

MIL-STD-2189(SH)
SECTION 310-1
11 January 1988

MILITARY STANDARD
DESIGN METHODS FOR NAVAL SHIPBOARD SYSTEMS
SECTION 310-1
ELECTRIC SYSTEM LOAD AND POWER
ANALYSIS FOR SURFACE SHIPS



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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

Washington, DC 20362-5101

Design Methods for Naval Shipboard Systems Electric System Load and Power
Analysis for Surface Ships

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1. GENERAL AND SCOPE

1.1 General. The procedures established by MIL-STD-2189 are applicable. This section and the basic standard (MIL-STD-2189) are to be considered as an integral single document.

1.2 Scope. This standard provides procedures for preparing an electrical system load and power analysis for conventional-powered surface ships. However, this standard may be used as a basis for preparing a load and power analysis for a ship powered by other means.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Standard. Unless otherwise specified, the following standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

STANDARD

MILITARY

MIL-STD-2189 - Design Methods for Naval Shipboard Systems.

2.1.2 Government publication. The following Government publication forms a part of this standard to the extent specified herein.

PUBLICATION

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

S9040-AA-IDX-010/SWBS 5D - Expanded Ship Work Breakdown Structure
for All Ships and Ship/Combat Systems
(ESWBS).

(Copies of standards and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Definitions of ship operating conditions.

3.1.1 Anchor. An anchor condition is a condition in which the ship supplies all electric power while the ship is at anchor.

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3.1.2 Shore. A shore condition is a condition in which the ship receives all electric power from a shore facility or a tender.

3.1.3 Cruising. A cruising condition is a condition in which the ship cruises at design cruising speed, without ship ordnance or at general quarters, but with power for test and checkout of combat systems.

3.1.4 Functional. A functional condition is a condition in which the ship is performing its designed function. The following are examples of a functional condition: battle for destroyers and frigates, air operations for aircraft carriers, debarking operations for cargo ships, replenishment-at-sea of ships for combat support or store ships, and tending operations for tenders and repair ships.

3.1.5 Emergency. An emergency condition is a condition in which the ship is on emergency generators with ship service generators down. The emergency generators, as a minimum, supply loads associated the following:

- (a) Surface combatant - Emergency ship control and selected weapons.
- (b) Aircraft carrier - Emergency ship control and either selected weapons (offensive) or limited air operations (recovery and strike down of aircraft).
- (c) Amphibious - Emergency ship control and limited unloading operations.
- (d) Auxiliary - Emergency ship control and selected weapons.
- (e) Mine warfare and patrol craft - Emergency ship control.
- (f) Service craft - These craft are only required to supply navigation lights and communication during emergency conditions.

4. GENERAL REQUIREMENTS

4.1 Emergency ship control. Emergency ship control shall include, as a minimum, the following electrical loads:

- (a) Steering gear auxiliaries
- (b) Vital propulsion auxiliaries. Vital propulsion auxiliaries are those required for cold starting the ship's plant and those which are necessary for machinery protection. They shall include, as a minimum, the following:
 - (1) Turbine generator pumps.
 - (2) Emergency or standby lubricating oil service pumps.
 - (3) Fuel service pumps.
 - (4) Forced draft blowers (low speed).
 - (5) Motor-operated boiler stop valves.
 - (6) Feed transfer pumps.
- (c) Machinery space circle W ventilation.

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- (d) Emergency lighting.
- (e) Emergency communications.
- (f) Surface search radar.
- (g) Fire pumps.
- (h) Interior communications.
- (i) Auxiliaries to support the emergency generator prime mover such as:
 - (1) Booster pumps.
 - (2) Starting air pumps.
 - (3) Compartment ventilation motors.
 - (4) Fuel transfer pumps.

4.2 System analysis. The system analysis is used to determine the aggregate power requirements of all the electric power consuming devices under the various operating conditions of the ship, such as anchor, shore, cruising, functional, and emergency, or other working load conditions, with particular emphasis being placed on the minimum and maximum power requirements. The minimum power requirement is of special importance when diesel engine prime movers are used in order to avoid excessive maintenance due to the operation of the engine at light loads for long periods of time. Various operating conditions are listed. However, variations of these conditions may exist. On ships with waste heat systems, a 10 degree Fahrenheit (°F) and a 90°F analysis shall be prepared for all conditions of operation. Loads are listed in accordance with NAVSEA S9040-AA-IDX-010/SWBS 5D. In preparing system load and power analyses, operating load factors are assigned for each individual item of equipment for each condition of operation. The multiplication of these factors by the connected load (rated kilowatt (kW) input) for each item of equipment gives the demand load of that item for each condition of operation.

4.2 Operating load factors. Consideration shall be given to the selection of load factors because of their influence on the proper selection of generator capacity. Each equipment application shall be considered from such standpoints as its service operation in the power system and its functional operation as determined by the type of ship involved and the type of service the ship performs. Such factors are determined as a result of experience and may vary to some extent with different conditions of service.

4.3.1 Typical operating load factors. Table I herein lists typical operating load factors. These load factors shall be used as a guide in selecting operating load factors and should be helpful in determining a relationship between total connected load and actual operating loads under the various conditions of ship operation. The compilation of the factors listed in table I is for guidance only and is not intended to preclude the exercise of good judgement when special circumstances modify these factors. The operating load factors listed in table I are used as follows:

- (a) The connected load (rated kW input) for each individual item of equipment is multiplied by each of the load factors (one load factor for each of the different operating conditions such as anchor, cruising, functional and emergency). The products resulting from the multiplications are the demand

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loads of that particular item of equipment for the various conditions of operation. For example, table I (ESWBS Group 5) shows that the load factors for a potable water pump are 0.3, 0.2, 0.3, 0.3, and 0 for the anchor, shore, cruising, functional, and emergency conditions, respectively. If the connected load for the pump is 19.1 kW, its demand load for each condition is 5.7 kW for anchor condition; 3.8 kW for shore condition; 5.7 kW for cruising condition; 5.7 kW for functional condition; and 0 kW for emergency condition.

- (b) The total demand load for each condition of operation is found by adding the individual demand loads for the condition.

TABLE I. Typical operating load factors for surface ships.^{1/}

<u>ESWBS Group 2 - Propulsion plant</u>	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
<u>General</u>					
Auxiliary seawater circulating pump	0.3	0.3	0.6	0.6	0
Blow in door heater, gas turbine	0	0	0.9	0.9	0
Cpch propulsion hydraulic oil heater	0.3	0.3	0.3	0.3	0
Cpch propulsion hydraulic oil pump	0	0	0.9	0.9	0
Cpch propulsion hydraulic oil purifier heater	0.1	0	0.1	0	0
Cpch propulsion hydraulic oil purifier	0.3	0	0.3	0.3	0
Electric propulsion equipment space heaters	0.9	0.9	0	0	0
Electric propulsion exciter	0	0	0.9	0.9	0
Emergency feed booster and transfer pump	0	0	0	0	0
Fuel service pump	0.4	0.1	0.9	0.9	0
Inlet louver heater, gas turbine	0	0	0.9	0.9	0
Lighting off forced draft blower	0.1	0	0	0	0
Lube oil purifier	0.3	0	0.3	0.3	0
Main circulating MO valve	0	0	0	0	0
Main circulating pump	0	0	0.9	0.9	0
Main condensate pump	0	0	0.9	0.9	0
Main engine cooling fan, gas turbine	0	0	0.9	0.9	0
Main engine prelube pump	0	0	0	0	0
Main feed booster pump	0.1	0	0.9	0.9	0.5
Main turbine gland exhaust	0	0	0.9	0.9	0
Main vacuum pump	0	0	0.9	0.9	0
Main feed lube pump	0.2	0	0.9	0.9	0
Module equipment, gas turbine	0.4	0.4	0.2	0.2	0
Port fuel oil service pump	0	0.1	0	0	0

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
ESWBS GROUP 2 - Propulsion Plant					
General					
Port use forced draft blower	0.2	0	0	0	0
Propulsion control console	0.5	0.2	0.6	0.8	0
Propulsion motor lubricating oil pump	0	0	0.9	0.9	0
Propulsion motor ventilation fan	0	0	0.9	0.9	0
Reserve feed transfer pump	0.2	0.2	0.2	0	0
Seawater booster pump	0	0	0.3	0.9	0
Shaft turning gear	0.1	0.1	0	0	0.1
Standby rden gear lubricating oil pump	0	0	0	0	0.2
Standby lubricating oil service pump	0	0	0	0	0.2
ESWBS Group 3 - Electric plant					
General					
Electrical plant control console	0.2	0.2	0.2	0.2	0.2
Emergency gen salt water booster pump	0	0	0	0	0.9
Forklift battery charger	0.2	0.2	0.3	0.3	0
Generator space heaters	0.9	0.9	0	0	0
Gas turbine gen enclosure cooling fan	0.9	0	0.9	0.9	0
Gas turbine salt water pump	0.9	0	0.9	0.9	0
Lighting machinery spaces	0.9	0.9	0.9	0.9	0.9
Lighting outside machinery spaces	0.6	0.4	0.6	0.6	0.4
Ship battery charger	0.2	0.2	0.2	0.2	0
STGEN circulating pump	0.5	0	0.5	0.9	0
STGEN condensate pump	0.5	0	0.5	0.9	0
STGEN start-up lubricating oil pump	0	0	0	0	0.9
STGEN vacuum pump	0.5	0	0.5	0.9	0
Uninterruptable power supply battery charger	0.2	0.2	0.2	0.3	0
Aircraft carriers					
Aircraft & helicopter start	0.1	0	0.1	0.5	0
101C M/G set	0.2	0.2	0.5	0.7	0.5
NTDS computer M/G	0.2	0.2	0.5	0.7	0.2
SS frequency changer	0.2	0.2	0.5	0.7	0.2

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
ESWBS Group 3 - Electric plant					
Aircraft carriers					
SS 400 Hz M/G set	0.2	0.2	0.5	0.7	0.2
Amphibious ships					
Helicopter starting rectifier	0	0	0.1	0.1	0.1
SS frequency changer	0.2	0.1	0.3	0.4	0.3
SS 400 Hz M/G set	0.2	0.1	0.3	0.4	0.3
Auxiliary ships					
Helicopter & elec M/G set	0.1	0.1	0.1	0.1	0.1
Helicopter starting rectifier	0	0	0	0	0
SS frequency changer	0.1	0.1	0.1	0.1	0.1
SS 400 Hz M/G set	0.1	0.1	0.1	0.1	0.1
Cruisers-destroyers-frigates					
Helicopter starting rectifier	0	0	0	0	0
SS frequency changer	0.2	0.2	0.5	0.7	0.4
SS 400 Hz M/G set	0.2	0.2	0.5	0.7	0.4
ESWBS Group 4 - Command and surveillance					
General					
Bathythermograph winch	0	0	0	0	0
Combat information center	0.2	0	0.4	0.7	0
Degaussing system	0.8	0	0.8	0.8	0
Electronic countermeasures	0	0	0.4	0.7	0.5
Electronic cooling system	0.4	0.2	0.7	0.7	0.5
Entertainment system	0.1	0.1	0.3	0	0
IC system	0.2	0.2	0.4	0.7	0.4
Lighting, navigation	0.6	0.4	0.6	0.4	0.2
Missile fire control	0.1	0	0.1	0.6	0
Movie projector	0	0	0	0	0
NTDS	0.2	0	0.4	0.7	0.4

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships. 1/ - Continued

	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
ESWBS Group 4 - Command and surveillance					
General					
Radar	0.2	0	0.5	0.7	0.5
Radio and teletype	0.2	0.1	0.4	0.7	0.4
Searchlight	0	0	0	0.2	0
Sonar	0	0	0.4	0.4	0
Amphibious ships					
Fire control	0.2	0.1	0.3	0.4	0.4
Auxiliary ships					
Fire control	0	0	0	0	0.6
Cruisers-destroyers-frigates					
Fire control	0.2	0.1	0.4	0.7	0.4
ESWBS Group 5 - Auxiliary systems					
General					
A/C chilled water pump	0.7	0.5	0.7	0.7	0.4
A/C compressor	0.7	0.5	0.7	0.7	0.4
A/C purge recovery unit	0.3	0.3	0.3	0.3	0
A/C sea water circulating pump	0.7	0.5	0.7	0.7	0.4
Anchor windlass	0	0	0	0	0
Auxiliary boiler	0.5	0	0	0	0
Auxiliary turbine gland exhauster	0.5	0	0.5	0.9	0
Bilge & fuel tank stripping	0.1	0.1	0.1	0	0
Bilge pump	0.1	0.1	0.1	0.1	0
Boat winch	0	0	0	0	0
Capstan	0	0	0	0	0
Cargo refrigerator compressor	0.3	0.3	0.3	0.3	0
Cathodic protection	0.9	0.9	0.9	0	0
Class circle W ventilation	0.9	0.9	0.9	0.9	0.4
Class circle Z ventilation	0.7	0.7	0.7	0	0
Class W ventilation	0.9	0.9	0.9	0.9	0.4

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

ESWBS Group 5 - Auxiliary systems (continued)	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
Class X and Y ventilation	0.7	0.7	0.7	0	0
Class Z ventilation	0.9	0.9	0.9	0	0
Control air compressor	0.2	0	0.6	0.6	0
Disinfectant agent pump	0.1	0.1	0.1	0.1	0
Distiller plant	0.5	0	0.7	0.7	0
Drinking fountain	0.4	0.4	0.4	0.4	0
Duct heater class Z	0.9	0.9	0.9	0	0
Duct heater class W	0.9	0.9	0.9	0.9	0
Duct heater class circle W	0.9	0.9	0.9	0.9	0
Dumbwaiter	0.1	0.1	0.1	0	0
Fire pump	0.2	0.2	0.2	0.4	0.4
Fuel str, drain and transfer pump	0.3	0	0.3	0.3	0
Fuel transfer pump	0.1	0.1	0.1	0.1	0
Fuel transfer pump purifier	0.3	0	0.3	0	0
Fuel tank stripping pump	0	0	0	0	0
Flushing system	0	0	0.1	0.1	0
Fresh water drain cltg tank pump	0.3	0.1	0.6	0	0
General service pump	0	0	0.1	0.1	0
Gas turbine wash down pump	0	0	0	0	0
Gas turbine water wash tank heater	0.1	0.1	0.1	0.1	0
High pressure air compressor	0.1	0.1	0.1	0.1	0
Hot water circulating pump	0.3	0.3	0.6	0.6	0
HP air compressor air dryer	0.1	0.1	0.1	0.1	0
LAMPS equipment	0	0	0.1	0.5	0.5
Lubricating oil transfer pump	0.1	0.1	0.1	0	0
Main steering gear pump	0	0	0.3	0.3	0.3
O ₂ N ₂ plant	0	0	0.1	0.1	0
PRAIRIE/MASKER compressor	0	0	0.9	0.9	0
Potable water booster pump	0.3	0.2	0.3	0.3	0
Potable water priming pump	0	0	0	0	0
Potable water pump	0.3	0.2	0.3	0.3	0
Sewage macerator	0.1	0.1	0.1	0.1	0
Sewage pump	0	0	0.1	0.1	0
Ship service air compressor	0.1	0.1	0.1	0.1	0
Soluble fog foam	0	0	0	0	0
Space heater class W	0.9	0.9	0.9	0.9	0
Space heater class Z	0.9	0.9	0.9	0	0

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

ESWBS Group 5 - Auxiliary systems (continued)	A	S	C	F	E
	N	H	R	U	M
General	C	O	U	N	E
	H	R	I	C	R
Aircraft carriers	O	E	S	T	G
	R		I	I	E
			N	O	N
			G	N	C
				A	Y
				L	
SS air compressor air dryer	0.1	0.1	0.1	0.1	0
SS refrigerator compressor	0.3	0.3	0.3	0.3	0
Steering auxiliary heater	0.9	0.9	0	0	0
Steering gear control	0	0	0.5	0.5	0.5
Steering gear servo pump	0	0	0.5	0.5	0.1
Standby steering gear pump	0	0	0	0	0
Steering gear fill & drain pump	0	0	0	0	0
Towing machine	0	0	0	0.3	0
Unit coolers	0.2	0.2	0.2	0.2	0
Ventilation, no class	0.9	0.7	0.9	0.9	0.4
Aircraft carriers					
Aircraft clg and hydr test unit	0	0	0	0.5	0
Aircraft elevator side door	0	0	0	0.1	0
Aircraft component elevator	0	0.1	0.1	0.2	0
Aircraft cooling carts	0	0	0	0.5	0
Aircraft crane	0	0	0	0	0
Aircraft elevator main pump	0	0	0.2	0.2	0
Aircraft elevator sump pump	0	0	0.1	0.1	0
Aircraft positioner	0	0	0.1	0.1	0
Arresting gear system	0	0	0	0.2	0.2
Aviation gasoline pump	0	0	0	0.1	0.9
Barricade stby hydr pump pkg	0	0	0	0.1	0
Catapult system	0	0	0	0.2	0
Cut bridle arrestor cont ckt	0	0	0	0.2	0.2
Decanning boom hoist	0.1	0.1	0.1	0	0
Elevator platform gate valve	0	0	0.2	0.2	0
Hangar division doors	0	0	0	0.1	0
Island elevator	0.2	0.2	0.2	0.2	0
Jet blast deflector hydr pump	0	0	0	0.2	0
JP-5 defueling pump	0	0	0	0.2	0
JP-5 purifier	0	0	0	0.2	0
JP-5 service pump	0	0	0	0.2	0
JP-5 tank drain str pump	0	0	0	0	0
Personnel elevators	0.2	0.1	0.2	0.2	0

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

ESWBS Group 5 - Auxiliary systems (continued)	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
Aircraft carriers					
Replenishment-at-sea-system Stern hoist, flammable liquid Stores conveyor	0 0.2 0.1	0 0.2 0.1	0.2 0 0.1	0 0 0	0 0 0
Amphibious ships					
Aircraft crane Aircraft elevator main pump Aircraft elevator sump pump Aircraft engine hoist Automotive gas defueling pump Aviation gasoline pumps Automotive gasoline pump Avionics outlets Cargo elevator Cargo elev emer hoist Deck edge door Jib crane hoist JP-5 cargo stripping pump JP-5 defueling pump JP-5 purifier JP-5 service pump JP-5 transfer pump Replenishment-at-sea system Stores conveyor Wire rope hoist	0 0 0 0.2 0.2 0 0.2 0 0.2 0 0.2 0 0.2 0 0 0.2 0 0.2 0.2 0.2	0 0 0 0.2 0.2 0 0.2 0 0.2 0 0.2 0 0.2 0 0 0.2 0 0.2 0.2 0.2	0 0.2 0.2 0.2 0 0.2 0 0 0 0 0.2 0 0 0.2 0.1 0.2 0.2 0.1 0.2	0 0.2 0.2 0.2 0 0.2 0.2 0 0.2 0 0.2 0 0.2 0.2 0.2 0 0 0 0.2 0.2	0 0 0 0 0.2 0.2 0.2 0 0.2 0 0 0 0 0 0 0 0 0 0 0.2
Auxiliary ships					
Cargo crane Cargo crane heater Cargo elevator Cargo elevator door Cargo fuel stripping pump Component transfer lift Highline winch Helicopter boom JP-5 priming pump	0.3 0.2 0.2 0.1 0 0 0 0 0	0.3 0.2 0.2 0.1 0 0 0 0 0	0.1 0.2 0 0.1 0 0 0 0 0	0.3 0 0.3 0.1 0 0.2 0.6 0 0	0 0 0 0 0 0 0 0 0

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
ESWBS Group 5 - Auxiliary systems (continued)					
Auxiliary ships					
JP-5 purifier	0	0	0.1	0.3	0
JP-5 service pump	0	0	0.1	0.3	0
JP-5 transfer pump	0	0	0	0	0
Outbd and inbd saddle winch	0	0	0	0.3	0
Outhaul and inhaul winch	0	0	0	0.3	0
Package conveyor	0	0.7	0	0.5	0
Power operated hangar door	0	0	0	0	0
Rammer cart	0	0	0	0.2	0
Retrieving line winch	0	0	0	0.3	0
Retrieving line winch heater	0	0	0	0	0
Sliding block power unit	0	0	0	0.3	0
Snaking winch	0	0	0	0.3	0
Span wire winch	0	0	0	0.6	0
Cruisers-destroyers-frigates					
Fan fare streaming winch	0	0	0	0	0
Fast elevator system	0.1	0.1	0.1	0	0
Helicopter winch	0	0	0	0	0
JP-5 purifier	0	0	0.1	0	0
JP-5 service pump	0	0	0.1	0	0
JP-5 transfer pump	0	0	0	0	0
Package conveyor	0	0.3	0.1	0	0
Torpedo hatch cover	0	0	0	0	0
ESWBS Group 6 - Outfit and furnishings					
General					
ARC welders ac/dc	0.1	0.1	0.1	0.1	0
Bake oven	0.2	0.2	0.2	0	0
Bakery chilled water	0.3	0.2	0.3	0.1	0
Bread slicer	0.3	0.2	0.3	0.1	0
Cash register	0	0	0	0	0
Centrifuge	0	0	0	0	0
Coffee maker	0.3	0.2	0.3	0.3	0
Coil winder	0.2	0.2	0.2	0	0

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

ESWBS Group 6 - Outfit and furnishings (continued)	A	S	C	F	E
	N	H	R	U	M
General	C	O	I	N	E
	H	R	S	C	R
	O	E	I	T	G
	R		N	O	E
			G	N	N
				A	C
				L	Y
Deep fat fryer	0.4	0.4	0.4	0	0
Dishwasher	0.3	0.2	0.3	0.2	0
Drill press	0.1	0.1	0.1	0	0
Dryer	0.2	0.2	0.2	0	0
Finisher	0.2	0.2	0.2	0	0
Flatwork ironer	0.2	0.2	0.2	0	0
Fry kettle	0.4	0.2	0.4	0.4	0
Garbage disposal	0.2	0.2	0.2	0	0
Garbage grinder	0.2	0.2	0.2	0	0
Generator test stand	0.1	0.1	0.1	0.1	0
Griddle	0.3	0.2	0.3	0.3	0
Grinder	0.1	0.1	0.1	0	0
Hand iron	0	0	0	0	0
Heated glass	0	0	0	0	0
Hydraulic test stand	0.1	0.1	0.1	0.1	0
Ice cream equipment	0.3	0.2	0.3	0.2	0
Ice maker	0.3	0.2	0.3	0.3	0
Lathe	0.2	0.2	0.2	0	0
Lube unit	0.1	0.1	0.1	0	0
Meat preparation equipment	0.3	0.2	0.3	0	0
Milling machine	0.1	0.1	0.1	0	0
Mixer	0.2	0.2	0.2	0.2	0
Oven	0.4	0.2	0.4	0.4	0
Photo equipment	0.1	0.1	0.1	0.1	0
Planer and joiner	0.1	0.1	0.1	0	0
Power saw	0.1	0.1	0.1	0	0
Prerinse booster pump	0.3	0.2	0.3	0.2	0
Range	0.4	0.2	0.4	0.4	0
Recharge pump	0.2	0.2	0.2	0	0
Refr/freezer combination	0.5	0.5	0.5	0.5	0
Refrigerator - small	0.3	0.3	0.3	0.3	0
Sewing machine	0.2	0.2	0.2	0	0
Shearing machine	0.2	0.2	0.2	0	0
Shirt folding machine	0.2	0.2	0.2	0	0
Shop hoist	0.1	0.1	0.1	0	0
Sterilizer - dressing	0	0	0.1	0.7	0.1

See footnote at end of table.

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TABLE I. Typical operating load factors for surface ships.^{1/} - Continued

	A N C H O R	S H O R E	C R U I S I N G	F U N C T I O N A L	E M E R G E N C Y
ESWBS Group 6 - Outfit and furnishings (continued)					
General					
Sterilizer - instrument	0.1	0.1	0.1	0.7	0.1
Stitcher	0.2	0.2	0.2	0	0
Test switchboard	0.1	0.1	0.1	0.1	0
Toaster	0.3	0.2	0.3	0	0
Trash burner fan	0.1	0	0.1	0	0
Ultrasonic cleaner	0.1	0.1	0.1	0	0
Valve replacer	0.2	0.2	0.2	0	0
Vegetable cutter	0.2	0.1	0.2	0	0
Vegetable peeler	0.2	0.1	0.2	0	0
Vertical sleever	0.2	0.2	0.2	0	0
Waffle iron	0.1	0.1	0.1	0	0
Washer extractor	0.2	0.2	0.2	0	0
Water heater	0.1	0.1	0.5	0.5	0.1
Window wipers	0	0	0	0	0
X-ray machine	0.1	0.1	0.1	0.2	0.2
Aircraft carriers					
Accommodation ladder	0	0	0	0	0
Photo equipment	0.4	0	0.4	0.4	0
ESWBS Group 7 - Armament					
General					
ASROC launcher	0.1	0	0.1	0.5	0
ASROC loading crane	0	0	0.5	0.5	0
ASROC system pumps	0	0	0.5	0.5	0
Gun mounts	0	0	0	0.6	0.6
Magazine bridge crane	0.2	0.2	0.1	0.1	0
Missile launcher	0.2	0	0.2	0	0
Weapons elevator	0.2	0.2	0	0.7	0
Weapons handling hoist	0.2	0.2	0	0.7	0

See footnote on next page.

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1/ Equipment items are categorized according to the first three digits of NAVSEA S9040-AA-IDX-010/SWBS 5D. Each ESWS group category is further broken down into general and specific ship type sub-categories, as required:

- (a) Zero load factors are assigned to equipment that is seldom used.
- (b) Load factors of 0.9 are used in cases where a motor operates at full load for an extended period of time during a specific ship condition.
- (c) All standby units shall be listed and assigned zero load factors except when the standby is actually kept running or is based on percent of power used while idling.
- (d) Some ships are equipped with special port use pumps for operation while the ship is at anchor, permitting the larger capacity pumps to be secured. The pumps not used when the port use pumps are used shall be assigned a zero load factor under anchor condition.
- (e) Load analyses for tenders and repair ships shall take into consideration the supply of power to ships alongside.
- (f) On some ships, one or more items of electric equipment are installed which draw a heavy load in comparison with the generator rating. In such instances, this equipment shall not be assigned load factors by assuming inoperative other equipment not essential at the time of using these large items of equipment.
- (g) Loads which vary due to ambient temperatures shall be identified by an asterisk (*). The load factor assigned for these loads should be for the same day (90°F or 10°F) and identified as such.

4.4 Selection of operating load factors. In order to obtain as realistic a value for operating load factors as possible, no single method for their determination is specified. It is intended that the method of selecting operating load factors be left to the preparer of the analysis. Conditions which have a general bearing on the selection of operating load factors and typical methods which have been used in their selection are listed below.

4.4.1 Relation of the kW rating of the driving motor to actual kW consumed by the driven auxiliary. In selecting the size of a motor necessary to drive an auxiliary at its rated output, a larger motor than actually required is normally chosen because:

- (a) In the design of the driven auxiliary, some margin in excess of calculated kW is allowed. Accordingly, the driving motor is not normally required to deliver its rated kW when operating the driven auxiliary at its maximum load condition.
- (b) The choice of available standard motor frame size may dictate selection of a larger than necessary motor.

Since a larger motor is selected, it may be assumed that an auxiliary operating at full output does not require the rated output of its driving motor.

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4.4.2 Assignment of a factor to each individual load. If a particular equipment operates continuously at a steady load during a given ship operational condition, the factor for that equipment may be taken as the ratio of the actual operating load to the connected load of the equipment, expressed as a decimal. If a load is intermittent, such as an air compressor motor, the factor shall be selected so as to reflect:

- (a) The ratio of the actual load to the connected load of the equipment, and
- (b) The effect of intermittent duty of the equipment of the generator load. Known or anticipated ship operating procedures and practices and characteristics of operation of the equipment involved shall be considered in estimating this effect.

4.4.3 Assignment of a factor to a group of loads. A single load factor may be assigned to a group of loads under the following conditions:

- (a) When two or more associated power consuming devices are known to operate with some relation to each other. This method may be used where the relationship of the loads to one another is clearly established. For example, in considering the group of motors associated with the operation of a gun mount, a clearly established relationship exists between the ramming motors and the elevating motors, since the rammers operate under load only when the barrels are horizontal, while the elevating motors are idling at no load.
- (b) When the relationship of the loads to one another is not clearly established but is known to exist. An example of this is a group of electrical loads in a galley where the electrical equipment in operation during the preparation of a fried meal may be different from that equipment which would be in operation during the preparation of a broiled or baked meal.
- (c) Where there is a group of low power consuming equipment within the same space and would be assigned approximately the same load factor. An example of this is a group of electronic equipment.

4.4.4 Use of known or established load values in lieu of a factor. For some pieces of equipment and groups of equipment, extensive investigations and tests have been conducted to determine operating load values during various ship operating conditions for use in preparing load analyses. Where such known and established operating load values are available, they shall be used. The source of data, such as from cognizant system engineers, shall be noted in the load analysis.

4.4.5 Electric load for power conversion equipment. A detailed analysis of electric loads that are fed through power conversion equipment shall be performed. Taking into consideration the efficiency of the conversion equipment, the kW load shall be listed in the power analysis in lieu of load factors.

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5. DETAILED REQUIREMENTS

Not applicable

6. NOTES

6.1 Intended use. This standard is intended for use in the preparation of an electrical system load and power analysis for conventional-powered surface ships.

6.2 Subject term (key word) listing.

Ship operating condition, anchor
Ship operating condition, cruising
Ship operating condition, emergency
Ship operating condition, functional
Ship operating condition, shore

Preparing activity:
Navy - SH
(Project 1990-N052)

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