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NAVSEA 0905-LP-512-9010

USS JULIUS A. FURER

FFG-6

(FORMERLY DEG-6)

Operating Guide For Propulsion Machinery

Built By

BATH IRON WORKS CORPORATION

BATH, MAINE

This publication supersedes NAVSHIPS 0906-002-0010 dated January 1967 for USS JULIUS A. FURER (FFG-6) only.

Published By Direction of Commander,
NAVAL SEA SYSTEMS COMMAND
DEPARTMENT OF THE NAVY
WASHINGTON, D. C. 20362

Prepared by Charleston Naval Shipyard 1 SEPTEMBER 1975

For Official Use Only

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FOREWORD

The information contained in this manual is intended for the guidance of operating personnel in establishing main and auxiliary propulsion machinery setups for various speeds and service conditions. All information is based on design calculations and test information where available.

For additional data and detailed operational procedures, consult the shipboard posted operating instruction plates, Ship Information Book (Volume 2), the various technical manuals furnished the ship and appropriate chapters of the Bureau of Ships Technical Manual.

REFERENCES

General Electric

	NAVSHIPS
Instruction Book - Main Propulsion Turbine	0941-LP-011-8010
Main Reduction Gears	0942-LP-001-0000

Bath Iron Work Corporation

Instruction Book - Piping Systems
NAVSHIPS SIB-DEG-6

Bethlehem Steel Corporation

Instruction Book - Main Condenser
NAVSHIPS 0346-LP-028-6000

Foster Wheeler Corporation

Instruction Book - Main Boilers
NAVSHIPS 0351-LP-074-6000

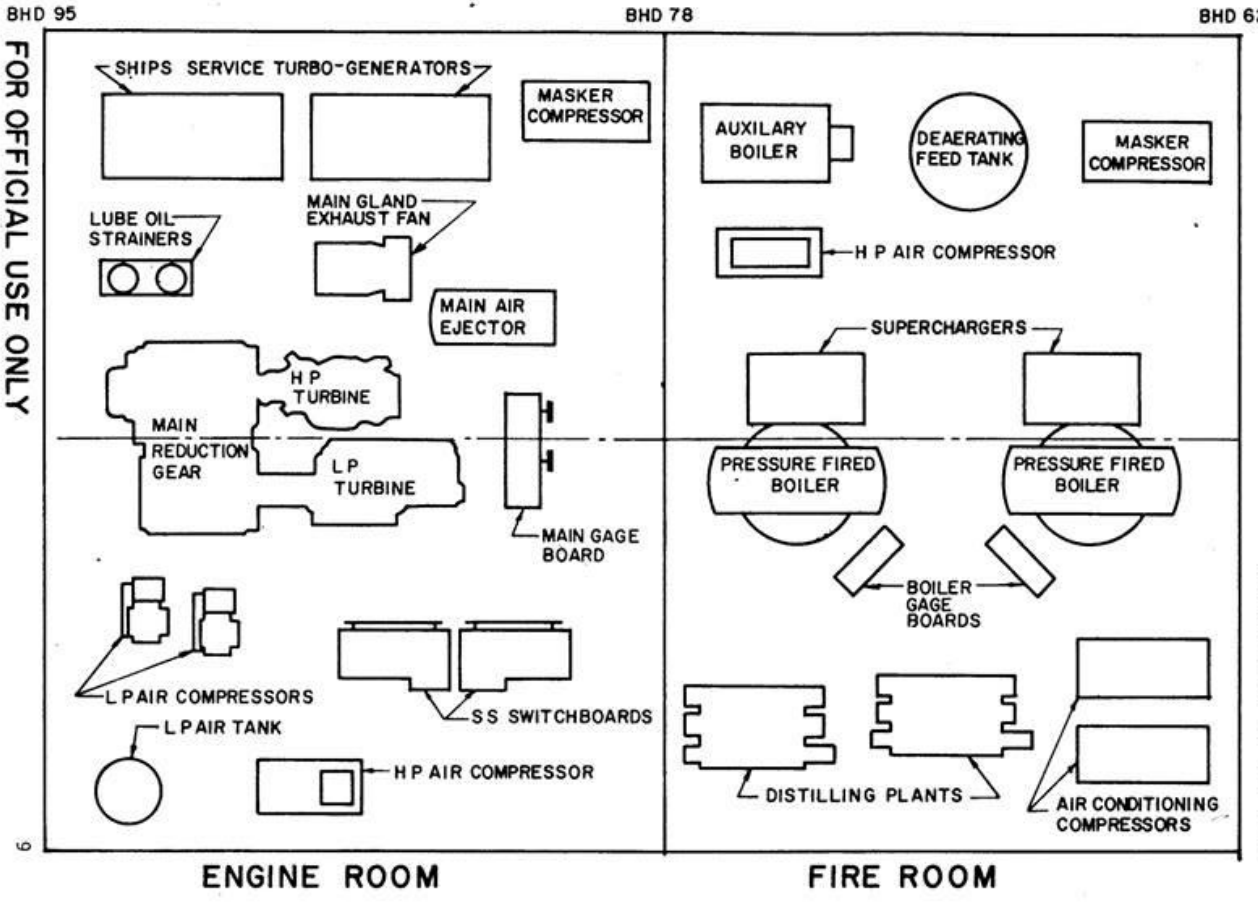
Foster Wheeler

Instruction Book - Main Air Ejectors
NAVSHIPS 0946-LP-000-2000

Bath Iron Works Corporation

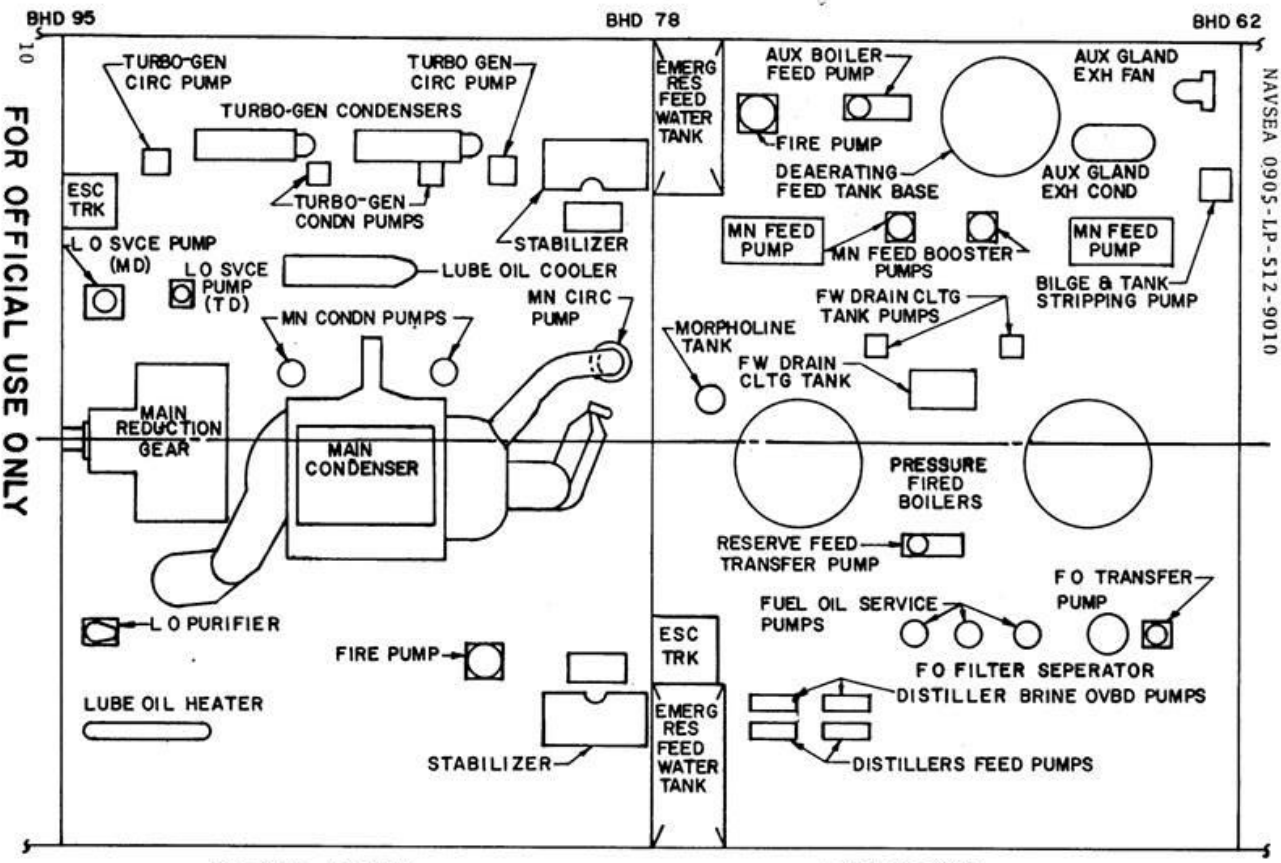
Steam Flow and Heat Balance Diagrams

Design Condition	BuShips No.
Design Full Power	DEG-4 245-1005535
25 Knots	DEG-4 245-1005536
20 Knots (One Boiler)	DEG-4 245-1005537
15 Knots	DEG-4 245-1005539
Boiler Overload	DEG-4 245-1005540
Astern	DEG-4 245-1005541
Standby (One Boiler)	DEG-4 245-1005542
Standby (Two Boilers)	DEG-4 245-1005543



MACHINERY ARRANGEMENT - UPPER LEVEL

NAVSEA 0905-LP-512-9010



MACHINERY ARRANGEMENT-LOWER LEVEL

NAVSEA 0905-LP-512-9010

PROPULSION MACHINERY RATINGS

Propulsion Turbine

Manufacturer: General Electric Company
One Unit Per Ship
35000 SHP Ahead @ 240 RPM, Design Condition
4500 SHP Astern @ 122 RPM

Astern elements are located at each end of the low pressure rotor

Design Conditions: 1050 PSI, 940°F at throttle
Back Pressure, AHEAD.....5"HgA
Back Pressure, ASTERN.....5"HgA

Main Reduction Gear

Manufacturer: General Electric Corporation
One Unit Per Ship
H-P Turbine Reduction, AHEAD.....6731/240 RPM
L-P Turbine Reduction, AHEAD.....6430/240 RPM

Main Condenser

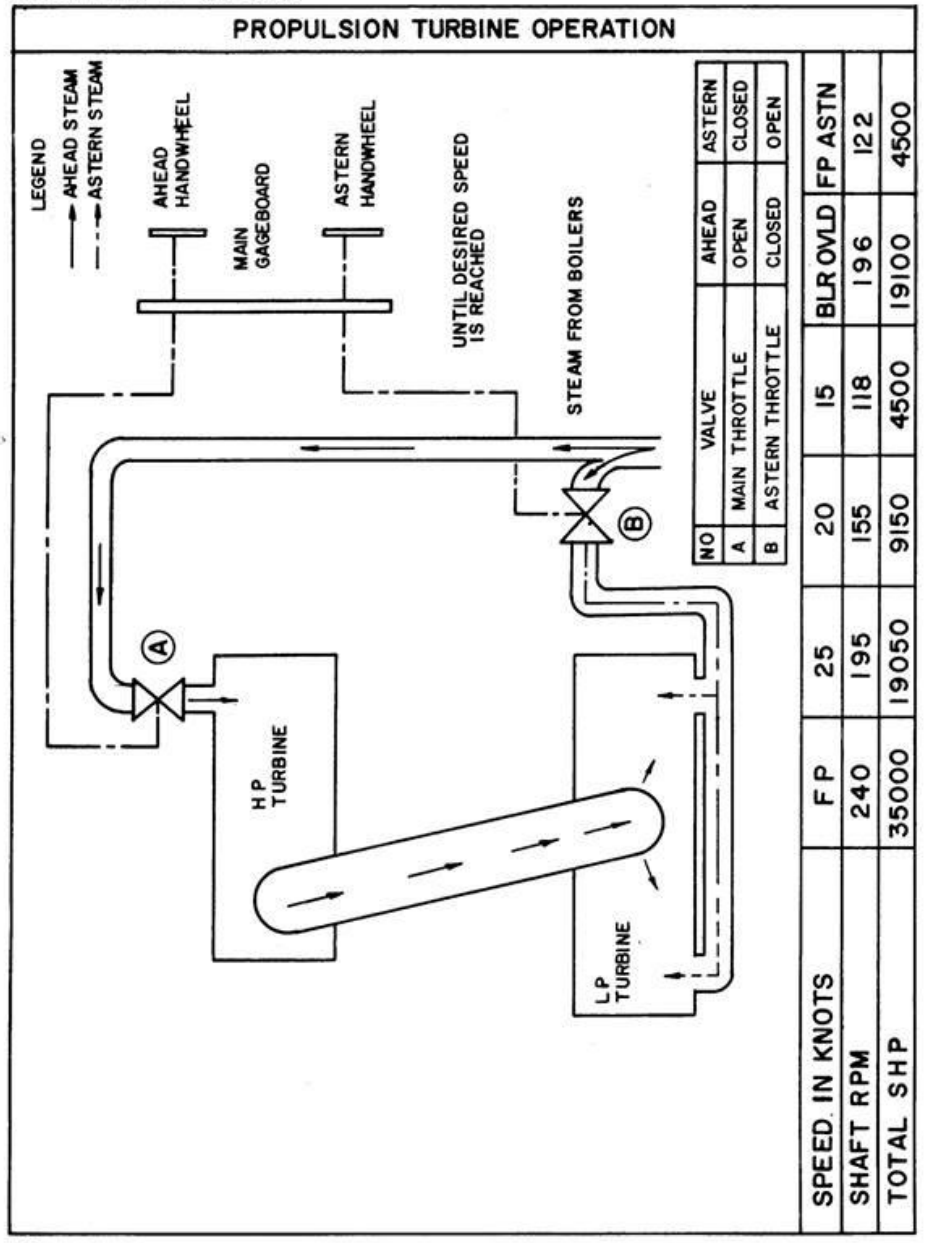
Manufacturer: Bath Iron Works Corporation (Designed by Bethlehem Steel Corporation)
One Unit Per Ship - Single Pass, Fore & Aft. 6535 Sq. Ft. Surface

Design Conditions: Maintains vacuum of 25" Hg at FULL AHEAD power when supplied with 23,800 GPM of 75°F sea water.

Propeller

The propeller is of solid manganese bronze, five blade, 15 feet in diameter, possessing a pitch of 15'-1.47" at 0.70 R.

The propeller is modified to permit passage of compressed air from the shaft through blade and comprises a part of the "Prairie Masker" system. The "Prairie Masker" system is a system whereby compressed air is distributed along the exterior hull of the ship, (in addition to the air dispersed through the propeller blades,) by means of two(2) emitter belts, one located at frame 62 and the other at frame 83 mounted on the exterior of the hull.



NOTES ON PROPULSION TURBINE OPERATION

During warm-up periods, the turbine should be carefully inspected for rubbing, for correct oil flow and bearing temperatures, for proper gland sealing steam flows and for freedom of operation. Under no condition should the turbine rotors be permitted to remain stationary longer than five minutes with sealing steam being admitted to the turbine glands. The rotors should be alternately spun ahead and astern every 3 to 5 minutes.

The steam path from the H.P. turbine enters the turbine through the throttle assembly and into the steam chest then progresses aft through the stages of the turbine, then it crosses to the L.P. by means of the crossover pipe. Then it passes by parallel flow through the low pressure stages and exhausts to the main condenser.

High pressure steam is supplied to the turbine from the ship's boilers through the main steam strainer. Steam from the strainer flows to the HP cylinder steam chest and to the astern valve of the LP cylinder. The flow of steam through the HP cylinder is controlled by the ahead handwheel. Flow through the astern elements of the LP cylinder is controlled by the astern handwheel.

When operating astern, the turbine is designed for continuous operation at 4500 SHP and 122 RPM when supplied with steam at 1190 PSI and 940°F and with a back pressure of 5" HgA. The astern elements are also designed to develop 50% of design full power ahead torque at 0 RPM with not more than 70% of the full power ahead steam flow.

It is important that the highest possible vacuum be maintained during all astern operations and that thermometer readings be carefully observed. If thermometer readings at any point on the turbine approach the limiting operating values, the unit should be slowed down.

The normal operating temperature of lube oil discharged from the bearings should be from 140°F to 160°F. The maximum temperature should not exceed 180°F. The maximum allowable temperature rise of the oil from inlet to outlet is 50°F.

In addition to its use as a jacking gear, the motor driven turning device can be used for keeping the turbine rotating slowly during warming and cooling periods. Under no circumstances should steam be admitted to the turbine while the turning device is engaged, nor should the device be engaged before the turbines have stopped rotating.

PROPULSION TURBINE OPERATING CONDITIONS							
	UNITS	FULL POWER	25 KNOTS	20 KNOTS	15 KNOTS	FP ASTERN	BOILER OV'RL'D
Shaft Horsepower	SHP	35000	19050	9150	4500	4500	19100
Shaft Revolutions	RPM	240	195	155	118	122	196
H.P. Turbine Inlet							
Pressure	PSI	1050	1190	1212	1235	-	1135
Temperature	°F	940	940	950	950	-	945
H.P. Turbine							
1st Stage Exit Press	PSI	700	335	145	73	-	-
1st Stage Exit Temp	°F	870	730	641	636	-	-
Exhaust Pressure	PSI	87.5	43.1	20.1	11.4	-	-
Exhaust Temperature	°F	435	327	271	306	-	-
Main Condenser							
Vacuum (at 75°F)	In Hg.V	25.0	27.2	28.4	28.6	25.3	27.5
Astern Turbine							
Pressure	PSI	-	-	-	-	473	-
Temperature	°F	-	-	-	-	940	-
Turbo-Generator Load (Estimated)	KW	773	709	705.5	703.7	709	709.1

NOTES ON AUXILIARY OPERATION

Because of augmenting and unloading valve settings, the pressure in the auxiliary exhaust line will vary between 8.5 and 12 PSI. Excess exhaust will be unloaded to the main condenser under standby conditions, astern operation and ahead speeds up to and including 20 knots. At speeds in excess of 20 knots, augmenting steam will be supplied to the deaerating feed heater from the boiler pressure desuperheated steam system via a reducing valve. Condensate temperature can shift this balance point either above or below the 20K design point.

The distilling plants are supplied with steam from the auxiliary exhaust system at all speeds. The rated output of each distilling plant is 8,000 GPD. When the auxiliary exhaust system is secured, a 135/10 reducing station supplies steam to distilling plant.

The main and auxiliary air ejectors are supplied steam from the 135 PSI desuperheated system in the Engine Room. In the Fireroom, the 135 PSI system, through an external desuperheater, also supplies steam to the distilling plant air ejectors and ship's whistle, and through individual reducing valves supplies the 50 PSI ship's constant and intermittent heating system, ASROC heating, galley and hot water system. An additional reducing valve supplies 100 PSI steam to the laundry.

Desuperheated steam is supplied at full boiler pressure to the main boiler supercharger booster turbines and through two 1200/600 PSI reducing stations to lube oil service pump, main circulating pump and Prairie-Masker compressor turbines.

During warm-up periods, the turbine generators should be carefully inspected for rubbing, for correct oil flow and bearing temperatures, for proper gland sealing steam flows and for freedom of operation. Under no condition should the turbine rotors be permitted to remain stationary longer than five minutes with steam being admitted to the turbine from any source.

ENGINE ROOM AND FIREROOM AUXILIARY MACHINERY GENERAL

Main Feed Pumps

The main feed pump is a double volute, four-stage, horizontal pump driven by a horizontal single-stage, axial flow, impulse steam turbine. The turbine rotor is connected to the pump shaft through a flexible coupling. The complete unit, with its auxiliaries (oil cooler, oil filter, auxiliary motor-driven oil pump, etc.), is mounted on a fabricated steel base. The oil reservoir for the unit is included in the base. The turbine and pump shafts are supported by sleeve bearings and located axially by thrust bearings.

Oil to the hydraulic governing and bearing lubrication system is normally provided by the main shaft-driven pump. An auxiliary motor-driven pump and a hand-operated pump are included in the system to provide oil at startup, low speed, and securing operations. Thermometers, gages, sight flow indicators, an oil cooler, and an oil filter are included to ensure proper operation of the lube oil system.

Control of the turbine and feed pump is by a pneumatic differential pressure system. This system regulates the speed of the turbine and feed pump so that feedwater pressure is maintained at 75 PSIG above the boiler economizer inlet water pressure. The control system functions automatically to maintain the pressure differential whether one or two pumps are on the line. A recirculation system is included at each feed pump to ensure that enough feedwater flows through the pump at all times, thus protecting the pump from overheating. A low feed pump suction trip is inserted in the turbine hydraulic system to trip out the turbine when the feed pump suction pressure drops below a pre-set value. In addition, a speed-limiting governor is installed at the turbine to keep the turbine and feed pump from exceeding at preset maximum speed in case the speed of the unit should rise above the normal operating speed range.

Auxiliary Boiler

A two pass horizontal fire tube unit equipped with all auxiliaries, accessories and controls for full automatic or manual operation.

Air for combustion is supplied by a blower wheel (fan) in the blower housing and is powered by a 10 H.P. blower motor. The oil pump, oil filter, oil duplex strainer, oil relief valve, pressure gauges, oil solenoid valve, fuel oil piping, oil regulating valve and nozzle comprise the fuel supply system. The oil pump is driven through a flexible coupling by the 1 H.P. fuel pump motor.

Water is pumped into the boiler through the feed check valve and feed stop valve. A feed water treatment tank is installed in the by-pass branch of the feed system, located ahead of the feed check valve. The feed water system is valved so that the feed water can be passed directly through the main feed piping on through the branch containing the feed treatment tank.

The water level control system consists of a pushbutton station, test switch , millionmeter, resistor, pump delay relay, two relays and four electrodes which serve to control operation of the feed pump and to safeguard the boiler against the possibility of damage by low water.

The combustion control system provides automatic ignition and fully automatic burner modulation to maintain steam pressure at 1400 $\pm$ 5 PSIG when the boiler is steaming at varying loads between 960 and 4800 lbs/hr. Below 960 lbs/hr. steam demand, the burner will automatically cycle off and on under control of a steam pressure limit switch. The system also includes protection against ignition or flame failure and loss of power or air pressure, and means of manual control.

The boiler is filled with safety valves, surface and bottom blow valves, salinometer, and air vent valves.

(NOTE)

When in port and the main boilers are secured this boiler supplies steam to the 135 lb. steam system.

Turbine Driven Lube Oil Service Pump (Normal)

This pump provides lube oil to main propulsion turbine and gears during normal operation, and is regulated by a pressure regulator governor located on the steam line to the turbine. The governor maintains constant discharge pressure under all operating conditions. The pressure regulator governor is actuated by lube oil pressure through a connection at the most remote main turbine bearing to control the flow of steam through turbine nozzles in response to lube oil pressure at the bearing. The governor is provided with a bypass needle valve adjusted to idle the pump to maintain adequate self-lubrication and to insure the pump is primed and ready to assume lube oil requirements of the main propulsion unit in the event of a casualty while using standby motor driven lube oil service pump.

Motor Driven Lube Oil Service Pump (Standby)

This pump provides lube oil to the main propulsion turbine and gears if the turbine driven pump becomes inoperative. It is controlled by a pressure switch which automatically starts the pump when lube oil header pressure drops below a predetermined value. Once in operation, the pump must be manually secured.

This pump is used to circulate oil during initial lube oil warm up. Warm up is accomplished by pumping oil from main lube oil sump, through the lube oil purifier heater via the transfer piping, and back to the sump. Should water be present in the oil within the reduction gear sump, the purifier should be used at least several hours before commencing plant warm up.

Main Feed Booster Pumps

Two motor driven centrifugal pumps get suction from DFT thru common suction main. Discharge piping allows pumps to discharge to any feed pump. A low pressure alarm, set at approximately 65 PSIG, is provided. An orificed recirculating line on the pumps discharge side and a vent line on the suction side is led to the DFT.

The discharge lines to main feed pump suctions are fitted with relief valves set at approximately 110 PSIG.

Fresh Water Drain Tank Pumps

Two motor driven, vertical centrifugal pumps are provided. Suction is from a drain collecting tank, discharge is to the DFT.

The pump is constant running. Automatic recirculation from the discharge to the drain tank assures a positive pump suction supply. The pump is provided gland seal water from the condensate system. These units handle the ship's low pressure, constant-intermittent service, and laundry drains.

Deaerating Feed Tank

Operating level in the DFT varies from 1250 to 1400 gallons (max. 1400 gallons). Water level is controlled by automatically controlled spill and make up valves. Local gauge glasses and a remote level indicator are provided to determine the tanks storage level.

The shell is protected by a vacuum breaker and relief valve set at 20 PSIG.

Air and noncondensible vapors go to the auxiliary gland exhauster condenser. Oxygen content can be determined by using the effluent sampling cooler and test valve. The steam used for deaeration is supplied by the auxiliary exhaust system.

AUXILIARY PROPULSION MACHINERY

NO. PER SHIP	SHIP'S SPEED	SPECIFIED PROPULSION FULL POWER	25 KNOTS	20 KNOTS
	Shaft RPM	240	195	155
1	Main Turbine Unit	1	1	1
2M	Main Condensate Pump	2	1	1
1T	Main Circulating Pump	0	0	0
1	Main Air Ejector	1	1	1
1T, 1M	Lube Oil Service Pump	1T	1T	1T
1	Lube Oil Cooler	1	1	1
1	Aux. Gland Exh. Condenser	1	1	1
1M	Main Gland Exh. Fan	1	1	1
1M	Aux. Gland Exh. Fan	1	1	1
2	Boilers In Use	2	2	1
2T	Main Feed Pump	1	1	1
2M	Main Feed Booster Pump	1	1	1
1	Deaerating Feed Tank	1	1	1
3M	Fuel Oil Service Pump	2	2	1
2T	Supercharger Booster	2	2	1
2M	Fresh Water Drain Pump	1	1	1
3M	Fire Pump	1	1	1
2	Turbo Generators In Use	2	2	2
2M	Auxiliary Conden. Pump	2	2	2
2M	Auxiliary Circ. Pump	2	2	2
2	Auxiliary Air Ejector	2	2	2
2M	H.P. Air Compressor	As required under		
2M	L.P. Air Compressor	As required under		
1M	Lube Oil Purifier	As required to maintain		

M-Motor Driven T-Turbine Driven

IN OPERATION DURING OPERATING CONDITIONS				
15 KNOTS	F.P. ASTERN	BOILER OV'RL'D	STANDBY 1 BOILER	STANDBY 2 BOILERS
118	122	196	0	0
1	1	1	0	0
1	1	1	1	1
0	1	0	1	1
1	1	1	1	1
1T	1T	1T	1T	1T
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	2	1	1	2
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	2	2	1	2
1	2	1	1	2
1	1	1	1	1
1	1	1	1	1
2	2	2	2	2
2	2	2	2	2
2	2	2	2	2
2	2	2	2	2
pressure switch control				
pressure switch control				
clean and waterless lube oil				

AUXILIARY MACHINERY PLANTS

IN USE DURING SPECIFIED

NO. PER SHIP	SHIP'S SPEED	FULL POWER	25 KNOTS	
-	Shaft RPM	240	195	
2T	Masker Compressor	2	2	
2	Distilling Plant	2	2	
2M	S. W. Feed Pump	2	2	
2M	Distillate Pump	2	2	
2M	S. W. Heater Drain Pump	2	2	
2M	S.W. Overboard Discharge Pump	2	2	
2M	Potable Water Pump	1	1	
1	Steering Gear Unit	1	1	
2	Diesel Generator			As
2M	Diesel Gen. S.W. Circ. Pump			As
1M	Res. Feed Trans. Pump			As
1M	Fuel Oil Trans. Pump			As
1M	Bilge & Tank Stripping Pump			As
4M	Air Conditioning Plant			As
4M	Air Cond. Chill Wtr. Circ. Pump			As
1M	JP-5 Service Pump			As
1M	JP-5 Transfer Pump			As
1	Diesel Oil Filter Separator			As
2	JP-5 Filter Separator			As
1	Ship's Stores Refrig. Plant			As

AND INDEPENDENT AUXILIARIES

PROPULSION OPERATING CONDITIONS

20 KNOTS	15 KNOTS	F.P. ASTERN	BOILER OVERLOAD	STANDBY 1 BOILER	STANDBY 2 BOILERS
155	118	122	196	-	-
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
1	1	1	1	1	1
1	1	1	1	1	1
required					
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RATINGS OF AUXILIARY MACHINERY

	Installed	Type
Main Condensate Pump	2M	V 2stg C
Main Circulating Pump	1T	V 1stg P
Main Air Ejector (Twin)	1	2stg
L.O. Service Pump, Turbine Driven	1T	VR
L.O. Service Pump, Motor Driven	1M	VR
L.O. Cooler	1	H Finned-Tube
Main Feed Pump	2T	H 4stg C
Main Air Ejector Gland Exh.Cond.Section	1	
Main Gland Leak-off Exhauster	1M	HC
Auxiliary Gland Leak-off Cond.	1	
Auxiliary Gland Leak-off Exhauster	1M	HC
Deaerating Feed Tank	1	V Direct Contact
F.O. Service Pump	3M	VR
Turbo-Generator	2T	
Diesel-Generator	2D	8 Cyl
Auxiliary Condensate Pump	2M	H 1stg C
Auxiliary Circulating Pump	2M	H 1stg C
Aixiliary Air Ejector (Twin)	2	2stg
Main Feed Booster Pump	2M	V 2stg C

V - Vertical C - Centrifugal
H - Horizontal R - Rotary

IN USE DURING PROPULSION

Capacity	Heat	BHP	Steam Supply
320 gpm	60 psi	17.8	-
Rated 13500 gpm	10 psi	110	575 psi
Bilge 3000 gpm	10 psi	70	575 psi
33.75 lb per hr dry air	4.0" HgA suct.	-	120 psi
500 gpm	55 psi	37.5	575 psi
500 gpm	55 psi	36	-
500 gpm	140°F to 120° F	-	-
590 gpm	1380 psi	735	1123 psi
642 lbs per hr.	-	-	-
200 cfm	12.5"H_2O Vac. suct.	1.22	-
750 lbs per hr.	-	-	-
15 cfm	17.0"H_2O Vac. suct.	0.79	-
233,776 lbs per hr.	-	-	-
25 gpm	600 psi	17.4	-
500 KW	450 volt	-	1050 psi
500 KW	450 volt	706	-
15 gpm	70 psi	2.0	-
550 gpm	10 psi	5.0	-
4.5 lb per hr dry air	1.75"HgA suct.	-	120 psi
630 gpm	65 psi	35.1	-

M - Motor Driven
T - Turbine Driven
D - Diesel Driven
P - Propeller

RATINGS OF MISCELLANEOUS

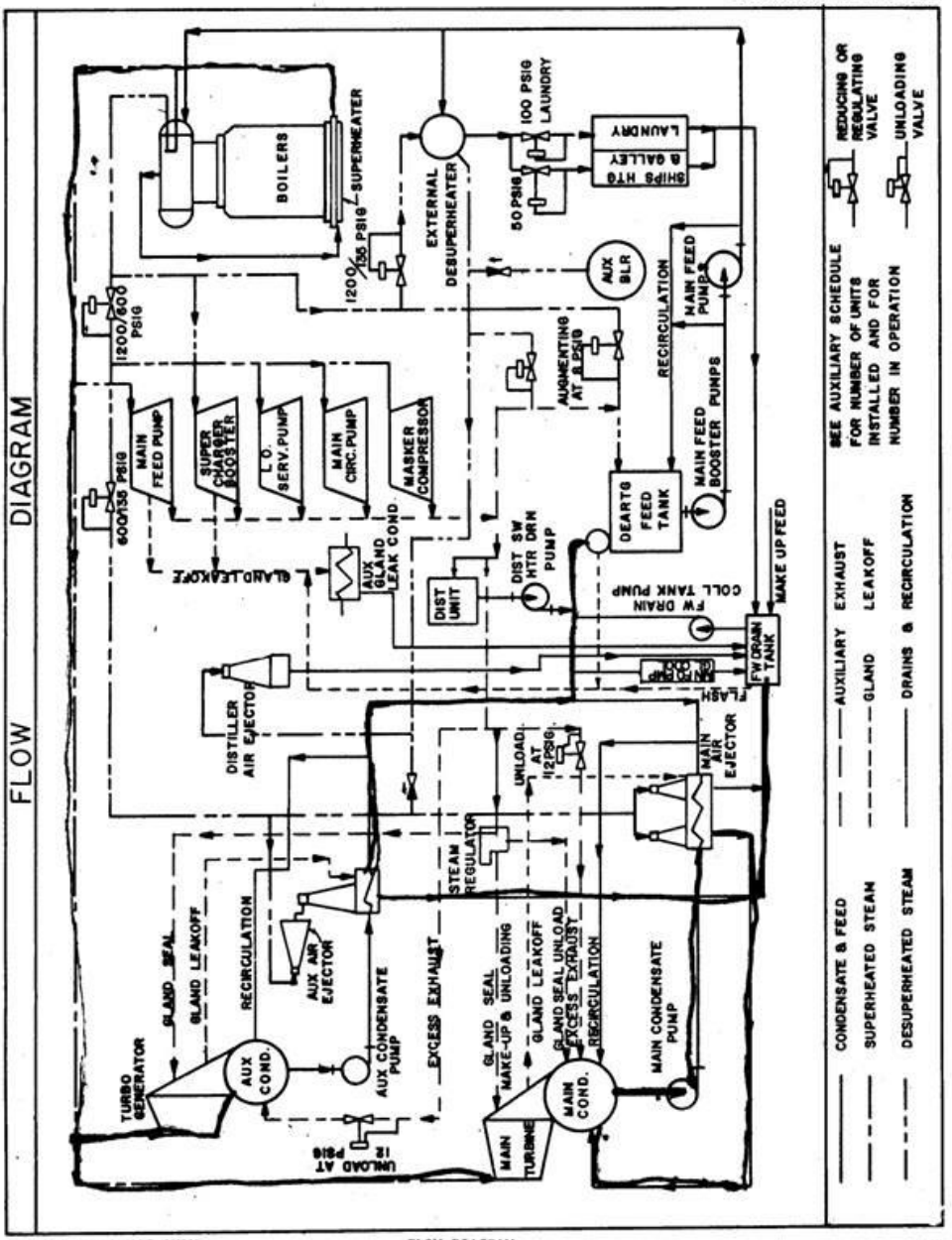
	Installed	Type
H.P. Air Compressor	2M	4stg Recip
L.P. Air Compressor	2M	2stg Recip
Distilling Unit	2	2stg Flash
Air Ejector	2	2stg
Prairie Masker Compressor	2T	H 1stg C
Pumps:		
Reserve Feed Transfer	1M	H 1stg C
Fire	3M	V 1stg C
Air Conditioning Chilled Water	4M	H 1stg C
Fresh Water Drain Transfer	2M	V 1stg C
Potable Water	2M	H 1stg C
Diesel Gen. S.W. Circulating	2M	H 1stg C
Auxiliary Boiler Feed	1M	H 2stg C
Distilling Unit:		
S.W. Feed	2M	H 1stg C
Distillate	2M	H 1stg C
S.W. Heater Drain	2M	H 1stg C
S.W. Overboard Discharge	2M	H 1stg C
Fuel Oil Transfer	1M	VR
Bilge and Tank Stripping	1M	H Recip

V - Vertical
H - Horizontal
C - Centrifugal
R - Rotary

MACHINERY SPACE AUXILIARIES

Capacity	Head	BHP	Steam Supply
7.5 cfh	3000 psi	25	-
~~50 cfm~~ 100 cfm	150 psi	15	
8000 gpd	-	-	1590 lb per hr @ 10 psi
5 lb per hr dry air	1.75" HgA suct.	-	125 psi
1400 cfm	25 psi	150	585 psi
100 gpm	50 psi	8.1	-
900 gpm	125 psi	84	-
75 gpm	60 psi	4.0	-
32 gpm	53 psi	2.2	-
40 gpm	50 psi	2.3	-
300 gpm	12 psi	2.6	-
15 gpm	175 psi	5.0	-
.125 gpm	25 psi	2.4	-
7 gpm	35 psi	1.1	-
4.5 gpm	49.9 psi	1.0	-
.120 gpm	30 psi	2.8	-
100 gpm	42.6 psi	6.6	-
50 gpm	50 psi	2.5	-

M - Motor Driven
T - Turbine Driven


FLOW DIAGRAM
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SUPER CHARGER BOOSTER
L.O. SERV. PUMP
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MASKER COMPRESSOR
AUGMENTING AT 8 PSIG
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MAIN FEED PUMPS
RECIRCULATION
MAIN FEED BOOSTER PUMPS
DEARTG FEED TANK
AUX GLAND LEAK COND
DIST UNIT
DIST SW HTR DRN PUMP
COLL TANK PUMP
FW DRAIN
MAKE UP FEED
FW DRAIN TANK
FLASH
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UNLOAD AT 12 PSIG
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TURBO GENERATOR
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AUX AIR EJECTOR
AUX COND.
AUX CONDENSATE PUMP
EXCESS EXHAUST
GLAND SEAL MAKE-UP & UNLOADING
GLAND LEAKOFF
GLAND SEAL UNLOAD EXCESS EXHAUST RECIRCULATION
MAIN COND.
MAIN CONDENSATE PUMP
MAIN TURBINE
UNLOAD AT 12 PSIG
50 PSIG
100 PSIG LAUNDRY
LAUNDRY
8 GALLEY
SHIPS HTG
CONDENSATE & FEED
SUPERHEATED STEAM
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AUXILIARY EXHAUST
GLAND LEAKOFF
DRAINS & RECIRCULATION
SEE AUXILIARY SCHEDULE FOR NUMBER OF UNITS INSTALLED AND FOR NUMBER IN OPERATION
REDUCING OR REGULATING VALVE
UNLOADING VALVE

BOILER PERFORMANCE DATA

Manufacturer: Foster Wheeler Corporation

Two installed per ship. Single drum, cylindrical, natural circulation, supercharged boilers using combustion air supplied by an exhaust gas-driven supercharger integral with each unit. The boilers are fitted with vertical firing oil burners and pancake coil superheaters. A booster steam turbine is supplied for driving the supercharger compressor at loads for which the gas turbine is not self sustaining.

OPERATING PRESSURES AND TEMPERATURES (FULL POWER)

Pressures	PSI	Temperatures	°F
Compressor Outlet	62 PSIA	Compressor Outlet	470
Steam Drum	1250	Gas Turbine Exhaust	540
Superheater Outlet	1200	Superheater Outlet	948
		Boiler Gas Outlet	860

Total Evaporation, LB/HR per Boiler - 118,027

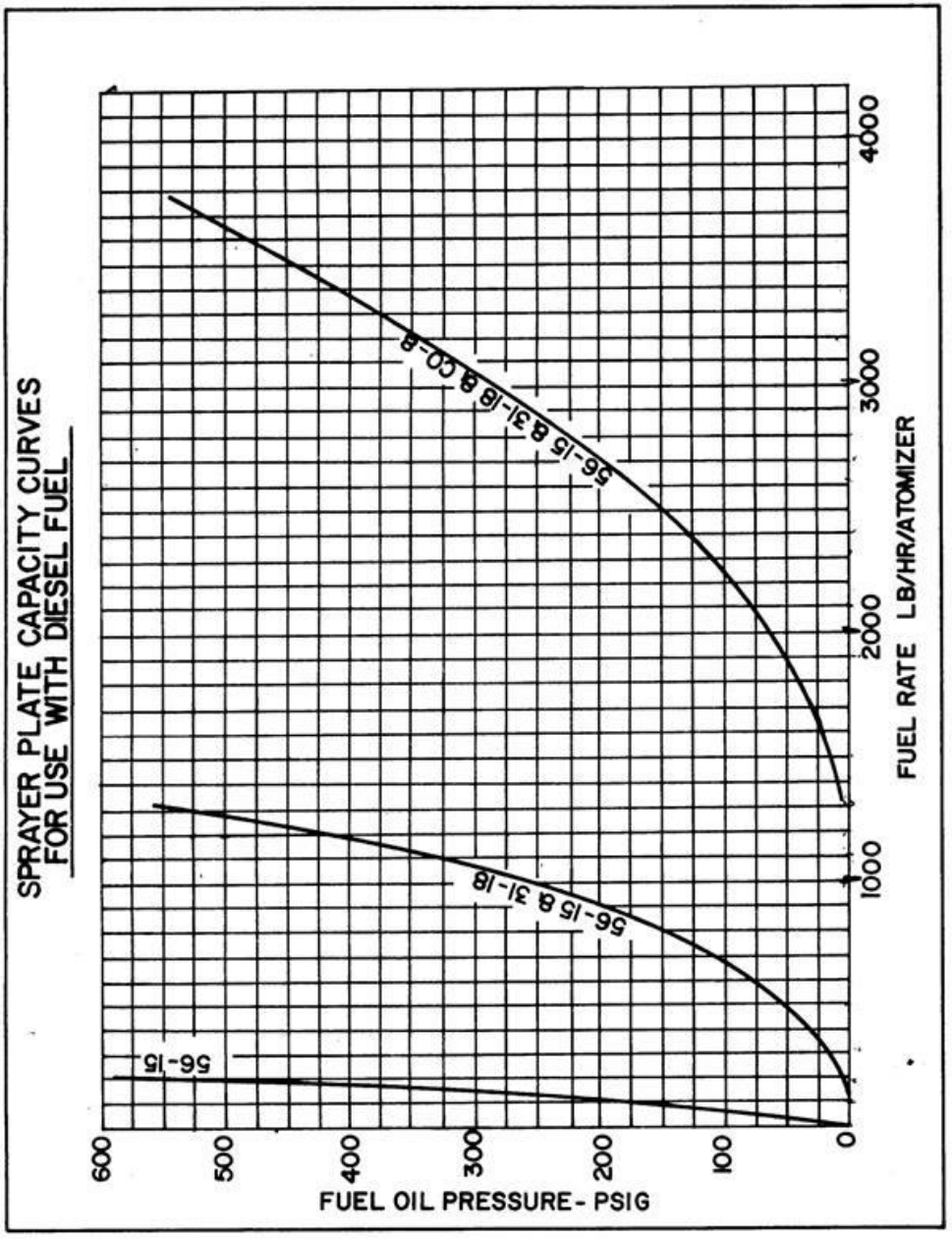
BOILER SAFETY VALVE SETTINGS

Valve	Popping PSI	Reseating PSI
Drum Valve #1	1325	1275
Drum Valve #2	1345	1295
Drum Pilot Valve	1300	1250
Superheater Safety Valve	1325	1275
Casing Relief Valve	95	90

Oil Burners: Each boiler is fitted with three Todd triple sprayer plate type wide range burners complete with ignitor, flame observation port and flame failure safeguard system.

The following mechanical tip sizes are provided in each burner:

1st Stage	2nd Stage	3rd Stage
56-15	31-18	C-08


SPRAYER PLATE CAPACITY CURVES
FOR USE WITH DIESEL FUEL
56-15 & 31-18 & CO-8
56-15 & 31-18
56-15
FUEL OIL PRESSURE - PSIG
600
500
400
300
200
100
0
FUEL RATE LB/HR/ATOMIZER
4000
3000
2000
1000

NOTES ON BOILER OPERATION

The plant parameters presented on the following pages are intended to serve as a guide only. The speeds and powers shown for each operating condition contain the specified allowances for roughness and sea conditions. The fuel oil on which these tables are based is Diesel Oil of 43 cubic feet per ton (7.0 pounds per gallon).

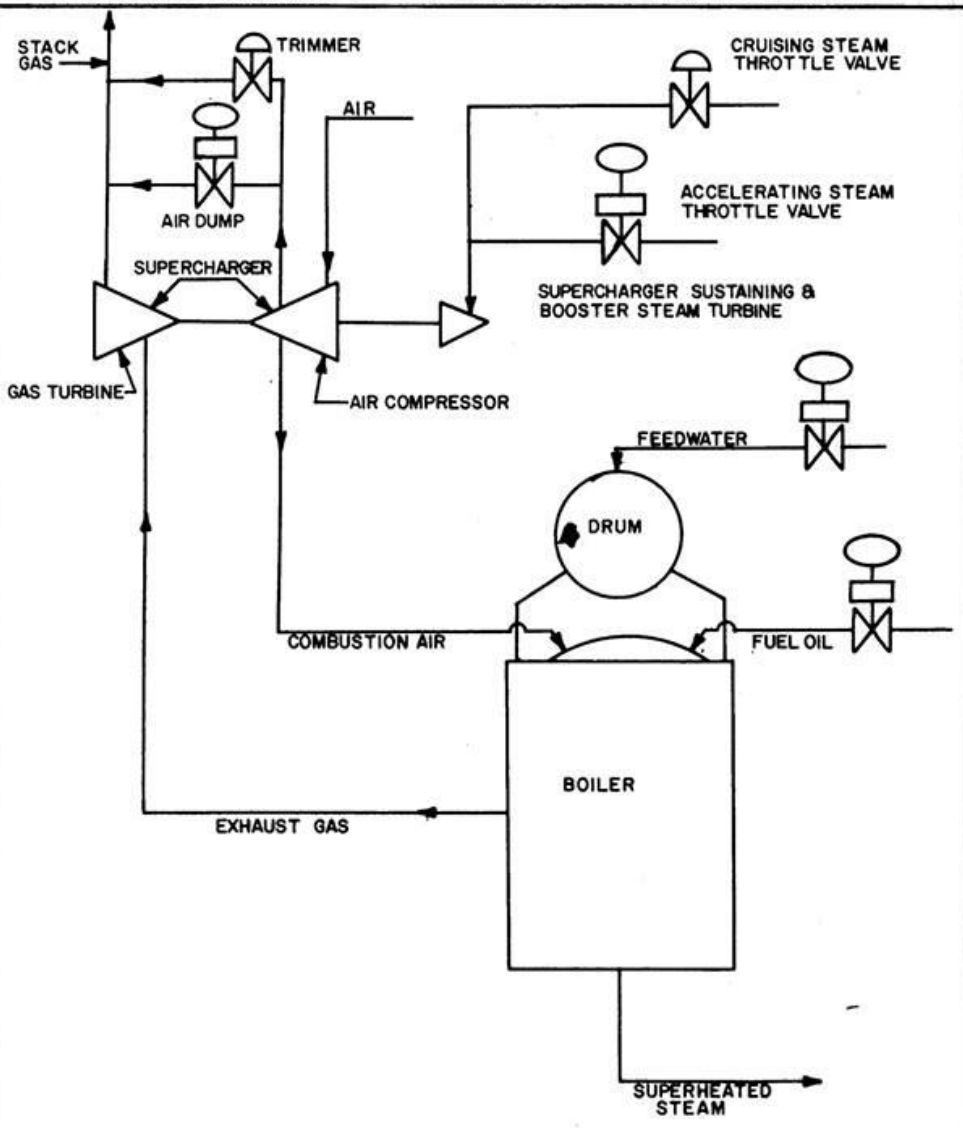
The boilers are fitted with a pneumatic combustion control system which maintains a constant drum pressure of 1250 PSI by varying the firing rate and proportioning the fuel and air flow to maintain optimum combustion conditions.

Fuel is supplied to each boiler by three burners incorporating triple-orifice atomizers capable of burning either JP-5 or diesel fuel. Each burner is fitted with three separate sizes of sprayer plates, the three plates of each size being connected to a common header. (See Page 23 for corresponding capacities). Firing rates are established by controlling oil flow to the second and third stages; first stage pressure is controlled by and held constant at oil pump discharge pressure. Note that each stage is carried to about 550 PSI before oil is admitted to the next stage. The system is designed so that all burners remain in service for all operating conditions from light-off to overload.

The maximum ship speed obtainable for single boiler operation without exceeding rated full power evaporation is approximately 23 knots.

All operating personnel should be familiar with the proper operating and maintenance procedures in order to maintain maximum efficiency and safely from the steam generating equipment and its auxiliaries.

SCHEMATIC DIAGRAM OF PRESSURE FIRED BOILER CYCLE



BOILER OPERATION		
DESIGN FULL POWER (2 BOILERS)		35000 SHP 240 RPM
MAIN STEAM CONDITIONS	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1200 PSI 948° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1185 PSI 680° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship *		2 3 3247 LB/HR 46.4 GPM
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 550 PSI 362 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 62 PSIA 470° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		56.4 PSIA 870° F 540° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		8 PSI 235° F 242° F
Supercharger Booster Turbine		2 Operating
Air Flow Supercharger		43.4 LB/SEC
* Based on Navy Diesel Oil (7.0 LB/GAL) & 75° F Inlet Oil Temperature		

BOILER OPERATION		
25 KNOTS (2 BOILERS)		19050 SHP 195 RPM
MAIN STEAM CONDITIONS	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1230 PSI 955° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1218 PSI 660° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship		2 3 * *
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 550 PSI 47 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 34 PSIA 310° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		31.0 PSIA 790° F 570° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		8 PSI 235° F 244° F
Supercharger Booster Turbine		2 Operating
Air Flow Supercharger		20.5 LB/SEC
* See Vol. I, Section S40-0, of Ship Information Book		

BOILER OPERATION		
20 KNOTS (1 BOILER)		9150 SHP 155 RPM
MAIN STEAM CONDITIONS	Drum Pressure	1250 PSI
	Superheater Outlet Pressure	1230 PSI
	Superheater Outlet Temperature	955° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure	1218 PSI
	Desuperheater Outlet Temperature	960° F
Number of Boilers in Use Per Ship		1
Number of Burners in Use Per Boiler		3
Fuel Oil Per Burner		*
Fuel Oil Per Ship		*
Fuel Oil Pressure - 1st Stage		550 PSI
2nd Stage		550 PSI
3rd Stage		75 PSI
Compressor Inlet Air Temperature		100° F
Compressor Discharge Pressure		37 PSIA
Compressor Discharge Temperature		340° F
Gas Turbine Inlet Pressure		33.7 PSIA
Gas Turbine Inlet Temperature		760° F
Gas Turbine Outlet Temperature		560° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure		8 PSI
Deaerating Feed Heater Temperature		235° F
Feed Temperature to Boiler		245° F
Supercharger Booster Turbine		1 Operating
Air Flow Supercharger		26.9 LB/SEC
* See Vol. I, Section S40-0, of Ship Information Book		

BOILER OPERATION		
15 KNOTS (1 BOILER)		4500 SHP 118 RPM
MAIN STEAM CONDITIONS	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1240 PSI 950° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1230 PSI 635° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship		1 3 * *
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 550 PSI 0 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 27 PSIA 240° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		24.9 PSIA 700° F 590° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		13 PSI 246° F 259° F
Supercharger Booster Turbine		1 Operating
Air Flow Supercharger		16.0 LB/SEC
* See Vol. I, Section S40-0, of Ship Information Book		

BOILER OPERATION		
FULL POWER ASTERN (2 BOILERS)		4500 SHP 122 RPM
MAIN STEAM	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1235 PSI 950° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1224 PSI 652° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship *		2 3 1667 LB/HR 23.8 GPM
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 550 PSI 25 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 32 PSIA 290° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		29.3 PSIA 740° F 570° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		13 PSI 246° F 256° F
Supercharger Booster Turbine		2 Operating
Air Flow Supercharger		21.3 LB/SEC
* Based on Navy Diesel Oil (7.0 LB/GAL) & 75°F Inlet Oil Temperature		

BOILER OPERATION		
	BOILER OVERLOAD (1 BOILER)	19100 SHP 196 RPM
MAIN STEAM CONDITIONS	Drum Pressure	1250 PSI
	Superheater Outlet Pressure	1180 PSI
	Superheater Outlet Temperature	948° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure	1135 PSI
	Desuperheater Outlet Temperature	710° F
Number of Boilers in Use Per Ship		1
Number of Burners in Use Per Boiler		3
Fuel Oil Per Burner		3713 LB/HR
Fuel Oil Per Ship *		26.5 GPM
Fuel Oil Pressure - 1st Stage		550 PSI
2nd Stage		550 PSI
3rd Stage		522 PSI
Compressor Inlet Air Temperature		100° F
Compressor Discharge Pressure		72 PSIA
Compressor Discharge Temperature		600° F
Gas Turbine Inlet Pressure		65 PSIA
Gas Turbine Inlet Temperature		880° F
Gas Turbine Outlet Temperature		550° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure		13 PSI
Deaerating Feed Heater Temperature		246° F
Feed Temperature to Boiler		255° F
Supercharger Booster Turbine		1 Operating
Air Flow Supercharger		47.7 LB/SEC
* Based on Navy Diesel Oil (7.0 LB/GAL) & 75° F Inlet Oil Temperature		

BOILER OPERATION		
STANDBY (1 BOILER)		0 SHP 0 RPM
MAIN STEAM CONDITIONS	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1246 PSI 955° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1236 PSI 642° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship *		1 3 636.7 LB/HR 4.5 GPM
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 90 PSI 0 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 19 PSIA 140° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		18.1 PSIA 630° F 620° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		13 PSI 246° F 257° F
Supercharger Booster Turbine		1 Operating
Air Flow Supercharger		7.5 LB/SEC
* Based on Navy Diesel Oil (7.0 LB/GAL) & 75° F Inlet Oil Temperature		

BOILER OPERATION		
STANDBY (2 BOILERS)		0 SHP 0 RPM
MAIN STEAM CONDITIONS	Drum Pressure Superheater Outlet Pressure Superheater Outlet Temperature	1250 PSI 1246 PSI 955° F
AUX STEAM CONDITIONS	Desuperheater Outlet Pressure Desuperheater Outlet Temperature	1236 PSI 641° F
Number of Boilers in Use Per Ship Number of Burners in Use Per Boiler Fuel Oil Per Burner Fuel Oil Per Ship *		2 3 304.7 LB/HR 4.35 GPM
Fuel Oil Pressure - 1st Stage 2nd Stage 3rd Stage		550 PSI 20 PSI 0 PSI
Compressor Inlet Air Temperature Compressor Discharge Pressure Compressor Discharge Temperature		100° F 17 PSIA 100° F
Gas Turbine Inlet Pressure Gas Turbine Inlet Temperature Gas Turbine Outlet Temperature		16.5 PSIA 650° F 650° F
CO_2 in Stack Gas		14.0 %
Deaerating Feed Heater Pressure Deaerating Feed Heater Temperature Feed Temperature to Boiler		13 PSI 246° F 256° F
Supercharger Booster Turbine		2 Operating
Air Flow Supercharger		4.4 LB/SEC
* Based on Navy Diesel Oil (7.0 LB/GAL) & 75° F Inlet Oil Temperature		