

# 24 Hour Average Load

Norbert Doerry

June 10, 2026

## 1. Introduction

The 24 hour average load is used when calculating fuel consumption rates. Calculating the 24-hour average load is similar to calculating the load that a particular piece of power system equipment must be able to support; the difference is the time scale of interest. For the 24-hour average calculation, the time scale is a day. For equipment sizing, the time scale depends on the equipment's ability to handle an overload; for generators and transformers, the time scale is typically on the order of minutes; for power electronics the time scale is typically on the order of seconds to minutes. Generally, the load calculated for equipment sizing is greater than the 24-hour average.

## 2. Load modeling considerations

Loads may be modeled somewhat differently for 24-hour calculations as compared to equipment sizing. Specific differences include:

- a. The total load is usually calculated at the total ship level rather than for specific power system equipment. If the ship is operated in split plant, then the total load for each independent power system is calculated.
- b. Loads that are correlated (likely to be “on” at the same time, or likely to be “off” at the same time) need not be modeled together; determining their long-term average is sufficient.
- c. Accounting for cycling loads being at their peak value is not required; zonal load factor analysis is not applicable.
- d. If for a given type of load (fire pumps for example) if only a subset of the loads is on during a given operational condition, then it usually does not matter which loads (of a particular type of load) comprise the subset.

## 3. Calculation methods

The following electric load calculation methods as defined in DPC 310-1 may be employed in calculating the 24-hour average.

### 3.1. Load Factor Analysis

Load factor analysis can be a very good technique if load factors that are based on long term averages are used. The load factor tables in DPC 310-1 are intended for sizing equipment and not for 24-hour average loads; using these load factors may result in 24-hour average load



predictions that are too high. The load factor tables in IEEE Std 45.1 are based on long term averages and may be used if better information is not available.

Ideally, load factors should be based on measurements of actual equipment on existing ships operated in a manner similar to the ship design being analyzed.

### 3.2. Stochastic Analysis

Stochastic analysis may also be employed; the mean value of the sum of the individual load “samples” obtained from Monte Carlo simulation should be used; a sufficient number of samples should be used to reduce the estimated error to an acceptable value.

### 3.3. Modeling and Simulation Analysis

Modeling and simulation may be used with a total time of about 2400 hours. The average value of the total load over the simulation time is used; the 2400 hours should be sufficient to determine a stable 24-hour average.

### 3.4. 24-hour average load parametric equation

For early-stage design, DPC 310-1 provides parametric equations for estimating the 24-hour average ship service load based on 100° F loads calculated for equipment sizing. Equation [1] is used for all surface ships except aircraft carriers and large deck amphibious assault ships. Equation [2] is used for aircraft carriers and large deck amphibious assault ships.

$$P_{24\_hour\_ave} = P_{prop\_steering} + 0.75(P_{cruise} - P_{prop\_steering}) \quad [1]$$

Where

$P_{24\_hour\_ave}$  = 24-hour average ship service load

$P_{prop\_steering}$  = Propulsion plant and steering systems loads

$P_{cruise}$  = Cruising ship operating condition load with margins and service life allowance

Electric propulsion load is not included in the 24-average ship service load.

$$P_{24\_hour\_ave} = P_{prop\_steering} + 0.60(P_{cruise} - P_{prop\_steering}) \quad [2]$$

The 24-hour average load parametric equation should not be used beyond early stage design. In preliminary design and later, one of the other methods for calculating the 24-hour average load should be used.

#### 4. References

DPC 310-1 Electric Power Load Analysis (EPLA) for Surface Ships

IEEE Std 45.1 IEEE Recommended Practice for Electrical Installations on Shipboard--Design

