

DDS 531-1

SURFACE SHIP DISTILLING PLANT SIZING DETAILS



**DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, DC 20362-5101**

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DESIGN DATA SHEET
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

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Supersedes DDS 531-1, dated 15 May 1984

531-1-a Reference

(a) OPNAVINST 9640-1 of 13 Nov 1979 Shipboard Habitability Program

531-1-b General

Reference (a) outlines the minimum daily requirements for personnel use on board ship.

531-1-c Criteria for plant capacity

Minimum distilling plant capacity is based on the summation of the usages indicated below as applicable for the ship type with consideration made for special services required by the ships characteristics or top level requirements plus a 10 percent growth factor.

For single or two shaft ships two distilling plants are to be provided, one shall be equal to required design capacity and the second being a full redundant plant. As an alternative three plants may be provided, two of which shall equal required design capacity and the third being a redundant plant with the same capacity as one of the two plants.

For a four shaft ship, at least four plants shall be installed which includes three plants equal to required design capacity and one redundant plant with the same capacity as one of the three plants.

For amphibious ships, the required design capacity is to include total troop and crew accommodations.

Distilling plant sizes as required shall be provided by NAVSEA Heat Exchanger Branch.

Based on reference (a) and service experience, the following usages are presently considered appropriate:

(1) Potable water. - Allowance is 30 gallons per crew accommodation per day. For ships which carry troops such as LPH, LST and LHA, etc., an additional allowance of 25 gallons per troop accommodation per day is provided. Allowance is 60 gallons per accommodation per day for civilian manned ships.

(2) Photo-laboratory. - Only aircraft carriers have extensive installations; some other large ships have smaller installations. Water rates for different model sinks, washers, and processors are as follows:

Sinks-

California Stainless Model 8-14 (2 ft x 4 ft)	2 gal/min, operated at 6 hr/day = 720 gal/day
California Stainless Model 808 (2 ft x 6 ft)	0.5 gal/min, operated at 6 hr/day = 180 gal/day

Processors-

2W-6740-00-766-5280 (with water saver kit)	30 gal/hr, operating 12 hr/day = 360 gal/day
2W-6740-00-766-5280; EH-38C (with water saver kit)	240 ga/hr, operating 12 hr/day = 2880 gal/day
2W-6740-00-766-5280 (with speed up kit)	75 gal/hr, operating 12 hr/day = 900 gal/day
2W-6740-01-010-2730; EH-38D (Kodak Versamat 11-40)	75 gal/hr, operating 12 hr/day = 900 gal/day
2W-6740-01-133-0055 (Image Maker)	5 gal/cycle @ 10 cycles/day = 50 gal/day
2W 6740-01-042-0871 (Royal Print)	30 gal/hr, operating 10 hr/day = 300 gal/day
2W-6740-01-042-0875 (Kreonite CPT-16)	60 gal/hr, operating 10 hr/day = 600 gal/day

(3) Miscellaneous - The following additional requirements are applicable:

Tender Service	3600 gal/day per submarine for 6 submarines 6000 gal/day per destroyer for 4 destroyers (or tended surface ships) 12,000 gal/day for "flush, dump and fill" of boiler tubes and/or hydroblast of CHT system
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Helicopters and Aircraft Washdown	Large Deck Ships (CVs, CVNs, LHA and LHD, etc.): 150 gal/day per aircraft (assume 55 aircraft helicopters washdown per day)
	Small Deck Ships (Battleship, Frigate, Destroyer or Auxiliary) 100 gal/day per helicopter with hangar 200 gal/day per helicopter without hangar
Vehicle Washdown	LCAC: 37 gal/day per craft (based on 1100 gallons per craft and 30 day washdown cycle)
	LVT: 40 gal/day per vehicle (based on 200 gallons per vehicle and 5 day washdown cycle)
Gas Turbine Water Wash	4 gal/day per GT (based on one wash of 120 gal/30 days)
Cooling System Makeup	50 gal/day
Freshwater Flushing (Vacuum Collection System)	2 gal/day per man
Medical Facility Water Requirements (For ships which have extensive medical facilities)	30 gal/day per hospital bed (combatant ships) 60 gal/day per hospital bed (hospital and amphibious ships)

(4) Make-up feed

(a) Auxiliary boilers. - Use two percent of full power steam rate.

(b) Diesel engine make-up. - Negligible.

(c) When reverse osmosis plants are selected, the quantities of potable and higher grade water shall be defined.

(d) Nuclear powered ships - Make-up feed for the reactor and steam plants is dependent on design, operating chemistry and other factors. Make-up feed rates for nuclear powered ships will be provided by NAVSEA 08.

(e) Propulsion boilers. - Make-up feed is defined as the amount of water which is introduced into the feed system to balance the amount of water lost through boiler blowdowns, soot blowers, vents, leakage and, in the case of aircraft carriers, catapult steam requirements.

Distilling capacity to be provided in the design of oil-fired ships to meet make-up feed requirements is determined by multiplying the total (per ship) full power steam flow by the percentages listed below:

<u>Ship Type</u>	<u>Make-up Feed in percent of total F.P. steam flow from boilers</u>
Destroyer frigate and cruiser types	0.75
Aircraft carriers (See Note)	1.50
Auxiliary types	1.75

For oil-fired surface ships utilizing steam atomizing burners, the make-up shall be increased by 0.75 percent of total full power (F.P.) steam flow from the boilers.

For aircraft carriers the distilling plant sizing shall be augmented to include 10,000 gal/day/catapult for steam catapults.

EXAMPLE: Assume an aircraft carrier, fitted with four catapults, has a full power steam flow, as determined by a heat balance of 1,500,000 lb/hr and utilizes steam atomizing burners. Applying the percentage noted above, the make-up feed requirement would be 0.015 plus 0.0075 times 1,500,000 or 33,750 lb/hr. Converting to gallons per day, 33,750 times 24 divided by 8.33 equals 97,200 gal/day. Adding the allowance of 10,000 gallons per catapult, or 40,000 gallons, the distilling capacity to be provided for make-up feed would be 137,200 gal/day.

EXAMPLE

SHIP:	CV	TYPICAL DISTILLING PLANT CALCULATION	DATE: 1 JAN 86
1.	No. of shafts = 4		
2.	Potable Water: Complement X Gal/Man/Day 4,000 X 30		120,000 Gal/Day
3.	Make-up Feed *MUF Factor x F.P. Steam Flow #/HR X 24 HR/DAY (MUF): 8.33#/Gal.		97,200 Gal/Day
	*MUF Factor includes steam atomization	.0225 X 1,500,000 X 24 8.33	
4.	Miscellaneous: (a) Catapults 4 X 10,000 (b) Photo Lab. (c) Washdown Service 150 Gal/Day x 55 aircraft (d) Medical Facility 30 Gal/Day x 70 beds		40,000 Gal/Day 8,150 Gal/Day 8,250 Gal/Day 2,100 Gal/Day
5.	Minimum Total Required: 120,000 + 97,200 + 40,000 + 8,150 + 8,250 + 2,100		275,700 Gal/Day
6.	Total Required X Growth Factor (10%) X 1.10		303,270 Gal/Day
7.	A = Required Capacity + Growth Factor (Gal/Day) B = Redundant Plant Capacity (Gal/Day) C = Total Distilling Plant Capacity (Gal/Day)		

For Multiple Shaft Ships

$$A / (\text{No. Shafts} - 1) = B \quad B \times \text{No. Shafts} = C$$

For Single Shaft Ships

$$A = B \quad A + B = C$$

Example:

$$303,270 / (4 - 1) = 303,270 / 3 = 101,090; \text{ say } 100,000 \text{ Gal/Day-Redundant Plant Cap.}$$

$$100,000 \times 4 = 400,000 \text{ Gal/Day-Total Plant Capacity}$$

8.	TOTAL NO. UNITS	CAPACITY/UNIT	TOTAL DISTILLING CAPACITY
	4	100,000 Gal/Day	400,000 Gal/Day
TOTAL PHOTO LAB REQUIREMENTS			

SPACE LOCATION	QTY & ITEM	MODEL NO.	UNIT Gal/Day	TOTAL Gal/Day
<u>Ships Photo Lab</u>				
Chem. Mix Rm	1 sink	California Stainless Model 8-14	720	720
Color Print Room	1 Print Processor	2W-6740-01-042-0875	600	600
	1 sink	California Stainless Model 808	180	180
B&W Print Room	1 B&W Processor	2W-6740-01-042-0871	300	300
	1 sink	California Stainless Model 808	180	180
Film Developing Rm. 1	1 Film Processor	2W-6740-01-133-0055	50	50
	1 sink	California Stainless Model 808	180	180
Film Developing Rm. 2	1 Film Processor	2W-6740-01-010-2730	900	900
		EH-38D	900	900
<u>Air Intelligence Lab</u>	4 Film Processors	2W-6740-01-010-2730	900	3600
Chem Mix Room	1 sink	California Stainless Model 8-14	720	720
	1 sink	California Stainless Model 8-14	720	720
			Total Water Usage	8150 Gal/Day

Calculated by: MHB
Date: 1/1/86

Checked by: MHB
Date: 4/1/86

REFERENCE: DDS 531-1