CHAPTER 31

SPARE PARTS

31.1 Spare Parts allowances

Spare parts allowance books have been furnished to all ships. These allowances are based on American Bureau of Shipping requirements and past experience in replacement requirements. The allowance list will be under continual change as operating experience dictates. Request for changes or additions to the allowance shall be submitted on NAVSHIPS Form 4380 and must include complete justification.

CHAPTER 33

LIVING AND BERTHING EQUIPMENT

33.1 Applicability of the BUSHIPS Manual.

Chapter 33, BUSHIPS Manual, is applicable with the exception of the following details.

33.2 Furniture and furnishings.

Coast Guard Rules and Regulations are applicable concerning furniture and furnishings in civil service-manned(USNS) ships and compliance is directed as follows:

1. Rooms containing incombustible furniture will be considered as those rooms in which all case furniture such as desks, wardrobes, dressing tables, bureaus, dressers, etc., is constructed entirely of incombustible materials, and all free standing furniture such as chairs, tables, sofas, etc., is constructed with frames of incombustible material. Upholstery, drapes, etc., may be of combustible material in such spaces.

2. Waste paper baskets shall be constructed of approved incombustible materials and shall have solid sides.

33.3 Navy type life preservers.

Fibrous glass (orange), Stock No. GS4220-142-1725 life preservers are approved by the U. S. Coast Guard for use in MSTS ships. When necessary, cleaning will be accomplished ashore, on annual contract.

CHAPTER 34

COMMISSARY EQUIPMENT

34.1 Maintenance of dishwashing machines.

a. General. Preventive maintenance and correct operation of dishwashing machines are essential for the proper sanitation of eating utensils. Dishwashing machines shall be inspected by maintenance personnel in accordance with the following schedules. Necessary repairs and replacements shall be made and reported on the BUSHIPS Material Analysis Data Report, Form NAVSHIPS 3621.

b. Weekly inspections and maintenance.

1. Check adjustment of tension on the conveyor chains of machines equipped with conveyors. If both chains are equipped with lugs, insure that the lugs on both chains are directly opposite each other.

2. Make certain that guide sprockets are properly located on their shaft so that the conveyor chain rides properly on the track assembly.

3. On single tank machines, inspect the operation of the doors to ensure that all counterweights are properly attached and the doors are held in the open position when raised.

4. After the machine has been placed in operation in accordance with operating instructions (Chapter 34, BUSHIPS Manual), check the operation of thermometers, pressure gages, thermostat and automatic mixing valve or booster.

5. Adjust the thermostat on the rinse tank of double tank machines so the machine cannot be started up unless the temperature in the rinse tank is 180°F or higher.

6. When the rinse valves are open, adjust the automatic mixing valve to maintain the temperature of the water at 180° or higher.

7. Inspect the pump packing and adjust as necessary to stop leakage around the pump shaft.

8. Check the force of the recirculating wash spray by holding a tray inside the ends of the machine so as to deflect the spray from the upper spray assembly farther into the machine and observe that the lower spray when not meeting the upper spray will rise to approximately the top

of the machine. If this does not occur, there is insufficient spray velocity to produce satisfactory results. The cause shall be determined and corrected. It may be due to any of the following:

(a) Blocked pump suction line.
(b) Missing cap on spray tube.
(c) Missing spray tube.
(d) Jet orifices worn so as to be too large.
(e) Pump running backwards.
(f) Pump impeller eroded.

9. Check conveyor on conveyor type machine to ensure proper functioning.

10. Determine whether the final rinse valve on double tank machine is functioning in a satisfactory manner, and that when the valve is open, a uniform spray is coming from each of the orifices.

11. Clean orifices as necessary.

12. Lubricate motor and pump bearings.

13. Check the gear reducer unit and lubricate as necessary.

14. Lubricate the conveyor shaft bearings and drive mechanism, sprocket chains, etc.

15. Replace any missing lubrication fittings.

16. Inspect all steam and water valves.

17. Adjust gland nuts as necessary to prevent leakage.

18. Fill tanks to normal operating level, but do not open any steam valves. Observe for five minutes, if there is no appreciable reduction in the water level, there are no faulty drain valves.

19. Fill tanks to the overflow opening and make certain that the overflow drain is functioning in a manner to prevent the water level from rising any higher.

20. Clean drains and overflow as necessary.

c. Annual inspection and maintenance. Disassemble pumps and inspect rotors for excess erosion or corrosion.

34.2 Safety precautions and operating instructions for steam cookers.

STEAM CHEF - Manufacturer: Cleveland Range Company

a. Operation.

1. Turn on water to boiler by turning hand valve located in the upper front of the boiler on the right side when facing the cooker. Check water level in liquid gage. The water level is maintained by means of a float in the boiler.

2. Place food to be cooked in the steamer compartment. Hook catch on door and revolve wheel clockwise until door is snug, but not tight.

3. Open the steam valve located on the upper left side of the boiler front and turn on the electric switch located on the left side. The electrically operated solenoid valve will open and permit steam to enter the boiler, and steam for cooking will be generated.

4. Observe steam gage until a pressure of about two pounds per square inch (psi) is indicated. If the gasket leaks, which is possible, tighten the hand wheel sufficiently to stop the leak. Do not tighten the hand wheel excessively as this will cause the door gasket to become hardened and deteriorated.

5. When the steam gage shows pressure, cooking has begun. Pressure will be regulated automatically by the solenoid valve-operated apparatus on the left side of the boiler.

6. Observe steam pressure gage frequently. The equipment is designed to operate at steam pressures of 5-7 psi. Excessive pressure (over 7 psi) can be reduced by adjusting the steam valve on the front of the boiler.

7. If pressure in excess of 10 psi is generated, it is relieved by the safety valve, which is installed at the after side of the boiler. If pressure in excess of 10 psi is observed for any length of time and is not relieved by the safety valve, SECURE THE EQUIPMENT AND NOTIFY THE CHIEF STEWARD IMMEDIATELY.

8. Average cooking times are as follows: (Time required for cooking other foods will vary proportionately according to size.)

(a)	10-12 lb. ham:	2 hours
(B)	8-10 lb. ham:	1-1/2 - 2 hours
(c)	Medium size potatoes:	45 minutes
(d)	Rice:	30 minutes

9. When cooking liquids or semi-liquids, spillage is sometimes caused by the rapid release of steam pressure causing the food temperatures to be rapidly lowered from about 225° to 212° F. To prevent such spillage, move the cooking steam venting valve handle on the side of the cooker compartment very slowly to the rear position, thereby insuring a gradual pressure drop.

b. Safety precautions.

1. Do not tamper with the safety valve located on the after side of the machine. Do not tie it closed. When painting in the area do not paint safety valve.

2. If pressures in excess of 10 psi are not relieved, secure the equipment and immediately notify the chief steward.

3. Test steam pressure gage every six months in accordance with BUSHIPS Manual, Article 87-14. Enter date and initials of person conducting the test on the dial certificate.

4. DO NOT PAINT compartment vents, steam valves, air vents, solenoid valve or pressure switch.

5. Report malfunctions to superior.

c. Maintenance.

1. Drain boiler once each week immediately after using. Clean out boiler as frequently as required. Keep compartments clean and compartment drains clear. Remove shelves or racks frequently for this purpose.

2. Clean waterline strainer frequently.

3. Keep door wheel screws clean and lubricate them monthly or oftener as required. Use lubricant sparingly.

4. Use only enough force on hand wheels to prevent steam from leaking. Excessive tightening of wheels wears out gaskets.

5. Do not tighten wheels when doors are open or unlatched.

6. Leave compartment doors ajar when not in use to prevent gaskets from adhering to compartment knife edges.

7. The installation and maintenance of the solenoid operated pressure control valve and pressure switch for steam supply to the boiler shall be accomplished in accordance with the manufacturer's instructions.

CHAPTER 36

SANITATION

36.1 Chlorination of water.

a. All fresh water aboard ship shall be rendered potable by chlorination.

b. Potability of water shall be determined by routine, orthotolidine tests on samples taken from the various outlets. The required chlorine residual is 0.2 to 0.4 PPM.

36.2 Responsibility.

a. In ships with medical departments.

1. Medical officer.

(a) The medical officer will be responsible for determining the potability of the water. The medical officer shall make periodic inspections and special surveys of water supply systems, including all measures for purification, and make necessary recommendations for the correction of any sanitary defects. In the event of an acute shortage of water, the medical officer shall advise the commanding officer and/or master relative to the rationing of water. Chlorine residual records will be maintained in the medical department and daily entries shall be made of the chlorine residuals taken.

(b) The medical officer shall work in close cooperation with the chief engineer on matters pertaining to the supply and purification of water. He shall acquire a working knowledge of the chlorination, storage and distribution of water, the hazards of cross-connections aboard the ship and between ship and shore, and the precautions needed when the ship operates in polluted waters.

2. Chief engineer. The chief engineer shall ensure the proper handling, storage, distribution and chlorination of the fresh water supply. He shall also take and record daily chlorine residuals.

b. In ships without medical departments. In ships without a medical representative, the entire procedure will be carried out by the chief engineer or his designated representative.

36.3 Chlorination procedures.

a. Automatic system. This system consists of an automatic chlorinator, detention tank and a de-chlorinator. Its operation will be in accordance with the Wallace & Tiernan Manual and instruction sheets for the Hydrodarco Purifier or in accordance with applicable instruction manuals for the chlorinator in use. Only sodium hypochlorite shall be used in the automatic chlorinator and adjustments shall be made to provide a concentration of 5-10PPM chloride in the detention tanks. The bypass shall be adjusted to provide the required residual concentration of 0.2-0.4 PPM in the system at all times.

b. Manual chlorination system. This system consists of storage tanks for water which is chlorinated by hand prior to delivery into the distribution system. Manual chlorination shall be accomplished as follows:

1. In a container of water, dissolve a sufficient quantity of calcium hypochlorite powder in the proportions of 1½ grams of unmixed powder for each ton of fresh water to be chlorinated.

2. The above solution is injected into the water tank through a sounding tube or a petcock prior to taking an additional water supply so that the swirling action of the incoming water will provide the proper agitation. A concentration of 0.2-0.4 PPM chlorine should result. If tests prove the chlorine concentration below requirements, sufficient quantities of calcium hypochlorite shall be added.

3. In ships having Everpure Filters installed on lines adjacent to outlets, calcium hypochlorite may be added to tanks at the rate of 5 grams per ton of water, which will give a chlorine residual of approximately 1.0 PPM. Dechlorination is accomplished by the filter.

36.4 Tests.

a. Chlorine residual test sets are required in all MSTSPACAREA ships. Ships not holding them shall requisition the required number from the Sharpe General Depot (Tracy Annex), Medical Supply Section, Lathrop, California. They shall be identified as Comparator, color, chlorine, Stock No. L6630-417-0000.

b. To test the efficiency of the system, samples shall be taken daily from two main sources:

1. From the fresh water tanks, from detention tanks when present, or from adjacent lines.

2. From the various outlets on the distribution system.

c. The tests shall be conducted and logged by the engine department. In ships with a medical department, medical personnel will also be responsible for conducting tests daily and logging results.

36.5 Precautionary measures.

a. Fresh water tanks shall be filled as soon after docking as practicable and not later than 48 hours prior to sailing to permit chlorination and the chemical and bacteriological studies required to insure a potable water supply.

b. A total of at least 72 hours shall be allotted for zinc dusting, cement washing and decontamination in the interior of the ship's potable water tanks during an inport period.

c. Fresh water hose shall be stowed in suitable lockers, preferably metal, and clearly labeled "FRESH WATER HOSE." These lockers shall be placed as near the ship's filling line as possible and shall be at least 18 inches from the deck. Care shall be exercised while taking fresh water on board to keep the hose from falling into harbor water which is usually contaminated with sewage. When not in use, the fresh water hose shall be properly rolled and stowed. It shall be used exclusively for loading fresh water. Old or dirty hoses shall never be used to take fresh water aboard.

36. 6 Contaminated Waters.

a. Unless determined otherwise by suitable tests, all water shall be considered contaminated in harbors, rivers, inlets, bays and landlocked waters, and in the open sea within 10 miles of the entrance to such waters. In other areas, contamination may be declared to exist by the fleet surgeon or his representative as necessity exists or as local conditions warrant.

b. Contaminated water or water that is suspected will be treated in accordance with the Manual of Naval Preventive Medicine (NAVMED P-5010), Chapter 5.

(1) Since the limited equipment available is not adequate for complete analysis, the flash color (the color appearing at 10 seconds after the addition of orthotolidine) should be used to indicate the amount of free chlorine available. Chlorination to the recommended level as outlined below is considered adequate whenever facilities are not available for testing and treating as outlined in NavMed P-5010.

(2) Addition of Sodium Hypochlorite or approved other substance, should be accomplished so as to allow for adequate mixing. Ten (10) to fifteen (15) grams of sodium hypochlorite per ton of water

should give 2 to 3 ppm free chlorine.

(3) After the desired amount of time (minimum of 20 minutes) has elapsed, test for free chlorine using flash color as above. If the reading is too low, additional Sodium Hypochlorite must be added and additional contact time allowed.

(4) The effectiveness of the free chlorine is dependent to a great degree upon the pH of the water. Only in unusual circumstances will the pH of the water be so high as to cause a need to make pH adjustments. The below figures are to be used as a guide in treating contaminated water at normal temperatures, (22 to 25 degrees Centigrade).

pH	ppm free chlorine	contact time
7.0 - 8.0	2.0	25 min.
8.0 - 9.0	2.0	80 min.
7.0 - 8.0	3.0	20 min.
8.0 - 9.0	3.0	60 min.

Higher concentrations of free chlorine are permissible but would require more dechlorination before the water is palatable. Dechlorination may be accomplished by the addition of small quantities of Sodium Thiosulfate with mixing.

(5) In any instance when water cannot be rendered potable by any other means, water for drinking and culinary purposes may be made safe by boiling.

(6) The below listed items should be procured and kept on hand:

1 L6630-442-8000 - Test Paper and Color Chart, with Dispenser
1 L6630-442-8010 - Test Paper, Hydrogen Ion, 5's
1 L6630-442-8020 - Test Paper, Hydrogen Ion, 5's
8 L6505-144-9000 - Sodium Thiosulfate, 1/4 lb. Bottle

36.7 Decontamination.

Decontamination of water involves super-chlorination with a large dosage of a chlorine compound followed by a detention period to render the water safe for human consumption. Decontamination of the various parts of the potable water system shall be carried out when one or all the following conditions arise:

1. Following routine cleaning and refinishing of the interior of the potable water tanks or other parts of the system.

2. Whenever any person or object has entered a potable water tank.

3. Whenever contamination of the tanks or the system is suspected because of defective plumbing or errors in water sanitation or when contamination is indicated by bacteriological or chemical tests or by an outbreak of water-borne disease.

CHAPTER 38

VENTILATION

38.1 Automatic fire dampers.

Automatic fire dampers of the fusable-link type shall be inspected semi-annually for designed operation by the ship's carpenter in accordance with his semi-annual schedule outlined in the Appendix.

38.2 Galley range hoods and filters.

Galley range hoods and filters shall be maintained as outlined in the Appendix.

38.3 Maintenance of ventilation filter screens.

The COMSTSPACAREA Maintenance Shop located at Naval Supply Center (Oakland) is provided with the facilities and will clean, oil and service ventilation filter screens installed in ships.

1. Request for cleaning, oiling and servicing shall be entered on the standard repair request submitted for voyage repairs.

2. Maintenance of filter screens shall be accomplished on a progressive basis. They shall be cleaned quarterly.

3. The removal and installation of ventilation screens in connection with servicing is considered within the scope of ship's force maintenance.

38.4 Cleaning of ventilation systems. Ventilation systems may be cleaned by the use of high pressure air and industrial vacuum cleaners. Where such equipment is present on board ship it is directed that ship's force make maximum utilization of it for greatest efficiency of the ventilation system.

In accordance with the general building specifications for ships of the U.S. Navy, it is desired that the access openings for cleaning purposes be incorporated in the ventilation ducts. Openings should be present on each side of heaters and/or cooling coils at the opening of the impeller end of axial fans and at the inlet side of all 90-degree bends.

Access may be provided by either access opening, with removable cover plates, or by removable sections of duct. Access openings

shall be the largest practicable. Where possible, the bottom plate or side plate of ducts or transition sections shall be made portable to serve as the access. Otherwise, access openings shall be made in, and approximately the full width of, the transition piece. The axial dimension shall be approximately 24 inches where the transition section will permit. Openings shall be located in the bottom of the duct unless the side is more accessible. Care shall be taken in locating equipment and access plates to insure that the plates are in fact readily accessible without the necessity of first dismantling other installations.

All access plates shall be of the same material and thickness as the vent duct or trunk.

Where access plates are installed in ducts fitted with thermal insulation, the plates shall be insulated with hard-surfaced fibrous glass board. Where the duct is fitted with acoustic insulation, the insulation on the access plate shall be similar to that on the duct.

All access and inspection plates shall have gaskets of either fiber or rubber, and shall be secured by a simple approved fastener disengaged by a rotation not in excess of 180 degrees. The degree of tightness required shall determine the number of fasteners used.

CHAPTER 41

MAIN PROPELLING MACHINERY

41.1 Applicability of Chapter 41, BUSHIPS Manual.

Except for subject matter specifically covered in this chapter, all articles of Chapter 41, BUSHIPS Manual, are applicable. Reports and requests mentioned in the manual for referral to the Bureau shall be submitted to the ship's administrative commander.

41.2 Astern power.

Wherever astern power limits of the main unit have been imposed by the manufacturer, a sign shall be placed in direct view of the throttleman showing the astern RPM for full power.

41.3 Reciprocating engines.

The interiors of cylinders and valves of reciprocating engines shall be examined at intervals not exceeding 2,500 hours' operation, or six months, whichever occurs first. The inspection shall be visual and indications of wear noted in the history. (In lieu of Article 41-798, Chapter 41, Section III, BUSHIPS Manual.)

41.4 C-4 carbon packing clearances.

The following clearances for carbon packing apply to Westinghouse 9,000 HP C-4 type turbines. This table supersedes the clearances indicated in the manufacturer's original book:

H.P. Forward	0.030"	Clearance (diametrical)
H.P. Aft	0.020"	" "
L.P. Forward and Aft	0.020"	" "

41.5 P-2 turbo-electric over speed trip and stop valve.

a. The Shutte and Koerting over speed oil-actuated trip and stop valve installed in P-2 turbo-electric ships is a balanced valve designed to be held open by lube oil pressure. The valve is designed to open by pulling the hand lever.

b. If at any time the valve does not open with the hand lever, an immediate investigation of the valve stems shall be made to determine if any of them are sticking. The hand oil pump shall not be used without first closing off the intermediate stop, since this could cause severe over-speeding.

c. Chief engineers of P-2 turbo-electric ships will post applicable operating instructions close to each valve.

41.6 Bridge gage readings.

Article 41-143 of the BUSHIPS Manual, which requires quarterly bridge gage readings of turbine bearings shall not apply if a positive and more simple method is applicable. Entries shall be made on the History Card quarterly outlining the method in use and the readings. Bridge gages shall be used during overhaul and American Bureau of Shipping surveys.

41.7 Care and Maintenance of Marine Propulsion Turbines

Marine propulsion turbines are precision built machines, capable of years of continuous service under all sorts of adverse conditions. Their initial reliability is generally accepted - but continued reliability is dependent upon regular planned maintenance. This article will discuss several factors which are necessary to maintain propulsion equipment "READY FOR SEA."

a. OIL SYSTEMS.

Oil systems for propulsion turbines may have the highest quality oil and the best equipment obtainable and still not do a proper job unless the oil is kept in proper condition. Dirty oil or oil that has lost its lubricating properties is a hazard to good operation. The following is a partial list of direct failures that can be attributed to dirty or tired oil:

(1) Scored journals.

(2) Journal bearing failure.

(3) Thrust bearing failure.

(4) Malfunction of over-speed protection system.

(5) Excessive vibration.

These items in themselves do not compare in value with the contributory losses that may occur.

Journal bearing failures can cause scored journals, loss of oil deflectors and may cause excessive vibration.

Loss of thrust bearings may cause bucket damage, diaphragm damage and packing damage.

Malfunction of over-speed system may cause loss of life as well as total loss of the turbine.

Excessive vibration can cause loss of journal bearings, oil deflectors, steam packing and rupture of oil lines. It is imperative that the lubrication system be maintained continually with good, clean oil.

b. STEAM SYSTEMS.

(1) Reliable operating propulsion turbines require that the steam system also be kept as clean as possible. Salt or other solids in the steam will cause rapid deterioration of the internal parts of the turbines. Most turbine buckets and diaphragm blades are made of stainless material which will give long life if given proper care. However, this material is highly susceptible to salt corrosion - especially in the dry steam region of the turbines. Salt particles which are deposited on the buckets and diaphragm blades will not attack them unless moisture is present. This takes place usually during the periods when the turbines are secured. If they have not been properly dried out by running the air ejectors for a short period of time after shut-down, then the remaining moisture will for concentrated salt solutions on the parts and result in rapid corrosion. If it is known that salt has contaminated the steam system, wash the unit with hot fresh water to remove it as soon as possible.

(2) Other solids should be removed by feed water treatment. These solids, if allowed to remain in the steam, will deposit on the turbine parts and may cause excessive vibration and plugging of the steam path. This plugging, if allowed to continue, will close up the steam passages and increase the loading of the thrust bearing - possibly to the point of failure. If the solids are water soluble, they can be removed by washing, but if they are insoluble, it will be necessary to chip off the deposits or remove the rotor from the ship for grit blasting. Keeping the steam clean and taking immediate action if it becomes contaminated will reduce maintenance costs greatly.

c. VIBRATION.

Excessive vibration in propulsion turbine should be corrected as soon as possible. Some of the common causes of excessive vibration are alignment, bent or bowed shafts, failure of associated equipment - such as bearings and worn couplings, and unbalance.

(1) Bowed shafts are usually caused by uneven heating of rotor. Failure to rotate rotor on turning gear when steam seal has been applied during the preparation for starting is one of the most common reasons for a bowed shaft. Always place unit on turning gear before applying steam seal. Packing rubs during warm-up periods can

also cause a bowed shaft. Continued operation of rotor in a bowed state will probably aggravate the condition as the bowed side of the rotor will rub against the packing. This will generate more local heating of the rotor and increase the bow in it. Placing unit on a turning gear for a short period of time will usually overcome this condition.

(2) Worn couplings are a very common source of rotor vibration. They should be checked periodically to see the teeth are not galled and the radial clearances are within manufacturer's normal limits.

(3) Broken babbitt in bearings, especially on the after end of the turbine can very often be caused by a worn or unbalanced coupling.

(4) Replacement of parts or whole couplings should be carefully balanced both statically and dynamically before installation to minimize any unbalance and then carefully check under operating conditions.

(5) Unbalance of the turbine rotor itself can also cause excessive vibration. This can be caused by uneven build-up of solids on the rotor or by failure of a bucket or shroud band. This most commonly blamed cause of vibration is extremely unlikely because of careful design and precision manufacture of the rotors. However, they should always be carefully inspected and magna-fluxed, each time the turbine is opened for inspection.

d. MONITORING THE TURBINE.

Monitoring the turbine can in many cases indicate impending trouble before it has reached the stage of expensive maintenance or has caused an unscheduled outage. Each time the turbines are reconditioned into "good as new condition" a complete set of readings of all operating instruments shall be made and recorded. This information shall consist of at least the following items:

(1) Propeller RPM.
(2) Inlet pressure and temperature.
(3) Condenser pressure.
(4) Barometer.
(5) Pressure at all heater openings.
(6) Cross-over pressure.
(7) First stage pressure.
(8) Hand valves opened.
(9) Inlet oil temperature.
(10) Bearing discharge oil temperature.
(11) Number of heaters in service
(12) Date

The data should be taken for as many speed and hand valve positions as are convenient. At periodic intervals (monthly or at least quarterly) duplicate data should be taken and compared with the original. Any variations in the readings will indicate that deterioration is taking place. The turbine manufacturer can analyze the data and usually indicate what the trouble is. Any variation of ten per cent or more in any of the regions is a signal for immediate action as further operation will very likely cause extensive damage to the equipment.

e. MAINTENANCE SCHEDULING.

Satisfactory operation of marine propulsion turbines cannot be expected unless they are kept in good condition. Time and sustained operation will gradually cause wearing of some parts, increase fuel consumption and corrosion of parts. The best way to reduce the effects of these things is a well planned maintenance schedule. The following suggestions are the minimum scheduled inspections that should be followed by all operators of marine propulsion turbines:

(1) Every four years (Maximum) - open turbine casings.

(a) Remove rotors.

1. Magna-flux completely.

2. Clean if necessary.

3. Replace parts recommended at previous inspection.

4. Check journals and refinish if necessary.

5. Check thrust collars and refinish if necessary.

6. Inspect coupling sleeve and replace if necessary.

(b) Remove diaphragms.

1. Clean and inspect.

2. Examine steam joints and repair if necessary.

(c) Inspect casings.

1. Check steam joints and repair if necessary.

2. Make sure all drain orifices are open and clear.

3. Repair areas of erosion in low pressure turbines.

4. Clean all areas of casing and bearing brackets.

(d) Inspect.

1. Bearings if necessary, replace

2. Oil deflectors - if clearances are excessive replace.

3. Packings - if clearances are excessive, replace.

4. Thrust - if scored or worn, replace.

(e) Replace diaphragm and rotor.

1. Check clearances.

a. Bearing, thrust and packing (axial and radial)

b. Nozzle to bands

(f) Inspect and correct valves and valve seats (if Necessary

1. Renew soft packing.

2. Dismantle and inspect maneuvering valve and safety devices, where necessary.

3. Dismantle, clean and inspect steam seal regulator (correct valve where indicated.)

4. Dismantle and inspect all non-return valves, guard valves and shut-off valves and correct where indicated.

(2) Every year (Maximum)

(a) Inspect all bearing and journals

(b) Inspect all end packings.

(c) Inspect last stage buckets of low pressure turbine and casing for erosion. Check to see that moisture removal orifices are open.

(3) Every start-up or at least weekly.

(a) Check over speed mechanism to see that it functions properly.

Marine propulsion turbines are well designed and built for years of trouble-free service - if properly maintained. It is strongly suggested that the manufacturer's services be called upon at each inspection, in order that the units may be inspected and cared for in accordance with recommendation.

41.8 Operation of Marine Steam Turbines

The procedure to be followed in starting, operating and shutting down a marine turbine will vary somewhat depending upon the particular installation. The following instructions apply to an 8000-horsepower, cross-compound, double-reduction turbine-gear set. The ship has one propeller which operates at 101.6 revolutions per minute at normal speed.

a. PREPARATION FOR WARMING THE TURBINE.

Before starting to warm the throttle, check the following points:

(1) See that the turbine rotors and gears move freely; this may be done by turning the units manually by means of the ratchet wrench, or electrically by means of the motor-driven turning device. If the motor-turning device is used, be sure to disengage it when finished with it.

(2) All valves and cocks for draining water from the main steam pipe, the maneuvering valves and the turbine casings, should be open.

(3) All steam valves at the maneuvering gear and about the turbines should be closed, but eased back slightly to prevent jamming when hot.

(4) See that the sentinel relief valve at the condenser is set at 10 pounds gage.

(5) The cocks to the pressure and vacuum gages on the turbine and the condenser should be open.

(6) Inspect the lubricating system thoroughly, with particular attention to the following points:

(a) See that the supply tank has sufficient oil for the system.

(b) See that any water that may be present is removed from the bottom of the supply and sump thanks through such fittings as may be provided at those points.

(c) Determine that there is a supply of circulating water through the oil cooler, by turning on the water and then turning it off. It is not necessary to cool the oil during the warming-up period, and the cooling water need not be turned on until the temperature of the bearings indicates that this is necessary.

(d) It sometimes happens that the supply of oil in the lubricating system becomes cold and viscous because of the weather or the location of the oil tanks. Therefore, before starting the equipment it may be necessary to heat the oil in the tanks sufficiently to allow it to flow freely. The initial oil temperature should not be lower than 90 degrees F.

(7) Start the oil pump and make sure that oil is flowing freely to all turbine and gear shaft bearings, to the thrust bearings, flexible couplings, and to the spray nozzles that supply oil to the points where the several gears and pinions mesh. With oil circulating in the system, again check the oil level in the reservoir.

b. USE OF TURNING GEAR IN STARTING AND STOPPING.

In addition to its use as a jacking gear in turning the turbine-gear set over when making inspection, the motor-driven turning device may be used to keep the turbine rotating slowly during the warming-up and cooling-down periods. The turbine and gear may also be rolled slowly by admitting a small flow of steam through the ahead throttle valve; the steam consumed by rolling in this manner is negligible. The turbine rotor should not remain stationary for more than a few minutes when steam is being admitted.

c. PURPOSE OF ROLLING TURBINES DURING WARMING-UP.

(1) The continued operating efficiency of steam turbines depends to a large extent on the maintenance of the relatively small radial packing clearances. These clearances can be maintained at the designed values only by keeping the turbine rotors straight, and to obtain this condition it is necessary to maintain a uniform temperature around the circumference of the rotor. When turbines are being warmed up or cooled down with the rotors stationary, the heat tends to collect in the top, particularly if sealing or warming-up steam is used, or if lubricating-oil flow is established. This uneven heating results in the temporary bowing or distortion of the rotors, and to some extent the turbine casings, with the ultimate result that rubbing of the packings when starting with a bent shaft. It is most desirable, therefore, that the shafts and shells be undistorted when a turbine is started, and this condition is obtained by rotating the shafts during warming-up or standby periods, either by means of the turning gear or by steam flow.

(2) It is also desirable to keep the turbines rotating slowly during a shut-down when the shut-down is for a period longer than a few minutes, or for less than about 12 hours. The necessity, however, for keeping the turbines rotating does not exist if the turbines are shut down for a period of several days or longer, since the shaft and shell will straighten out during that time, provided steam from any source does not enter the turbines.

(3) The length of time that the rotors should be kept turning after shut-down depends on local conditions and must be determined through experience with the particular turbine; however, it should be kept turning until the turbine cools off, or as long as there is the possibility that the turbine will be called upon for a quick start. The lubricating-oil pump should be run during this period in order to keep an oil pressure of not less than 6 pounds on all bearings.

d. WARMING THE TURBINE.

Although it is probable that a turbine can, if its shaft is straight, be started from a cold condition without warming up, such operation does not contribute to continued successful operation of the unit. The temperature strains set up in the casings and rotors by such rapid heating have a harmful effect. The turbine should be warmed as slowly as local conditions permit. When a turbine is cold the following starting cycle should be observed, after blowing the throttle drains, opening the turbine drains and following other preliminary steps previously outlined:

(1) Provide sufficient lubrication at all bearings for slow turning, and then start the turbine rolling on the turning gear.

(2) Start the air and circulating pumps, and admit sealing steam to the turbine packings. Do not work the jets faster than is required to maintain a vacuum of about 10 inches; higher vacuum during the warming-up period would lengthen the time required to heat the turbine, and might cause inequalities in temperature that would result in distortion. Under these conditions, allow the turbine to run on the turning gear for at least 15 minutes.

(3) After the foregoing warming period, disengage the turning gear, then rotate slowly with steam from the ahead throttle valve for another period of 15 to 20 minutes. Close all drains.

(4) After the above warming period and until the vessel is under way, the turbine should be kept turning slowly, or turned every few minutes.

(5) With steam being admitted to the packings, the turbine should not under any circumstances be permitted to remain stationary more than a few minutes.

(6) When the turbine is warmed to operating temperature, bring the vacuum up to normal, and, if necessary, turn on water to the oil coolers. Observe the oil temperature at all main-bearing oil discharges to verify that oil is flowing freely.

(7) When the warming period is completed, the turbine ~~may~~ be brought up to about half speed. Higher speeds should be reached

gradually, and at least another 15 minutes allowed in getting up to full speed.

e. UNDER WAY AT SEA.

(1) Close all drains from the ahead turbine, but keep the drains from the astern element cracked open.

(2) Observe the level in the gravity tank through the sight glass provided for this purpose, to guard against loss of oil through leaky joints in the oil-piping system; if the oil level in the tank rises, the oil cooler should be examined for leaking water tubes.

(3) Check the location of the turbine rotors by means of the clearance indicators located at the forward end of each turbine; this measurement indicates whether any wear is taking place in the thrust bearings, and should be checked each week while at sea.

(4) If any shaft or thrust bearing shows signs of excessive heating, slow down immediately and ascertain the cause. Pay special attention to the lubrication of the thrust elements at the forward end of each turbine, and to the main thrust bearing located at the forward end of the low-speed gear.

(5) Regularly determine and log the temperature of the bearings, as indicated by the temperature of the discharging oil. A fair running temperature is 150 to 160 degrees F.

f. SECURE THE TURBINE.

(1) Close all regulating and sealing-steam valves.

(2) Open all turbine drains.

(3) Keep the condenser pumps working until the turbines are thoroughly drained; then shut down the pumps. The matter of drying out the turbines is very important; it is equally important that the interior of the turbines be kept dry when the vessel is in port. This may be done by running the steam jets for about one hour every second day to draw fresh air through the turbine.

(4) Open and clean all strainers.

(5) Examine the gear oil nozzles to see that they are not obstructed; when doing this, do not place a naked light near the opening in the casing because of the possibility of explosive vapor. Clean the nozzle strainers.

(6) When the oil supply has settled thoroughly in the reservoir, a small quantity should be drawn off from the bottom; if the sample shows that the oil is becoming thick, the supply should be renewed.

(7) Every second day start the oil pump and force a fresh supply of clean, dry oil through all bearings and to the spray nozzles; this is to prevent rusting and pitting that might take place while the unit remains idle. While the oil is being circulated, turn the unit through one and one-half revolutions of the propeller in order to oil all of the gear teeth and to let the rotor come to rest in a new position.

41.9 Main Reduction Gear Inspection Plates *

In order to facilitate the periodic inspections of main reduction gears required by COMSTS INSTRUCTION 4700.7, each ship shall assure that all paint is removed from the main reduction gear inspection plates and their corresponding mating surfaces on the gear casings. Inspection plates, joining surfaces, studs and nuts shall be coated only with a light lubricating oil or consol oil to assure that chips of paint and other foreign substances do not fall into the gear case when the cover is removed.

41.10 Propulsion Power Limitations

a. Design and operational data of ships under the administrative control of COMSTSPACAREA including propulsion power limitations as established and speeds of advance normally to be expected as those limits are shown in table, page 41-12.

b. The limits as established may be exceeded only in an emergency or with prior message approval of COMSTSPACAREA in order to meet a schedule.

c. Whenever in an emergency it is necessary to exceed the established limitations, the Master shall submit a written report to Commander Military Sea Transportation Service, Pacific Area explaining the reason therefor (Report of Exceeding Propulsion Power Limitations, MSTSPAC Report 9410-1).

CHAPTER 42

REDUCTION GEARS

42.1 Applicability of BUSHIPS Manual.

All of Chapter 42, BUSHIPS Manual, is informative and applicable to USNS ships.

42.2 Main thrust indicators.

a. Close observation of the main thrust position and float is imperative at all times. Clearances shall be maintained within the manufacturer's prescribed limitations.

b. Log entries shall be made at least weekly that the indicator has been checked for normal running position. During any maneuvering, close observation of the lateral shaft movement when going from ahead to astern will give the true main thrust float.

c. If the engine manufacturer has not installed a thrust indicator, the ship's force shall improvise and install one. It may be in the form of a tram and shall be located as close to the thrust bearing as possible. Its purpose and use shall be explained to all watch engineers.

42.3 Dangers of overloading.

Geared turbine ships shall be operated within their prescribed horsepower ratings. Overloading of gears and the increase in tooth contact pressures results in gear flaking with subsequent galling. Weather conditions, e.g., severe head winds and rough seas will increase the gear tooth contact pressure. When such weather conditions are encountered the engine shall be operated on a reduced number of nozzles. Torque characteristics rise sharply when the headway and shaft revolutions are reduced because of external conditions.

42.4 Security of inspection plates. *

All inspection plates and access openings to the main and auxiliary reduction gears shall be maintained free of paint, including an area around such openings approximately one half inch (1/2") wide. A light coating of oil or prussian blue pigment in oil may be applied as a rust preventative. All inspection plates or other openings shall be kept locked. The custody of the keys shall be the responsibility of the chief engineer.

42.5 Inspection of flexible couplings.

a. Flexible couplings that are lubricated in a forced feed system have a centrifuging effect on the oil. Couplings have been opened and found loaded with impurities and the coupling teeth worn away as a result of the abrasive action. This centrifuging effect can be stopped by drilling holes in the outer coupling shell, thus allowing the oil to circulate through.

b. Ship's force will inspect and clean all flexible couplings quarterly. Those without holes in the outer shell shall be watched closely and cleaned often if necessary. All new couplings shall be drilled prior to installation. Installed couplings shall be drilled when convenient with other repair work.

CHAPTER 43

SHAFTING AND BEARINGS

43.1 Applicability of BUSHIPS Manual.

All of Chapter 43, BUSHIPS Manual, is informative and applicable to USNS ships.

43.2 Propulsion shafting.

a. The main propulsion line shaft from the reduction gear coupling to the stern shaft coupling shall be maintained free of all rust, paint, and other foreign matter. Shaft may be cleaned and polished using emery cloth and/or cocoa mats. After the shaft has been polished, a light film of oil or prussian blue pigment in oil may be applied as a rust preventive. If prussian blue is applied, care must be exercised to prevent a thick accumulation. At least once per year, all prussian blue should be removed and a new application applied.

b. The stern shaft section between the gland bulkhead and coupling should be cleaned to bare metal and coated with a damp-proof primer ("Wetsall", Apexior, or a similar product) to prevent rusting.

CHAPTER 45

LUBRICANTS AND LUBRICATION SYSTEMS

45.1 Care of lubricating oil.

a. Proper care of lubricating oil is vital to the safe operation of the main propulsion units and gears. BUSHIPS Manual, Articles 45-102, 103 and 104 are applicable.

b. The solvent action of oil used in certain MSTSPAC ships tends to loosen grit and foreign particles that would otherwise remain dormant.

c. To remove impurities from the oil and the lubrication systems, the following procedures shall be established in all ships:

1. Oil purifiers will be operated continuously while underway.

2. Lubricating oil will be renovated in accordance with Articles 45-103 and 45-104 whenever examination indicates excess impurities or water content and at least once during each six month interval. The interior of the sump and gravity tanks shall be inspected and wiped down at the same time.

3. Lubricating oil samples will be submitted for analysis once every six months and at any intermediate time when the condition of the oil appears questionable. Samples will be labeled in accordance with the sample tag found on the following page. An analysis of the samples submitted will be returned to the ship for record purposes, in order to compare the analysis with the standards for the various types of turbine oils. The table below is submitted for information: *

	2190T	MOBILE RL-285-E	MOBILE DTE EXTRA HEAVY
API	27.5	27.4	27.5
MAX. POUR	20°	25°	25°
MIN. FLASH	410°	425°	420°
SSU, 100°F	425	600	600
SSU, 210°F	60	70.6	69
VISC. INDEX	100	104	95
WATER	None	None	None
SEDIMENT	None	None	None

SAMPLE

LUBRICATING OIL SAMPLE TAG

(To be prepared by ship and affixed to each sample)

LUBRICATING OIL SAMPLE

Ship's Name _____

Date Submitted _____

Name of Chief Engineer

_____

U. S. Navy symbol No. of Oil

_____

Company oil designation if not

Navy _____

Source of Sample _____

Date Oil in Service _____

No. service hours when sample

was drawn _____

CHAPTER 46

CONDENSERS AND AIR EJECTORS

46.1 Care of copper condenser tubes.

a. When copper is exposed to salt water, it forms a protective film on its surface. This film will prevent tube corrosion and erosion if it remains undisturbed. Disturbance of this film can be caused by any of the following:

1. High velocity of water.
2. Grit and solids in the water.
3. Scratching by tools and implements.
4. Foreign bodies lodged in the tubes which cause impingement of water in localized areas.

b. Frequent inspections of the tube ends shall be made to detect any disturbances in the normal protective film. Corrective action, as required, shall be taken promptly and may consist of the following:

1. Removal of foreign material.

2. Coating the tube ends with Apexior #3 or, in severe cases, the use of plastic inserts.

3. In the event of large deposits of marine growth, a concentration of sodium hypochloride solution injected into the tube on the salt waterside for several hours while in port will loosen up the organisms and restore a clean tube surface.

46.2 Condenser leaks.

In the event of a condenser leak at sea, it is possible to temporarily check the leak until arrival in port by injecting saw dust into the circulating water inlet. This procedure is recommended especially in single screw ships which would have to shut down at sea to plug tubes. When saw dust is used to check a condenser leak, the condenser shall be tested and tubes plugged at the first convenient port.

46.3 Maintenance of water boxes.

Water boxes on all salt water equipment shall be examined quarterly. Apexior #3 shall be used as necessary on all ferrous interiors. Zinc plates or anodes shall be cleaned or renewed as necessary. Installations of zinc shall be at least equal to one square foot of zinc area per one thousand (1000) square feet of cooling surface.

46.4 Large gate valves in salt water service.

a. To preclude costly diver expenses and delays in basic jobs resulting from sea valves which cannot be secured because of galled threads, a loose bushing in valves of the gate type, dirt accumulation in gate valve bonnet, etc., the chief engineer shall establish the following procedures:

1. Operate all large sea valves at least once monthly to eliminate accumulations of sea growth and foreign matter.

2. Use high injection when the ship is in shallow or confined waters to eliminate foreign matter going through the condenser.

3. Valves that are installed in an upside down position shall be fitted with a drain so that the bonnet can be periodically drained of accumulations that are trapped. Most large valves have a small inspection plate that can be removed when the valve is closed.

b. When a work order is submitted for work on a main condenser or system connected with a sea chest and such work is dependent upon the closing of these valves, the chief engineer shall check the valves to insure that the system can be secured. If it cannot be secured, he shall so state in the basic request.

CHAPTER 47

PUMPS

47.1 Submersible pumps (Sawyer Model 822.A).

a. Maintenance precedures. After each period of service the pumps shall be operated in fresh water for a sufficient period to completely flush out the salt water. After flushing the pump, the intermediate chamber shall be drained. This is accomplished by removing either of the lower pipe plugs in the pump housing marked "OIL HERE." When the intermediate chamber is thoroughly drained, pour 1/2 pint of lubricating oil, Navy Symbol 3050 (SAE20), in the chamber and reinstall the plug.

47.2 Victory ship pumps.

The valve chests of Victory ship feed pumps and fuel oil service pumps contain a slide valve that actuates tha main piston valve. Most troubles with this type valve gear can be traced to improper maintenance; conversely, most troubles can be eliminated by its proper maintenance. Permanent damage can be done by the use of washers to alter the designed valve stroke. The use of washers or major adjustments to the valve half nuts and tappets is unnecessary when the valve is maintained as prescribed below.

1. Remove the cover plate monthly to inspect surfaces of the valve face and slide valve.

2. If necessary, smooth up by grinding, turning in lathe or lapping.

3. Restore port in slide to original dimensions by cutting out metal with end mill in drill press or hand grinder or by chipping out with a cape chisel. The length of the port shall be twice the diameter of the drilled hole in the valve plate plus the distance between two adjacent holes. It may, of course, be twice the diameter of the drilled hole in the valve plate plus the distance between two adjacent holes. It may, of course, be measured from a new slide valve.

4. Failure to complete step 3, above, is the reason for most troubles with these pumps since repeated wear and resurfacing reduces the length of the port.

CHAPTER 48

PIPING

48.1 Safety precautions when working on piping.

a. Safety precautions listed in BUSHIPS Manual, Article 48-291, are applicable and shall be observed.

b. Serious casualties have been suffered by personnel while removing blank flanges from undrained pipes. Cognizant ship officers shall assure that pipes are properly drained, relieved of all pressure, and vented before allowing personnel to work on a pressure or vacuum system. Blank flanges used for temporary isolation measures will be fitted with drain valves to facilitate equalizing pressure and draining wherever practicable.

48.2 High pressure flange gaskets.

a. Spiral wound gaskets for all butt type flange steam joints shall be installed with a reinforcing compression ring. The approved gaskets are FSN G5330-239-2862 through G5330-239-3758. The proper installation method is described in BUSHIPS Manual, Article 48-48.

b. Spiral wound gaskets shall be installed dry. Spiral wound gasket failures have been traced to badly corroded stainless steel winding. Since it is customary to use anti-seize compounds and joint materials containing graphite in other repair work, engine department personnel shall ensure that shipyard workers do not install gaskets with a graphite coating. Under high temperatures, graphite attacks stainless steel causing rapid deterioration.

CHAPTER 49

COMPRESSED AIR PLANTS

49.1 Applicability of BUSHIPS Manual.

a. BUSHIPS Manual, Chapter 49, is applicable to USNS civil service manned ships with the exception of Articles 49-131 thru 49-137.

b. All references to the Bureau shall be changed to read; "The Administrative Commander."

49.2 Cleaning, inspection and testing.

Air receivers shall be cleaned, inspected and tested as required by U. S. Coast Guard regulations for testing unfired pressure ships (Article 54.01-35 of USCG 115).

49.3 Draining off air tanks.

Ship engineers shall establish daily routine to drain off water accumulations in all compressed air tanks and receivers.

CHAPTER 51

BOILERS

51.1 Applicability of BUSHIPS Manual.

a. All sections of the BUSHIPS Manual, Chapter 51, that refer to boiler inspections required by the Bureau of Ships or that require its approval prior to accomplishment of work or that concern reports to the Bureau upon completion of the work do not apply to civil service-manned (USNS) ships. Current U. S. Coast Guard regulations govern all boiler tests, repairs and safety-valve setting and sealing.

b. The following articles are not applicable:

51-62 51-107 51-201 51-203 51-236
51-67 51-172 51-202 51-204

51.2 Cleaning of boilers.

In lieu of Article 51-42, 51-82, the following procedures shall be established:

1. Cleaning of firesides. Firesides shall be hand cleaned when inspection indicates that the mechanical (steam or air) soot blowing equipment is not maintaining the boilers in a satisfactory condition * of cleanliness for continued operation. Hand cleaning will consist of water washing. When washing with water, provisions shall be made to prevent water from saturating brick work and insulation. Whenever operating conditions permit, this cleaning will be accomplished by the ship's crew. In addition to this cleaning, firesides will be cleaned by hand completely prior to the annual inspection by the U. S. Coast Guard Inspector.

2. Cleaning of watersides. The mechanical cleaning of watersides will be resorted to only when conditions indicate that mechanical cleaning is necessary for continued operation. Proper control of boiler water and correct operating procedures as listed in Article 56.2 thru 56.5 of this manual will minimize waterside deposits.

51.3 Refractory expansion joints.

Rigid expanded polystyrene (styrofoam or polyfoam) for expansion joints shall be used in setting up brickwork. Reports from the Bureau * of Ships indicate that the use of wooden batten strips in making boiler expansion joints is unsatisfactory. Frequently the wooden strips do not burn out in sufficient time to accommodate refractory expansion causing the refractory to buckle.

CHAPTER 53

FORCED DRAFT BLOWERS

53.1 Victory ship forced draft blowers.

a. Experience with Westinghouse Vertical Forced Draft Blowers in victory ships has revealed that the oil reservoirs must be checked daily for water. Failure to follow this simple precaution can result in the loss of the thrust bearing. The design of this blower is such that the thrust bearing takes more load and gets less oil at slow speeds. It is, therefore, necessary to take special precautions when operating in port under light loads.

b. The thrust float clearance shall be watched closely for change and checked at least monthly. After the original setting of the float and nozzle clearance, the float clearance can be checked by lifting the rotor assembly gently with a 24-inch screw driver placed under the condensate slinger ring attached to the shaft below the carbon packing assembly. Exact measurement of the rotor movement can be obtained with a telescope gage or inside calipers.

CHAPTER 55

FUEL OIL STOWAGE AND EQUIPMENT

55.1 Applicability of BUSHIPS Manual.

All articles of the BUSHIPS Manual, Chapter 55, are applicable to the operation of civil service-manned (USNS) ships, except Article 55-23 (2). The subject of Bunker Six oil for USNS ships is covered in Article 55.4 of this manual.

55.2 Oil spills.

a. The Oil Pollution Act of 1924 was enacted to "protect navigation from obstruction and injury by preventing the discharge of oil into the coastal navigable waters of the United States." Applicable portions of the act have been reprinted in poster form and are furnished for posting in all MSTS ships.

b. An oil spill is defined as any contamination of water surrounding a ship from the accidental or intentional release of petroleum liquids from cargo or ship's bunkers. Discharge of oily bilge or ballast water is considered as coming within the scope of an oil spill. Contaminating substances may be oily rags, containers, sludge or cargo tank mucking which may pollute waters.

c. Any MSTSPACAREA ship violating the Oil Pollution Act of 1924; or responsible for an oil spill in a harbor, channel, bay, restricted waters; or in waters less than 100 miles offshore of any foreign country shall submit a Report of Oil Spill (MSTSPAC Report 3100-1). This letter report shall be submitted to COMSTSPACAREA (or to COMSTSPACAREA via the local administrative commander, when appropriate) within 48 hours after occurrence and will include the following:

1. Description of the incident.
2. Estimate of the amount of material lost overboard.
3. Action taken to remove spillage.
4. Corrective procedure effected to prevent recurrence.
5. Disciplinary action taken.

d. If the oil spill occurs in the Twelfth Naval District, MSTSPACAREA shall be notified immediately by telephone. Outside normal working hours, the Staff Duty Officer shall be contacted by telephone (PR6-2200, Ext. 4205, 4206). Arrangements to contain and/or remove the oil spill will be made by cognizant district personnel.

The following information shall be included in the telephone report:

1. Name of ship.
2. Location where oil spill occurred.
3. Identity of the person making the report.
4. Extent of spill or field of influence.
5. Coverage of surface.
6. Character of pollution.
7. Has sample been obtained.
8. What is being done about the condition.
9. Is assistance required in containing and/or removing spill.

c. If while in port in the San Francisco Bay area, it becomes necessary to discharge oil-contaminated ballast, arrangements shall be made with the Harbor Services Section of the Naval Base, San Francisco (EXbrook 2-3931, ext. 2842 or 2843). Oil rings will be provided to receive the ballast and arrangements will be initiated to remove oil from spills.

55.3 Instructions for handling and burning fuels.

a. Normally USNS ships are furnished Bunker Six oil, occasionally lighter fuel may be furnished at outports or when the ship is on a special mission.

b. Segregate, insofar as possible, any new lot of boiler fuel from any lot already on board. When necessary to mix fuels, such tanks shall be free of all water.

c. The mixed fuel shall be consumed first to keep the sludge formation to a minimum. When a tank is nearly empty and before it is refilled with other fuel or ballast, strip the bottom material into a tank set aside for sludge accumulations. The sludge tank shall be one equipped with heating coils. The accumulated sludge can then be processed for partial recovery of fuel oil by application of heat and/or by extended periods of settling.

d. The fuel oil strainer shall be cleaned at least once during each watch while under way.

e. The fuel oil shall not be preheated to a temperature higher than that necessary to reduce the viscosity of 135 second Saybolt Universal. In no case shall the temperature of Navy Special be raised above 145°F. This is the temperature at which the heaviest Navy Special procurable has a viscosity of 135 second Saybolt Universal.

f. Fuel oil in the tanks and other parts of the system shall

not be heated to a temperature higher than that necessary to insure that the oil will flow freely to the suction of the pumps and, in no case, shall the oil be heated to a temperature higher than 120° F.

g. Care shall be taken when heaters are being operated at low fuel output to insure that excessive fuel oil temperatures are not reached.

h. Idle burners shall be removed or withdrawn.

i. Burner tips SHALL NOT BE MIXED. All burners in use at any one time shall have similar tips installed.

j. Burner tips are a precision part. Close attention shall * be given to obtaining and using the correct tips. Tips shall be cleaned carefully using a solvent, never a hammer, chisel, file or any other harsh tool or abrasive.

55.4 Burning of Bunker Six fuel

a. Article 55-23(2) of BUSHIPS Manual does not apply to * Bunker Six fuel presently in use in MSTS ships. The optimum burning viscosity for Bunker Six fuel is 150° second Saybolt Universal.

b. Two charts for determining the proper burner temperature * will be provided for each ship. One chart shall be placed in the Fire Room under glass and the second copy shall be retained in the Chief Engineer's office.

c. The greatest single cause of trouble in the use of Bunker Six fuel is burning it at improper temperatures. In addition to creating operational difficulties, incorrect burning is responsible for poor boiler efficiency. Below are listed some of the common troubles encountered, their causes and recommended remedies:

TROUBLE	CAUSE	REMEDY
Soot accumulation in boiler and economizers	Incomplete combustion due to:	
	1. Poor atomization	1. Check all mechanical burner and register parts for proper operation. Minor adjustments or faults with equipment are often the cause of trouble. One important adjustment often overlooked is the positioning of the atomizer barrel in the distance piece (jacket tube). This position must be set accurately

TROUBLE:	CAUSE:	REMEDY:
		according to dimension given in the manufacturer's instruction book. The adjustment is accomplished by screwing the distance piece in or out until the relationship between the face of the atomizer tip nut and the diffuser is as recommended. It is suggested the ship make a simple template to readily check this dimension periodically. Check all other adjustments against manufacturer's instruction books and BUSHIPS Manual, Chapter 51.
	2. Flame too long or too short.	2. Check angle of burner arch throat with sweep provided by manufacturer. Adjust the position of the diffuser with respect to register. This distance is maintained with wing nuts in the jacket tube carrier.
	3. Burning at improper temperatures.	3. Check viscosity vs. temperature. Proper burning temperature is of vital importance and may vary from 163°F to 222°F depending on oil viscosity at 122°F. The viscosity of Bunker Six fuel is established by Navy specification and may vary from 45 to 300 Saybolt Furol Seconds (SFS) at a temperature of 122°F. Chart, Figure 55-1, Chapter 55, BUSHIPS Manual, may be used to determine the correct burning temperature in the following manner: EXAMPLE I: Given fuel of 45 SFS at 122°F enter Figure 55-1 at the left side of scale 45SFS and locate intersection of the horizontal line with the vertical temperature line of 122°F, then proceed parallel to line marked "Bunker C" until intersection of horizontal line marked "Optimum Burning Viscosity". Read 163°F at bottom scale. EXAMPLE II: Given a fuel of viscosity 300 SFS at 122°F, follow the same procedure and read 222°F as the temperature to obtain Optimum Bruning Viscosity.

TROUBLE:	CAUSE:	REMEDY:
		The above suggested temperature calculation is offered as a guide only. It will be noted that the temperatures referred to are "Burning Temperatures". The actual temperature at the burner tip will be somewhat higher than the temperature of the oil leaving the heater due to heating of the atomizer and barrel from furnace radiation. This difference is considerably greater when steam atomization is employed. Consequently the oil temperature must be gradually reduced until an efficient combustion is reached. This point can be determined by observation of the flame, condition of the smoke and CO_2 tests.
Sludge	Water in oil due to ballasting or other causes.	Prior to ballasting, as much of the oil as possible shall be removed from the tank, lines manifold and pump. The lines and tank shall be flushed several times with sea water prior to filling. The application of heat while flushing increases the effectiveness of removing all oil and sludge-forming residue. Proper flushing of tanks to be ballasted is most important to prevent sludge. If oil is allowed to remain in the tank with ballast water for several days, there will be a heavy sludge of asphalt-like consistency. Flushing removes this oil before it starts to solidify. If sludge is allowed to form, solvents and, in severe cases, shovels will be required to break it up.

d. The heating of fuel in tanks adjacent to troop compartments shall be minimized in tropical climates when discomfort to troops would result.

55.5 Instructions for sludge removal from bunker tanks where salt water ballast is used

a. Salt water ballast may be used in bunker tanks in order to maintain the stability of the ship within desired limits, but use of salt water when it may contaminate a bunker tank requires intelligent handling and procedures. Salt water and fuel oil, regardless of

whether the fuel is Navy Special or Grade 6, when mixed, will produce sludge which will be a detriment to combustion. After a number of successive ballastings, it will be necessary to take additional steps over and above the normal settling out of the fuel in the settling tanks in order to keep the tanks relatively sludge-free and not jeopardize combustion.

b. MSTS ships have now, for some years, been using sludge dispersal compounds to keep sludge to a minimum in ballasted tanks. Currently there are three approved manufacturers of these compounds, all of which are producing substantially the same kind of product. These three are the Gamlen Chemical Company, New Process Chemical Company and Wyandotte Chemical Company. Use of the compounds is as prescribed by the manufacturer thereof, and when such chemicals are requisitioned, the barrel capacity of the individual tanks to be desludged is the key to the amount of compound which the manufacturer will prescribe.

* c. Fuel oil treatment compounds can be added either to the ballasted tank or the tank which contains oil. During the rolling of the sea and with the application of heat, the salt water will precipitate out of the oil and leave the oil in a combustible condition and the salt water ready to pump overboard. During the separation process, all sludge in the tank, will, if time and treatment are sufficient, dissolve and the tank will be rendered clean once again. Repetition of the process will be accomplished as need therefor is required, however, it is recommended that each bunker tank which is ballasted at one time or another be desludged a minimum of twice a year. The primary purpose of fuel oil treatment compounds is to assure a uniform fuel and better atomization. These compounds should be added to the fuel oil tanks prior to bunkering. During the bunkering process, the compound is satisfactorily intermixed with the fuel oil. If a light sludge exists in the tanks it will be dissolved and intermixed with the incoming fuel oil. With the application of heat, any water present will be separated and may be discharged overboard leaving the fuel oil in good combustible condition.

* The proper use of these compounds will minimize the formation of sludge in fuel oil tanks that are to be ballasted and will assist in maintaining fuel oil lines and fuel oil heaters in a clean condition. The amount of compound required varies with the manufacturer's product and capacity of the tank or tanks to be treated. However 1/2 gallon to one gallon per 100 barrels is the usual dosage. Manufacturer's Instructions in the use of these compounds should be strictly adhered to. The use of these compounds is highly recommended.

* Fuel oil treatment compounds should not be confused with desludging and gas freeing compounds.

d. In addition to fuel oil treatment compounds, desludging and gas-freeing compounds are available from the same manufacturers. These compounds serve a dual purpose of (1) Emulsifying residual oils and sludge so they can be pumped overboard, and (2) Gas-freeing the tank. When properly used the tank will be rendered clean and gas-free to accomplish anticipated internal survey or hot work, safe for men and flame. *

The intelligent and systematic use of these compounds is encouraged. *

55.6 Ordering fuel oil.

a. Efficient management of fuel oil purchases requires that, dead- * weight and other considerations permitting, ships take the maximum quantity of bunkers at the port of the voyage with lowest priees. In the Pacific this means bunkering to capacity at California ports and limiting overseas replenishment to minimum requirements with a prudent safety margin. A ship's rated bunker capacity is 98% of absolute tank capacities. Maximum utilization of tank capacities requires that any residue of NSFO be consolidated prior to bunkering in California ports in a manner to minimize ullage which is unusable due to incompatability of the two grades of fuel oil.

b. Fuel oil tanks shall be sounded immediately after arrival at a * bunkering port and the quantity of bunkers requested in LOGREQ corrected as necessary by telephone. Orders for fuel oil shall be expressed in gross barrels, which are reduced to net barrels, 60 degrees fahrenheit, for accounting purposes. Accuracy in ordering fuel is of utmost importance when bunkering to capacity by barge. Over-ordering will result in the barge being on hire until the retain is disposed of and the barge returned to the home pier. Under-ordering results in a hidden expense when replenishment is required at an overseas port due to the higher cost per barrel overseas.

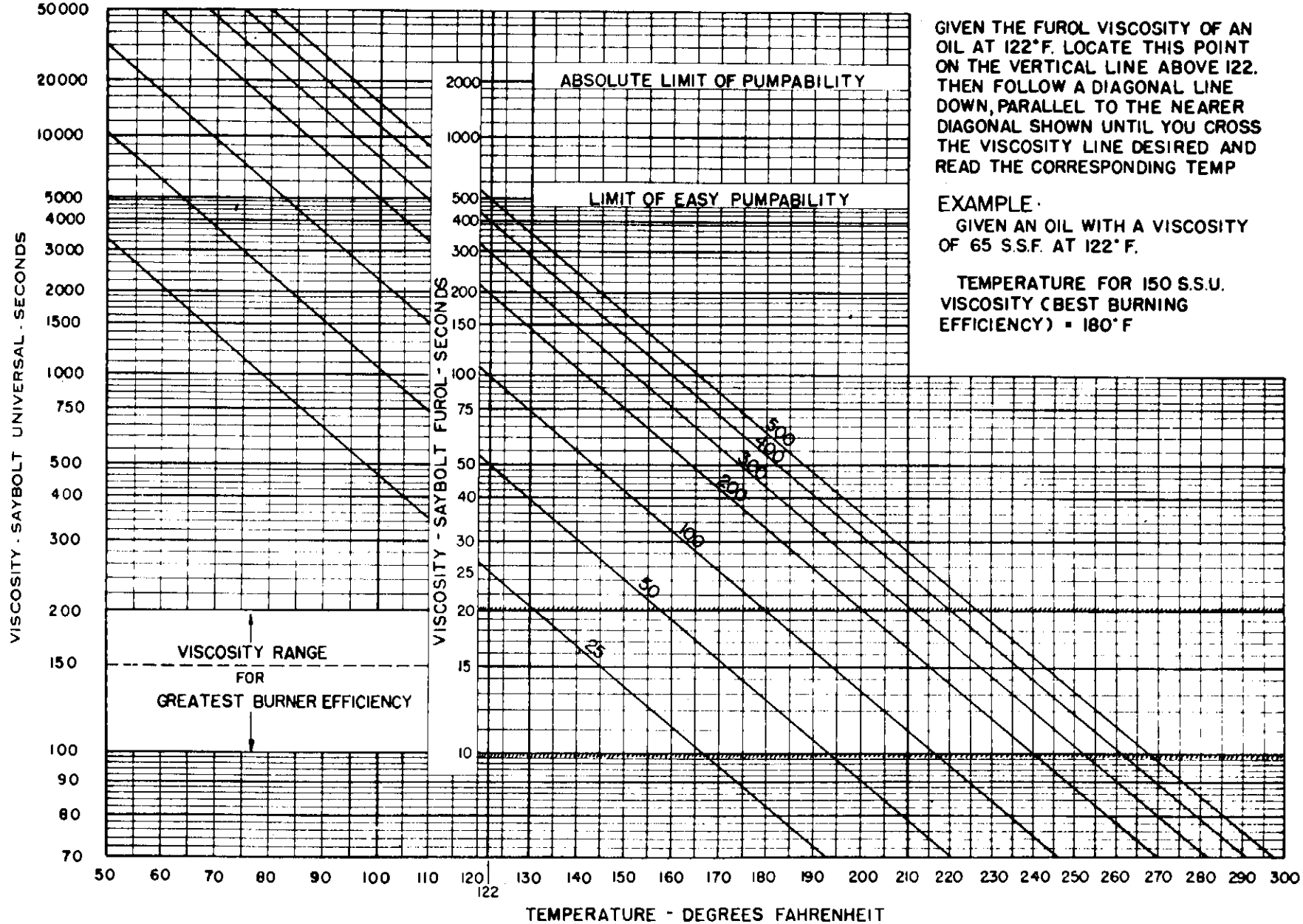
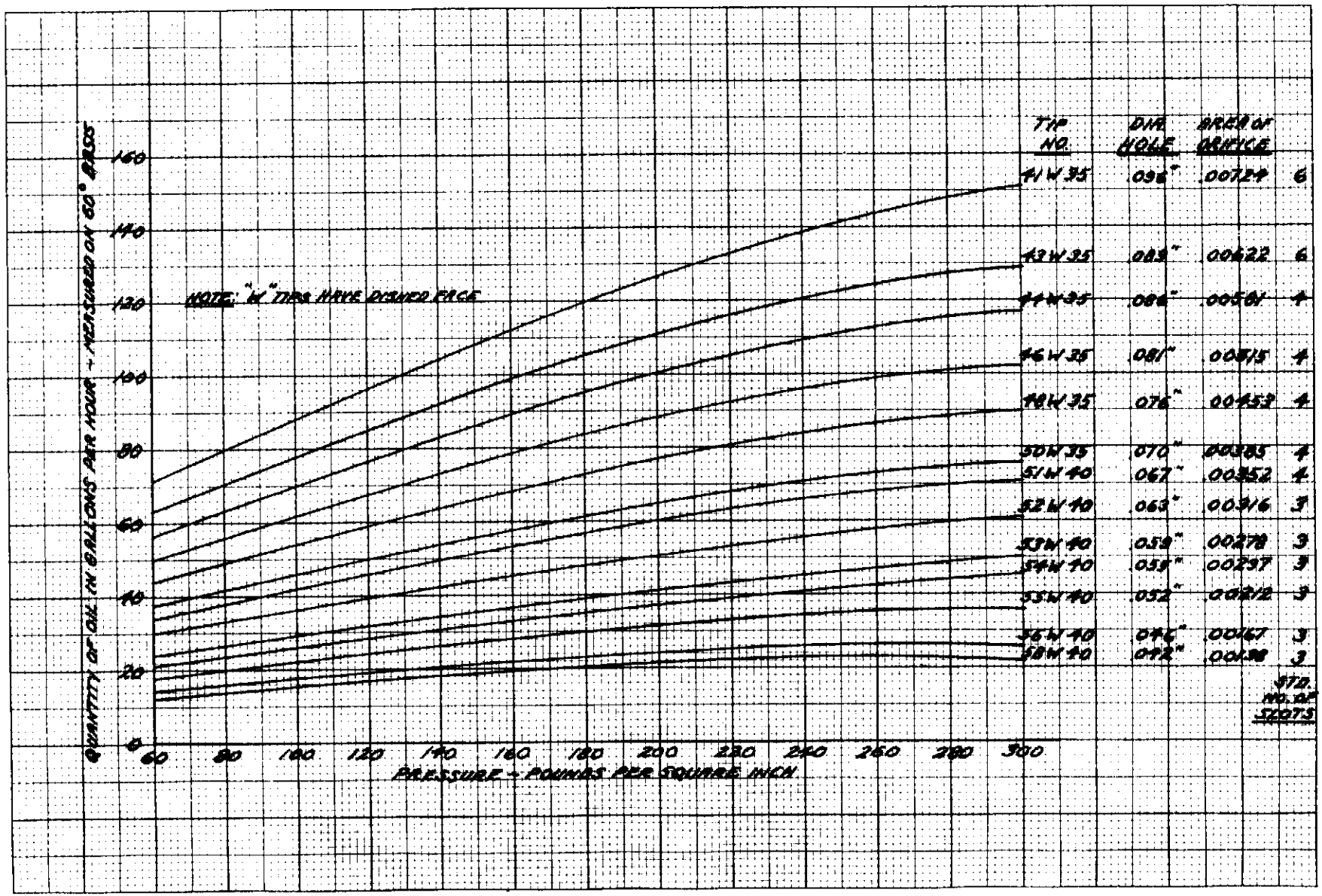


CHART FOR DETERMINING PROPER BURNER TEMPERATURE TO GIVE MOST EFFICIENT COMBUSTION.

HOURLY QUANTITIES THROUGH MECHANICAL BURNER TIP AND ATOMIZER AT 150 S.S.U.



TIP NO.	DIA. HOLE	AREA OF ORIFICE	
41W35	.096"	.00724	6
42W35	.083"	.00622	6
44W35	.086"	.00581	4
46W35	.081"	.00515	4
48W35	.076"	.00453	4
50W35	.070"	.00385	4
51W40	.067"	.00352	4
52W40	.063"	.00316	3
53W40	.059"	.00278	3
54W40	.055"	.00237	3
55W40	.052"	.00212	3
56W40	.046"	.00167	3
58W40	.042"	.00138	3

STD. NO. OF SIZE 75

CHAPTER 56

BOILER FEED WATER AND FEED WATER APPARATUS

56.1 Applicability of BUSHIPS Manual.

Parts 1,2 and 3 of Section I and all of Section II, Chapter 56, BUSHIPS Manual, are applicable to civil service-manned (USNS) ships.

56.2 Contract boiler water services.

a. The services of qualified water treatment engineers are provided under annual contract to furnish technical advice, special apparatus, printed instructions and the necessary testing and treatment chemicals for the diagnosis and control of boiler feed water.

b. The testing, treatment and control of boiler water will be conducted in accordance with the charts and instructions provided. Unsatisfactory results or services will be reported to the administrative commander.

56.3 Boiler water test frequency.

Boiler water testing for chlorides, alkalinity, oxygen and hardness shall be scheduled as follows:

1. Daily, on each steaming boiler.
2. Weekly, on each idle boiler.
3. When boiler is filled with fresh water.

56.4 Condensate test frequency.

Electrical salinity indicators, when installed, will be maintained in operating condition. To provide a check on salinity indicators, chemical tests for salinity will be taken hourly on main and auxiliary condensate systems.

56.5 Boiler water control.

a. Proper limits and control of boiler water shall be maintained as shown below:

		RANGE		
		200 to 450 PSI	600 PSI	850 PSI
1.	Excess phosphate PPM	40 - 80	30 - 50	20 - 30
2.	Hardness GPG	00	00	00
3.	Phenolphthalein alkalinity GPG	15 - 25	15 - 20	10 - 15
4.	Total alkalinity GPG	25 - 35	20 - 25	15 - 20
5.	Chlorides GPG	under 5	under 3	under 3
6.	pH (condensate)	7.6 - 8	7.6 - 8	7.6 - 8

b. Samples from each boiler shall be taken prior to arrival at the home port at the end of each voyage for tests by the boiler water contractor. A record of blow down will be kept on the daily work sheet.

56.6 Boiler waterside scale control.

a. With proper supervision, water treatment and elimination of salt water entry into the feed system, hard scale formation on watersides will be eliminated.

b. Soft scale is usually caused by sludge resulting from an excess of phosphates and a high concentration of solids deposited on hot boiler surfaces after water circulation has ceased.

c. The purpose of water treatments is to keep the boiler water alkaline, oxygen free and to keep scale forming matter in a state of suspension.

d. As ship operating schedules permit, boilers shall be given a series of bottom blows with all burners secured once each week to reduce the total solids in suspension. THIS IS IMPORTANT.

e. Once each quarter, boilers shall be completely emptied and washed out. The excessive use of treatment chemicals to maintain boiler water analysis within recommended limits is indicative of an abnormal condition, which requires prompt investigation and corrective action. Such conditions will be caused by the excessive use of feed, contamination of condensate returns or boiler tube leakage.

CHAPTER 58

DISTILLING PLANTS

58.1 Applicability of BUSHIPS Manual.

All articles of Chapter 58, BUSHIPS Manual, are applicable to civil service-manned (USNS) ships with the except of Articles 58-67 and 58-68 (3) and (4).

58.2 Hydrostatic tests.

If the distilling plant is dismantled for cleaning or repairs or for the purpose of searching out air leaks which cause a reduction in plant capacity, a hydrostatic test shall be applied after its reassembly.

58.3 Pumps and pump piping.

In lieu of Articles 58-68 (3) and (4), the following paragraphs shall apply:

1. All pump piping shall be air tight. Even the slightest leakage, particularly, on the suction side, at the tube next drain, condensate and/or brine pumps will result in improper operation. In searching for air leaks, the gage and vent lines shall be investigated.

2. The hyrostatic test of the distilling plant shall include the pump piping. At least annually, the pumps shall be completely dismantled. Wearing ring clearance and shaft packing sleeves shall be checked and the pumps repacked. The adding of packing rings indefinitely is prohibited as this will cause gradual displacement of the lantern ring in relation to the external water sealing line connection.

58.4 Operational test.

a. A 24-hour operational test shall be conducted quarterly to determine maximum capacities with the objective of establishing in all ships the ability to be self-sufficient in times of emergencies. Results shall be recorded in the Engineering Log.

b. In the event that the evaporators do not operate at maximum capacity during the above test the master shall take necessary steps to correct deficiencies contributing to poor operation. If the required work or repair is beyond the capacity of the ship's

force, it will be made the subject of an item on the next repair list.

58.5 Use of corn starch and boiler compound.

a. Article 58-37 of the BUSHIPS Manual outlines the usage of corn starch and boiler compound. The effectiveness is largely dependent upon constant feed. The use of a sight glass feed to the first effect located in full view of operating personnel has proved very effective and is recommended.

b. In addition to corn starch and boiler compound, "HAGEVAP" * stock No. 6810-682-6435 has been approved for use as a scale retardant compound on distiller tubes. The compound should be mixed in accordance with manufacturer's recommendations. Normally the existing equipment used for injecting corn starch and boiler compound maybe used for "HAGEVAP".

c. Acid cleaning of distilling plants may be accomplished by ship's force when using sulfamic acid which has been approved for this purpose stock No. 6850-637-6142, supplied in 100 lbs drums. The existing equipment on board may be used to circulate the chemical and should be mixed in accordance with the manufacturer's instructions. Article 58-75 of BUSHIPS Manual outlines cleaning instructions and safety precautions that are to be observed when using these chemicals.

CHAPTER 60

ELECTRIC PLANT, GENERAL

60.1 Applicability of BUSHIPS Manual.

BUSHIPS Manual, Chapter 60, is applicable to civil-service-manned (USNS) ships, with the exception of the following articles:

60-184 (3)	Records and reports
60-240 (2)	Insulating varnish
60-300	Hand stoning (commutators)
60-353 (2) (B)	Circuit breakers, contractors and plated contacts

60.2 Insulating Varnish.

All insulating varnish of the air-drying and baking types used in insulation repairs shall be compatible with existing insulating varnish. When required to comply with the foregoing, the use of commercial types of insulating varnish is authorized.

60.3 Hand Stoning.

The use of non-ridged mounted commutator stones is prohibited.

60.4 Plated Contacts.

Contacts of the silver plated types shall be burnished when necessary. Only crocus cloth shall be used for this purpose.

60.5 Cleaning of Electrical Equipment.

Procedures outlined in Section IV, Part 4, Chapter 60, BUSHIPS Manual, shall be followed in the cleaning of electrical equipment. The use of carbon tetrachloride is prohibited aboard ship because of the injurious effects of its vapors on personnel.