

1.6.15 For emergency services and their emergency power supplies required to be capable of being operated under fire conditions, 'high fire risk areas' are:

- (a) machinery spaces, as defined by SOLAS 1974 as amended, *Chapter II-2 - Construction - Fire protection, fire detection and fire extinction*;
- (b) spaces containing fuel treatment equipment;
- (c) galleys and pantries containing cooking appliances;
- (d) laundries containing drying equipment;
- (e) hazardous zones and spaces; and
- (f) for passenger ships carrying more than 36 passengers:
 - (i) public spaces containing furniture and furnishings of other than restricted fire risk and having a deck area of 50 m² or more;
 - (ii) barber shops and beauty parlours; and
 - (iii) saunas.

Requests to exempt spaces identified in *Pt 6, Ch 2, 1.6 Definitions 1.6.15* may be considered when evidence is submitted that demonstrates emergency services will remain available in the event of a fire in the space (e.g. studies of fire protection measures, installation locations, system redundancy, etc.).

1.6.16 An 'electric arc' is an electrical discharge or a short-circuit through ionised air caused by isolation or insulation integrity failure.

1.6.17 'Incident energy' is the amount of energy impressed on a surface, a certain distance from the source, generated during an electric arc event.

1.7 Design and construction

1.7.1 Electrical propelling machinery and associated equipment together with equipment for services essential for the propulsion and safety of the ship are to be constructed in accordance with the relevant requirements of this Chapter.

1.7.2 The design and installation of other equipment is to be such that risk of fire due to its failure is minimised. It is, as a minimum, to comply with a National or International Standard revised where necessary for ambient conditions.

1.7.3 Electrical equipment is to be suitable for its intended purpose and accordingly, whenever practicable, be selected from the *List of Type Approved Products* published by LR. A copy of the Procedure for LR Type Approval System will be supplied on application.

1.7.4 For areas susceptible to deluge or submersion, cable entries are to prevent water ingress. In general, cable entries are to be in accordance with IEC 60092-101: *Electrical Installations in Ships – Part 101: Definitions and General Requirements*.

1.8 Quality of power supplies

1.8.1 All electrical equipment supplied from the main and emergency sources of electrical power and electrical equipment for essential and emergency services supplied from d.c. sources of electrical power is to be so designed and manufactured that it is capable of operating satisfactorily under normally occurring variations of voltage and frequency.

1.8.2 Unless specified otherwise, a.c electrical equipment is to operate satisfactorily with the following simultaneous variations, from their nominal value, when measured at the consumer input terminals:

- (a) voltage:
 - permanent variations +6 per cent –10 per cent
 - transient variations due to step changes in load ± 20 per cent
 - recovery time 1,5 seconds
- (b) frequency:
 - permanent variations ± 5 per cent
 - transient variations due to step changes in load ± 10 per cent
 - recovery time 5 seconds
 - A maximum rate of change of frequency not exceeding $\pm 1,5$ Hz per second during cyclic frequency fluctuations.

1.8.3 **Harmonics.** Unless specified otherwise, the total harmonic distortion (THD) of the voltage waveform at any a.c switchboard or section-board is not to exceed 8 per cent of the fundamental for all frequencies up to 50 times the supply

frequency and no voltage at a frequency above 25 times supply frequency is to exceed 1,5 per cent of the fundamental of the supply voltage. THD is the ratio of the rms value of the harmonic content to the rms value of the fundamental, expressed in per cent and may be calculated using the expression:

$$THD = \frac{\sqrt{\sum_{h=2}^{\infty} V_h^2}}{V_1} \times 100$$

where

V_h = rms amplitude of a harmonic voltage of order h

V_1 = rms amplitude of the fundamental voltage.

1.8.4 Unless specified otherwise, d.c. electrical equipment is to operate satisfactorily with the following simultaneous variations from their nominal value, when measured at the consumer input terminals:

(a) When supplied by d.c. generator(s) or a rectified a.c. supply:

Voltage tolerance (continuous)	±10 per cent
Voltage cyclic variation deviation	5 per cent
Voltage ripple	10 per cent

(a.c. rms over steady state o.c. voltage)

(a) When supplied by batteries:

- (i) Equipment connected to the batteries during charging: Voltage tolerance +30 per cent, –25 per cent;
- (ii) Equipment not connected to batteries during charging: Voltage tolerance +20 per cent, –25per cent.

Different voltage variations as determined by the charging/discharging characteristics, including ripple voltage from the charging device, may be considered. When battery chargers/battery combinations are used as d.c. power supply systems adequate measures are to be taken to keep the voltage within the specified limits during charging, boost charging and discharging of the battery.

1.9 Ambient reference and operating conditions

1.9.1 The rating for classification purposes of essential electrical equipment intended for installation in ships to be classed for unrestricted (geographical) service is to be based on an engine room ambient temperature of 45°C, and a sea-water temperature at the inlet of 32°C. The equipment manufacturer is not expected to provide simulated ambient reference conditions at a test bed.

1.9.2 In the case of a ship to be classed for restricted service, the rating is to be suitable for the ambient conditions associated with the geographical limits of the restricted service, see *Pt 1, Ch 2 Classification Regulations*.

1.9.3 Main and essential auxiliary machinery and equipment is to operate satisfactorily under the conditions shown in *Pt 5, Ch 1, 3.6 Ambient operating conditions*. Electrical equipment satisfying alternative ambient operating condition requirements for installation on ships contained in an acceptable and relevant National or International Standard may be considered to satisfy this requirement.

Note Details of local environmental conditions are stated in Annex B of IEC 60092-101-2002: *Electrical installations in ships – Part 101: Definitions and general requirements*.

1.9.4 Where electrical equipment is installed within environmentally controlled spaces, the ambient temperature for which the equipment is suitable for operation at its rated capacity may be reduced to a value not less than 35°C provided:

- the equipment is not for use for emergency services and is located outside of machinery space(s);
- temperature control is achieved by at least two cooling units so arranged that, in the event of loss of one cooling unit, for any reason, the remaining unit(s) will be capable of satisfactorily maintaining the design temperature;
- the equipment is able to be initially set to work safely within a 45°C ambient temperature until such a time that the lesser ambient temperature may be achieved; the cooling equipment is to be rated for an ambient temperature of not less than 45°C; and
- alarms are provided, at a continually attended control station, to indicate any malfunction of the cooling units.

See also *Pt 6, Ch 1, 1.3 Control, alarm and safety equipment 1.3.3*.