MP	A]	LAR	M							
Di sio		Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Fresh water generator	1)	0		1									2) ①	1						Е	1) Dump to evaporator by
		Bilge separator	8)	\circ		1									3) ②	2						Е	high salinity
	1.	Sewage treatment unit													4) ①	1						Е	2) Due to high salinity
	General	Ballast Water Treatment System													4) ①	1)						Е	3) Due to high oil content and separator abnormal
	Ğ	Waste oil incinerator		0		1	4) ①						1		4) ①	1)						Е	4) Due to abnormal
INE		Air dryer													<mark>4)</mark>	2						E	5) Due to follows
MACHINE		Hot water heater steam valve	7)																				Non-voltageOver loadHyd. oil tank low level
		Hot water heater outlet	6)		1																		• Phase failure
ARY	.p.	Sea water (Ref. mach. C.S.W. pump outlet)								Â	1												6) By the pneumatic type temp. control valve
AUXILILARY	Temp.	Sea water circ. line	6) ()		(1)																		
4UX																							7) Auto. shut by thermostat
		Steering goor										<u> </u>	<u> </u>		5)	0			0			Б	8) Auto. 3-way valve
		Steering gear Air conditioner		0								2	2		4)	8	0		2	0		Е	
		ref. machine		0		-							1		① 4)	1						Е	-
	Etc.	Provision ref. machine Local fire	0	0									2		② 4)	2						Е	
		fighting system													1	1						Е	
		Local fire fighting system start	0												1	1						Е	

				LOC	CAL		С	ENT	RAI	. CO	NTF	ROL	STA	TIO	N		BI	RIDO	ъE			
					0.			INI	DICA	T.	LA	MP	A	LAR	M			0				
Divi- sion	Item	Automation	Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
	Lamp & buzzer test switch						\bigcirc									\circ						1) Source failure
	Buzzer stop button						0									0						
	Flicker stop button						0															
	Function test button						0															
	Automatic exchange telephone		0				0									0						
T	Common battery telephone						0									0						
GENERAL																						
GEI	Patrol man call						0															
	Engineer's call						0															
	Clock							1									1					
	Rudder angle							1									3					
	Console electric source (AC & DC)						0				2	2		1)	2						Е	

					LOC	CAL		C	ENT	RAI	CO	NTF	ROL	STA	TIO	N		BI	RIDO	ΈE			
									INI	DICA	ΛT.	LA	MP	A.	LAR	M							
Divi- sion		Item		Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks
		Main lub. oil pump	1)	0				\circ				2	2		3) ② 3)	2						С	1) Auto. change by detect. the non-voltage and
	Λ	M/E hydraulic pump													2	2						C	pressure
		Fuel oil booster pump	2)	0				\circ				2	2		3) ②	2						С	2) Auto. change by detect.
		M/E fuel oil circulating pump	2)	0				\circ				2	2		3)	2						С	the non-voltage 3) Abnormal stop 4) Auto. start and stop detect. by D/G running
		Jacket cool. F.W. pump	2)	0				\circ				2	2		3)	2						С	
7		Cooling S.W. pump	2)	\circ				\bigcirc				2	2		3) ②	2						С	
FAN		Stern tube lub. oil pump	6)	0				\bigcirc				2	2		3) ②	2						С	5) Auto. change by detect. the non-voltage
AND	И. G.	Emergency G M.D.Q . pump A	<u></u>	\bigcirc				 			;		1		3) 1	<u> </u>						D	Auto. start by restart of D/G via black-out
		D/G fuel oil circulating pump	2)	\circ				0				2	2		3)	2						D	6) Auto. change by detect.
PUMP		D/G diesel oil M. G. O. booster pump	5)	0				\circ				2	2		3) ②	2						D	the non-voltage and non-flow
		D/G pre-Heating pump	4) O	\bigcirc				<u>O</u>				1	1		3) ①	1						D	7) Auto. stop by starting
		Fresh water generator distillate pump		<u></u>				<u></u>															fixed water- based local fire fighting system
		Fresh water generator ejector pump		\bigcirc				<u></u>															8) Start and stop in emergency generator room
		D/G lub. oil priming pump	4)	0		3		<u></u>					3		3)	3						D	
		Engine room ventilating fan	7)	8) ○				\bigcirc				3	3		3)	3						С	

	Item				LOCAL								NTR	OL	STA	TIO	N		Bl	RIDO	ъE			
					۵			INI	DIC <i>A</i>	ΔT.	LA	MP	A]	LAR	M			d						
Divi- sion			Handling	Indicator	Indicat. Lamp	Alarm	Handling	Independent	Display	Recording	Independent	Display	Independent	Display	Recording	Handling	Indicator	Indicat. Lamp	Alarm	Recording	Alarm group	Remarks		
	Fuel oil transfer pump	1)	\circ				\bigcirc				1			5) ①	1						E	1) Auto. start and stop by		
	M. G. O. Diesel oil transfer pump	2)	0				##				1											detecting the H.F.O. settling tank level		
	Lub.oil transfer pump		0				\circ				1											2) Auto. start and stop by detecting the D.Q.		
	Bilge pump	3)	0				\bigcirc				1			7) ①	1						Е	<u>service</u> tank level M. G. O. sett.		
	Sludge pump		10)				\circ				1											3) Auto. stop by bilge separator abnormal4) Auto. change by detect.		
	Lub. oil purifier supply pump		0				0				1			5) ①	1						E			
FAN	D/G L.O. puri. supply pump		0				\circ				1			5) ①	1						<mark>E</mark>	the non-voltage		
AND	Boiler feed water pump	4)	0		2		0					2		5)	2						D	5) Abnormal stop		
	Fire & G.S. pump		0				\circ				1	1				0		1				6) Auto. start and stop by detecting the press. tank		
PUMP	Bilge & ballast pump		0				0				1	1				\bigcirc		1				pressure		
	Ballast pump		0				0				2			5)								7) Due to long running 2 8) "No.1" "No.2"		
	Ref. mach. C.S.W. pump		0				0				1	1)		5) ①	1)						Е	9) Auto. start and stop by detect. main air comp. running 10) Pump side and		
	Fresh water pump	6)	0				0				2													
	Drinking water pump Hot water	6)	0				0																	
	circulating pump		\circ																			Near the waste oil tank		
	M.G.O. Cooling Fresh Water pump		\bigcirc																					



SECTION 14 SPARE PARTS

14.1 **GENERAL**

Spare parts shall be provided according to the requirement of the Classification rule and Maker's standard.

Smaller spare parts shall be stowed in suitable boxes with contents, on suitable position where convenient to the crew in engine room, but larger one shall be mounted and the stored directly on the wall of the ship.

Spare parts shall include the following at least.

Quantities shall be for one (1) ship.

Additional spare required by the Owner, if any, shall be supplied at extra cost.

14.2 MAIN ENGINE

(1) Cylinder cover and their fittings

Cylinder cover complete with studs, nuts, disk spring for valves	
(excluding valves)	1 cyl.
Studs and nuts for cylinder cover tightening	1/2 cyl.
Fuel valve complete	1 engine+1cyl.
O-ring for fuel valve	1 cyl.
Exhaust valve complete	3 cyl.
Piston rings for exhaust valve (driving side)	1 cyl.
Starting air valve complete	2 cyl.
Bursting disk for starting air valve	1 cyl.
Indicator valve complete	1 cyl.

(2) Main bearing

Main bearing shell	1 journal
Studs and nuts for one main bearing	1 set

(3) Cylinder liner

Cylinder liner	1 cyl.
O-ring for cylinder liner	1 cyl.
Non—return valves for lubrication	1/2 cyl.



(4)	<u>Thrust</u>	<u>bearin</u>	g

Thrust bearing segments for ahead	1 set
(5) <u>Piston</u>	
Piston complete with piston rings, cooling pipe and piston rod Piston rings Piston rod stuffing box complete with sealing rings and scraping rings Telescopic pipe for piston cooling oil O—ring for stuffing box	1 cyl. 1 cyl. 1 cyl. 1 cyl. 1 cyl.
(6) <u>Connecting rod</u>	
Crank pin bearing shell Studs and nuts for crankpin bearing Crosshead bearing shell lower part Studs and nuts for crosshead bearing	1 cyl. 1 cyl. 1 cyl. 1 cyl.
(7) <u>Fuel pump</u>	
Fuel pump barrel assembly with plunger Suction valve complete High pressure pipe, each type	1 cyl. 1 cyl. 1 cyl.
(8) Camshaft chain	
Camshaft chain Bearing shells with guide ring for camshaft at chain wheel	6 links 1 each
(9) <u>Cylinder lubricator</u>	
Maker's standard spare	1 set
(10) Hydraulic cylinder unit (HCU)	
Maker's standard spare	1 set
(11) <u>Hydraulic system – Hydraulic power supply (HPS)</u>	
Maker's standard spare (Accumulator diaphragm(s) of each size	1 set 2 sets)



(12) Engine control system (ECS)

Maker's standard spare 1 set

(13) Exhaust gas turbocharger

Maker's standard spare 1 set

(14) Auxiliary blower

Maker's standard spare parts 1 set

(15) <u>Turning gear</u>

Maker's standard spare parts 1 set

(16) Air cooler

Zinc plate 1 engine
Maker's standard spare (except the above) 1 set

(17) Miscellaneous

Special packing of each size for one engine not specified elsewhere 1cyl. or 1set



14.3 SHAFTING AND PROPELLER

Stern tube seal device Maker's standard

14.4 <u>STEAM GENERATING PLANT</u>

(1) Aux. boiler

Safety valve spring	1
Case for water level gauge	1
Gauge glass and packing for water level gauge	2
Packing for drum manhole	1
Nozzle tip	1 set
Spare parts of fuel oil burning unit without above said	Maker's standard

Other necessary spare parts shall be in accordance with Maker's standard.



14.5 **DIESEL GENERATOR ENGINE (for one ship)**

Piston ring	1 cyl.
Oil ring	1 cyl.
Crank pin metal	1 cyl.
Piston pin	1 cyl.
Piston pin metal assembly	1 cyl.
Bolts for connecting rod	1 cyl.
Suction valve (complete)	1 cyl.
Exhaust valve (complete)	2 cyl.
High pressure pipe for fuel oil (complete)	1 cyl.
Fuel injection pump (complete)	1 cyl.
Fuel injection valve (complete)	3 cyl.
Main bearing metal for each kind	1 brg.
Bolt assembly for main bearing	1 brg
Relief valve and spring for lub. oil	1 set
Special packing for each kind	1/4 eng.
O ring of each kind	1/4 eng.
Main bearing for turbocharger	1 eng.
Packing for rotor shaft of turbocharger	1 eng.

Other necessary spare parts shall be in accordance with Maker's standard.



14.6 **PUMP**

(1) Centrifugal pump (for each size of pump)

For Cooling S.W. pump (2 sets) and Jacket cooling F.W. pump (2 sets)

Impeller shaft	1 set
Ball bearing (if fitted)	1 set
Casing ring	1 set
Gland packing or mechanical seal	1 set
Coupling bolt and nut (if fitted)	1 set

For Fire & G.S. pump and Bilge & ballast pump

Ball bearing (if fitted)	1 set
Casing ring	1 set
Gland packing or mechanical seal	1 set
Coupling bolt and nut (if fitted)	1 set

For Fresh water pump (2 sets), Drinking water pump (1 set), Ref. machine C.S.W. pump (1 set), Boiler feed water pump (2 sets), Ballast pump (2 sets), Hot water circ. pump (2 sets), MGO Cooling Fresh Water pump (1 set) and D/G Pre-Heating Pump (1 set)

Ball bearing (if fitted)	1 set
Casing ring	1 set
Gland packing or mechanical seal	1 set
Coupling bolt and nut (if fitted)	1 set

For main L.O. pump (2 sets)

Ball bearing (if fitted)	1 set
Casing ring	1 set
Oil seal	1 set
Coupling bolt and nut	1 set



(2) Gear pump (for each size of pump)

For F.O. trans. pump (1 set), L.O. trans. pump (1 sets), S/T L.O. pump (2 sets), L.O. Puri. supply pump (1 set) and D/G L.O. puri. supply pump (1 set)

Bearing metal	1 set
Gland packing or mechanical seal	1 set
Safety valve spring	1
Coupling bolt and nut or coupling bush	1 set

(3) Screw pump 🖄

M. G. O.
For D.O. trans. pump (1 set), F.O. boost. pump (2 sets), M/E F.O. circ. pump (2 sets), D/G F.O. circ. pump (2 sets), D/G D.O. boost. pump (2 sets) and Emergency MDO pump (1set)

M. G. O.

M. G. O.

Ball bearing	1
Safety valve spring	1
Mechanical seal	1 set
O ring	1
Coupling bush	1 set

(4) Reciprocating pump

For Bilge pump (1 set)

Piston ring	2
Valve and valve seat	4 sets
Gland packing	1 set
Safety valve spring	1
V belt	2

(5) Monros pump

For Sludge pump (1 set)

Ball bearing	1
Safety valve spring	1
Gland packing	1 set
O ring	1
V belt	2
Stator	1



14.7 MAIN AIR COMPRESSOR

1st stage valve complete	1 set
2nd stage suction valve complete	1 set
2nd stage delivery valve complete	1 set
Piston ring	1 cyl.
Connecting rod bearing	1 cyl.
Piston pin bush	1 cyl.
Special packing	each 1
Other Maker's standard spare	1 set

14.8 <u>HEAT EXCHANGER</u>

(1) Cooler and condenser (shell & tube type)

Protecting anode
Packing
Pressure gauge
(2) Oil heater

Total number
1 set
1 set
1 set

Relief valve spring each 1

14.9 OTHER MACHINERY

Spare parts for machinery except above shall be in accordance with Maker's standard.



SECTION 15 TOOLS AND OUTFITS

15.1 GENERAL

Tools and outfits shall be provided as necessary for proper maintenance and overhauling of equipment according to Maker's standard.

Smaller tools shall be stowed in suitable boxes with contents on suitable position where convenient to the crew in engine room, but larger ones shall be mounted and stored directly on the wall of the ship.

Tools and outfits shall include the following at least.

Quantities shall be for one (1) ship.

15.2 MAIN ENGINE

Hydraulic tightening tools with pump		
for cylinder cover stud		
for exhaust valve stud		
for stay bolt		
for main bearing stud		
for crosshead bearing stud		
for crankpin bearing stud		
Grinding machine for exhaust valve spindle and seat	1 set	
Fuel valve injection testing device	1 set	
Indicator	1 set	
Deflection gauge	1 set	
Gauge for measuring and adjusting for the engine	1 set	
Maker's standard tool for the accessories such as turbocharger,		
air cooler, governor and aux. blower	1 set	
Air driven pump for M/E air cooler cleaning	1 set	
Other necessary tools for overhaul and reassembling of the engine	1 set	



15.3 SHAFTING AND PROPELLER

Spanner for shaft coupling bolt each 1

15.4 <u>AUXILIARY BOILER</u>

Tube stopper	12
Standard pressure gauge	1
Water tester	1 set
Beaker for water sampling	1 set

Other necessary special tools shall be in accordance with Maker's standard.

15.5 <u>DIESEL GENERATOR ENGINE</u>

Special tool for overhauling and reassembling	1 set
Lapping tool for suction and exhaust valves	1 set
Fuel valve testing device	1 set
Cylinder bore gauge	1 set
Deflection gauge	1 set
Indicator	1 set

Other necessary special tools shall be in accordance with Maker's standard.

15.6 HEAT EXCHANGER

For shell & tube type heat exchanger:

Tube expander each kind 1
Tube cleaning tool 1 set
Brass plug 10

15.7 OTHER MACHINERY

Other necessary special tools for dismantling and assembling shall be in accordance with Maker's standard.



15.8 GENERAL TOOLS AND OUTFITS

<u>Item</u>	No. of set		<u>Remarks</u>
Thermometer (alcohol)	2		100℃
Thermometer (mercury)	1		500°C
Parallel bench vice	1		150 mm
Hand lantern	3		
Shackle	Each 2 (total	8)	1, 2, 3, 5 T
Eye bolt	Each 2 (total 8	3)	M10, M12, M16, M20
Hexagon head bolt & nut	Each 10 (total	140)	M10, M12, M16, M20
Plain washer	Each 10 (total	140)	M10, M12, M16, M20
Split pin	Each 10 (total	130)	2×12 mm, 3.2×18 mm, 4×25 mm
Tap & dies	Each 1	Tap	M6, M8, M10, M12, M16, M20, M24
	Each 1	Dies	M6, M8, M10, M12, M16, M20, M24
Steel tape measure	1		30 m
Scaffolding plate (wood)	2		$4000 \text{ mm} \times 300 \text{ mm} \times 50 \text{ mm}$
Steel plate	Each 2 (total	4)	$1.6~\mathrm{mm} \times 914~\mathrm{mm} \times 1829~\mathrm{mm}$
			$3.2 \text{ mm} \times 914 \text{ mm} \times 1829 \text{ mm}$
Steel bar	Each 2 (total	8)	ϕ 9 mm, ϕ 13 mm, ϕ 16 mm, ϕ 19 mm
			Length: 2000 mm
Surface plate	1		$500 \text{ mm} \times 500 \text{ mm}$
Copper plate or brass plate	1		$0.3 \text{ mm} \times 365 \text{ mm} \times 1200 \text{ mm}$
Listening rod	2		
Valve handle spanner	8		
White board and eraser	4		$450~\mathrm{mm} \times 600~\mathrm{mm}$
Hand hammer	Each 1 (total 2	2)	$0.91 \mathrm{kg}, 0.45 \mathrm{kg}$
Steel wire	1		φ1 mm (1 kg)
Tool cabinet (in the workshop)	2		
Tool cabinet (in the workshop) 2 Trolley (for propeller, intermediate shaft) 2 Suspended tool board 1			
Suspended tool board	1		
Fire proof curtain			

The following machine tools are listed in the Subsection 1.2 MACHNERY PARTICULAR.

Lathe	1	Center distance 1,000 mm
Drilling machine	1	φ 32 mm
Grinding machine	1	$\phi 255 \times 25t$
Electric welder	2	300Amp
Chain block	1/2/3	3 ton / 1 ton / 0.5ton
Gas cutting machine	1	Oxygen B. \times 2, Acetylene B. \times 1
		Flame arrestor for Acetylene B. \times 1
		Flame arrestor for Oxygen B. \times 1
		Hose : Each 25m× <mark>4</mark>