Excerpt from ABS Rules Developed for Motors rated above 100kW for Essential Services

Booklet developed on 1 January, 2026

Excerpt from ABS Rules
Developed for Motors rated above 100kW for Essential Services

American Bureau of Shipping
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of the State of New York 1862.

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Foreword

Purpose

This booklet is an excerpt from the ABS Rules. It has been created to support equipment manufacturers in identifying the appropriate ABS Rules for their products.

Application

Equipment manufacturers seeking to have their products approved for marine and offshore applications under ABS classification or certification will find this booklet a practical reference for determining which sections of the ABS Rules are applicable to their specific equipment types.

This excerpt does not replace or supersede the complete ABS Rules. Users are responsible for consulting the full text of the applicable Rules and ensuring compliance with the most current edition, including any published corrigenda and notices.

Additional Information

For questions regarding the applicability of specific Rules to your equipment. Please contact your local ABS office.

The ABS Rules are available in their complete form at American Bureau of Shipping (ABS) Eagle.org.

1.5 Certification of Equipment

The electrical equipment indicated below are required to be certified by ABS for complying with the appropriate provisions of this section (see also [4-1-1/TABLE 3]):

- Generators and motors of 100 kW (135 hp) and over intended for essential services (see definition in 4-8-1/7.3.3) or for services indicated in 4-8-3/15 TABLE 7. See 4-8-3/3.
- Main, propulsion and emergency switchboards. See 4-8-3/5.
- Motor controllers of 100 kW (135 hp) and over intended for essential services or for services indicated in 4-8-3/15 TABLE 7. See 4-8-3/5.7.
- Motor control centers with aggregate load of 100 kW (135 hp) and over intended for essential services or for services indicated in 4-8-3/15 TABLE 7. See 4-8-3/5.7.
- Semiconductor converters used to control motor drives having a rated power of 100 kW(135 hp) and over intended for essential services or for services indicated in 4-8-3/15 TABLE 7. See 4-8-3/8.
- Battery charging and discharging boards for emergency and transitional source of power. See 4-8-3/5.9.
- Uninterruptible power system (PS) units of 50 kVA and over. See 4-8-3/5.9.
- Propulsion controls, propulsion semiconductors and propulsion cables. See 4-8-3/9 and 4-8-5/5.11.3, 4-8-5/5.17.8 and 4-8-5/5.17.11.

Other electrical equipment items are to be designed, constructed and tested in accordance with established industrial practices, manufacturer's specifications and applicable requirements in this Section. Acceptance will be based on manufacturer's documentation which is to be made available upon request and on satisfactory performance after installation. Mass produced items can, at the discretion of the manufacturers, be certified under the Type Approval Program, Appendix 1A-1-A3 of the ABS Rules for Conditions of Classification (Part 1A) and 4-1-1/9 TABLE 3.

1.11 Enclosures

1.11.1 General

Electrical equipment is to have a degree of enclosure for protection against the intrusion of foreign objects and liquids appropriate for the location in which it is installed. The minimum degree of protection is to be in accordance with 4-8-3/15 TABLE 2.

For the purpose of defining protection levels used in 4-8-3/15 TABLE 2, the following conventions apply. The degree of protection by an enclosure with respect to the intrusion of foreign particles and water is defined by the designation 'IP' followed by two digits: the first digit signifies the protection degree against particles, and the second digit signifies the protection degree against water. For complete details, see 4-8-3/15 TABLE 1A and 4-8-3/15 TABLE 1B. These designations are identical to that specified in IEC Publication 60529. For high voltage equipment see 4-8-5/3 TABLE 1.

1.11.2 Equipment in Areas Affected by Local Fixed Pressure Water-Spraying or Local Water-mist Fire Extinguishing Systems in Machinery Spaces

Electrical and electronic equipment within areas affected by Local Fixed Pressure Water-spraying or Local Water-mist Fire Extinguishing Systems are to be suitable for use in the affected area. See 4-8-3/1.11.2 FIGURE 1. Where enclosures have a degree of protection lower than IP44, evidence of suitability for use in these areas is to be submitted to ABS taking into account:

i. The actual Local Fixed Pressure Water-spraying or Local Water-mist Fire Extinguishing system being used and its installation arrangements, and
ii. The equipment design and layout (e.g., position of inlet ventilation openings, filters, baffles, etc.) to prevent or restrict the ingress of water mist/spray into the equipment. The cooling airflow for the equipment is to be maintained.

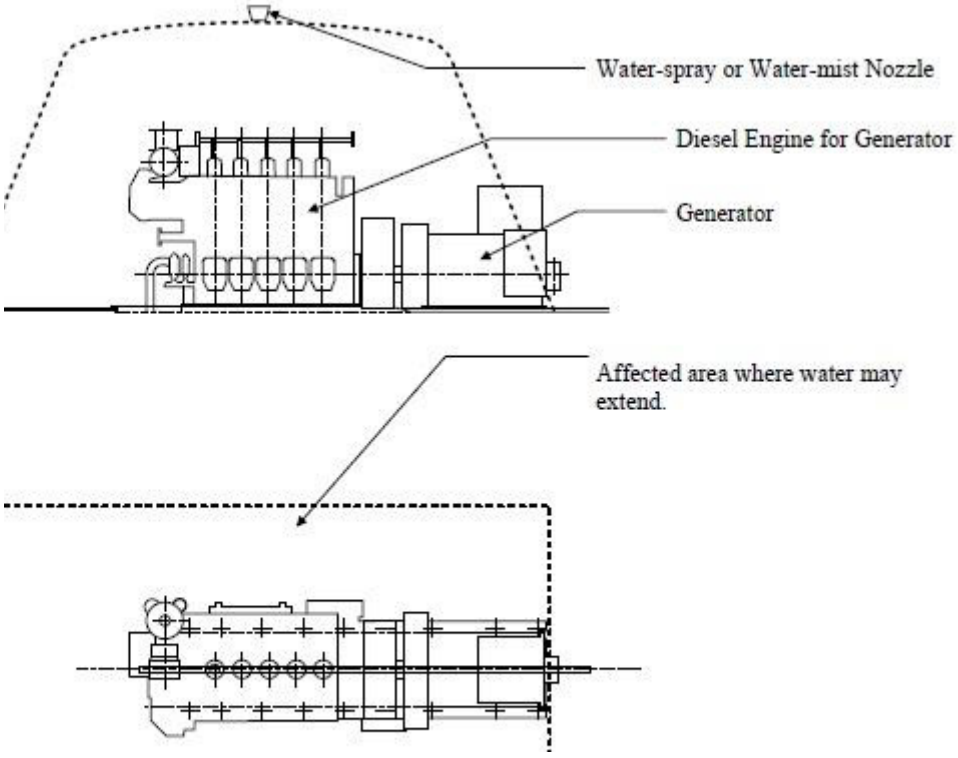
Notes:

Additional precautions may be required to be taken with respect to:

a. Tracking as the result of water entering the equipment
b. Potential damage as the result of residual salts from sea water systems
c. High voltage installations
d. Personnel protection against electric shock

Equipment may require maintenance after being subjected to water mist/spray.

FIGURE 1
Example of Area Affected by Local Fixed Pressure Water-spraying or Local Water-mist Fire Extinguishing System in Machinery Spaces



1.15 Insulation

1.15.1 Insulation Material **(2024)**

Insulating materials are to be classified by their maximum continuous operating temperatures in accordance with the following table:

Class	Maximum Continuous Temperature	
	°C	°F
E	120	248
B	130	266
F	155	311
H	180	356

Materials or combination of materials which by experience or accepted tests can be shown to be capable of satisfactory operation at temperature over 180°C (356°F) will also be considered. In this regard, supporting background information, reports, tests conducted, etc. ascertaining their suitability for the intended application and operating temperature are to be submitted for review.

1.15.2 Insulated Handrails or Handles **(2024)**

Insulated handrails or handles are to be provided for the equipment which are required to be operated safely during motion or inclination of the vessel. This include the main and emergency switchboards, motor control centers, distribution boards for essential and emergency services, as well as deck mounted electrical equipment necessary for specific Class notations (such as refrigerated cargo notation, dynamic positioning system, etc.). See also 4-8-3/5.5.3, 4-8-3/8.5.5.

Commentary:

Handrails or handles are required on the front of equipment only, unless normal operation is expected at the rear or sides of the equipment.

End of Commentray

1.17 Ambient Temperatures

1.17.1 General

For purposes of rating of equipment, a maximum ambient temperature of 45°C (113°F) is to be applied.

Where ambient temperatures in excess of 45°C (113°F) are expected, the rating of equipment is to be based on the actual maximum ambient air temperature.

The use of lower ambient temperatures can be considered provided the total rated temperature of the equipment is not exceeded and where the lower values can be demonstrated. The use of a value for ambient temperature less than 40°C (104°F) is only permitted in spaces that are environmentally controlled.

1.17.2 Reduced Ambient Temperature for Electrical Equipment in Environmentally Controlled Spaces

1.17.2(a) Environmentally-controlled Spaces.

Where electrical equipment is installed within environmentally-controlled spaces, the ambient temperature for which the equipment is to be rated can be reduced from 45°C and maintained at a value not less than 35°C, provided:

i. The equipment is not to be used for emergency services.
ii. Temperature control is achieved by at least two independent cooling systems so arranged that in the event of loss of one cooling system for any reason, the remaining system(s) is capable of satisfactorily maintaining the design temperature. The cooling equipment is to be rated for a 45°C ambient temperature.
iii. The equipment is to be able to initially start to work safely at a 45°C ambient temperature until such a time that the lesser ambient temperature may be achieved.
iv. Audible and visual alarms are provided, at a continually-manned control station, to indicate any malfunction of the cooling systems.

1.17.2(b) Rating of Cables.

In accepting a lesser ambient temperature than 45°C, it is to be ensured that electrical cables for their entire length are rated for the maximum ambient temperature to which they are exposed along their length.

1.17.2(c) Ambient Temperature Control Equipment.

The equipment used for cooling and maintaining the lesser ambient temperature is to be classified as a secondary essential service, in accordance with 4-8-1/7.3, and the capability of cooling is to be witnessed by the Surveyor at sea trial.

3 Rotating Electrical Machines (2024)

3.1 Application (2024)

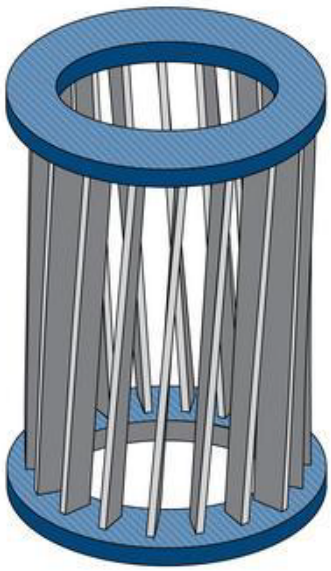
All generators and motors of 100 kW (135 hp) and over intended for essential services (see 4-8-1/7.3.3) or for services indicated in 4-8-3/15 TABLE 7 are to be designed, constructed and tested in accordance with the requirements of 4-8-3/3.

Furthermore, their design and construction are to withstand all loads (e.g., mechanical, electrical, thermal, cyclic, etc.) that would be imposed during the intended operation.

For squirrel cage electric motors serving essential services, special attention is also to be given to the method of attachment of the rotor bars to the rotor so that the overall operational integrity of the motor will not be affected during service. The common arrangement is with the shorting ring in full contact, via brazing or welding, with the ends of the rotor bars. A less common arrangement is with the shorting ring only in partial contact with the ends of the rotor bars. For these less common arrangements, calculations, analyses, tests and/or operational service history data are to be provided in this regard substantiating the design and construction of the rotating machine for its intended application and service. See 4-8-3/Figure 2.

All other rotating electrical machines are to be designed, constructed and tested in accordance with established industrial practices and manufacturer's specifications. Manufacturer's tests for rotating electrical machines less than 100 kW (135 hp) for essential services or for services indicated in 4-8-3/15 TABLE 7 are to include at least the tests described in 4-8-3/3.15.2 through 4-8-3/3.15.11, regardless of the standard of construction. The test certificates are to be made available when requested by the Surveyor. Acceptance of machines will be based on satisfactory performance after installation.

FIGURE 2
Example of Rotor Bar and Short Ring (2024)



3.5 Rating

Generators are to be of continuous rating. Motors are to be of continuous rating unless utilized on an application which definitely imposes an intermittent duty on the motor.

For maximum ambient temperatures to be used when rating rotating machines, see 4-8-3/1.17.

To satisfy the requirements of 4-8-3/3.1, the required power output of gas turbine prime movers for ship's service generator sets is to be based on the maximum expected inlet air temperature.

3.7 Overload and Over-current Capability **(1 July 2019)**

Overload and over-current capabilities for AC and DC generators and motors are to be in accordance with IEC Publication 60034-1. For convenience, the following requirements for AC generators and motors are provided.

3.7.2 AC Motors

3.7.2(a) Over-current capacity.

Three phase induction motors having rated output not exceeding 315 kW (422 hp) and rated voltage not exceeding 1 kV are to be capable of withstanding a current equal to 1.5 times the rated current for not less than 2 minutes. For three phase induction motors having rated outputs above 315 kW (422 hp) the over-current capacity is to be in accordance with the manufacturer’s specification. The test can be performed at a reduced speed.

3.7.2(b) Overload capacity for induction motors.

Three phase induction motors, regardless of duty, are to be capable of withstanding for 15 seconds without stalling, or abrupt change in speed, an excess torque of 60% above the rated torque; the voltage and frequency being maintained at the rated values. For windlass motors, see 4-5-1/5.1.3.

3.7.2(c) Overload capacity for synchronous motors.

Three phase synchronous motors, regardless of duty, are to be capable of withstanding an excess torque as specified below for 15 seconds without falling out of synchronism; the excitation being maintained at the value corresponding to the rated load:

- Synchronous (wound rotor) induction motors: 35% excess torque
- Synchronous (cylindrical rotor) motors: 35% excess torque.
- Synchronous (salient pole) motors: 50% excess torque.

Synchronous motors fitted with automatic excitation are to meet the same excess torque values with the excitation equipment operating under normal conditions.

3.11 Construction

3.11.1 Shafting

3.11.1(a) Rotors of non-integrated auxiliary machinery. **(2026)**

The design of the following specified rotating shafts and components, when not integral with the propulsion shafting, are to comply with the following:

- Rotor shaft: 2-4/5.3.1 and 4-2-4/5.3.2
- Hollow shaft: 3-2/5.3
- Key: 3-2/5.7 and 4-2-4/5.3.2
- Keyless Fitting 3-2/5.19.4
- Coupling flanges and bolts: 3-2/5.19

3.11.1(b) Rotors of integrated auxiliary machinery. **(1 July 2021)**

The shaft diameters of the shaft motors and shaft generators, which are an integral part of the line shafting, are to be evaluated per 4-3-1/5.9.1, 4-3-1/5.9.7.i., and 4-3-1/5.9.7.ii., for maximum torsional moment (steady and vibratory) acting within the operating speeds, instead of torsional moment at rated speed.

The shaft diameter of the motors and generators, that are an integral part of the line shafting, are to also be designed per 4-3-2/5 and are to be evaluated based on engineering analyses per 4-3-2/1.1.

The following components intended for propulsion installations are to be tested in the presence of a Surveyor per 4-3-2/3: thrust shafts, line shafts, propeller shafts, shafting for propulsion generators and motors, coupling bolts, and in the case of direct-connected turbine-driven propulsion generators, fan shrouds, centering and retaining rings. Major castings or built-up parts such as frames, spiders and end shields are to be surface inspected and the welding is to be in accordance with the requirements of Chapter 4 of the *ABS Rules for Materials and Welding (Part 2)*.

3.11.2 Shaft Circulating Current

Means are to be provided to prevent circulating currents from passing between the journals and the bearings, where the design and arrangement of the machine is such that damaging current may be expected, due to the unbalance of magnetic fields. Where such protection is required, a warning plate is to be provided in a visible, stationary location cautioning against the removal of such protection.

3.11.3 Lubrication

Rotating machine's shaft bearings are to have the required lubrication at all rated operating conditions, and with the vessel inclined as specified in 4-1-1/7.9. Where forced lubrication is employed, generators are to be fitted with means to shut down their prime movers automatically upon failure of the generator's lubricating system. Each self-lubricating sleeve bearing is to be fitted with a means for visual indication of oil level.

3.11.4 Cooling

Where water cooling is used, the cooler is to be so arranged to avoid entry of water into the machine, whether through leakage or condensation in the heat exchanger.

3.11.5 Moisture Condensation Prevention

All generators, and each propulsion motor, are to be provided with a means to prevent moisture condensation in the machine when idle.

Motors, rated 50kW and over, used for essential services and located in damp spaces or exposed to weather are to be provided with a means to prevent moisture condensation in the machine when idle.

3.11.6 Stator Temperature Detection

AC propulsion generators and motors rated above 500 kW (670 hp) are to be provided with means of obtaining the temperatures at each phase of the stationary windings.

3.11.7 Enclosure and Terminal Box

Cable terminal boxes are to be fitted with means to secure the cables. Enclosures of rotating machines including the cable terminal boxes are to be such as to eliminate mechanical injury and the risk of damage from water, oil and shipboard atmosphere. The minimum degree of protection is to be in accordance with 4-8-3/15 TABLE 2.

Terminals are to be provided at an accessible position and protected against mechanical damage and accidental contact for earthing, short-circuit or touching. Terminal leads are to be secured to the frame and the designation of each terminal lead are to be clearly marked. Terminal leads are to be terminated securely with a vibration resistant means of termination. Cable glands or similar are to be provided where cable penetrations may compromise the protection property of terminal enclosures.

3.11.8 Nameplate Data **(1 July 2020)**

Nameplates of corrosion-resistant material are to be provided and are to indicate at least the following, as applicable (for AC generating sets, see 4-8-3/3.19.4):

The manufacturer's serial number
(or identification mark)
Type of machine
Rating
The rated voltage
The rated speed
The rated ambient temperature
The rated frequency
Type of winding connections
Rated exciter current

The manufacturer's name
The year of manufacture
Degree of protection by IP code
The rated output
The rated current
The class of insulation
Number of phase
The rated power factor
Rated exciter voltage

8 Semiconductor Converters for Adjustable Speed Motor Drive

8.7 Inspection and Testing

Semiconductor assemblies for motor drives are to undergo Type tests, Routine tests and Optional tests, if any specifically required by the Owner, at manufacturer's production facility as per the Table below. The Type tests, Routine tests and Optional tests are to be conducted in the presence of and witnessed by an ABS Surveyor. Type tests are to be carried out one prototype of a converter or the first of a batch of identical converters. Routine tests are to be carried on each assembly. A summary of the required type tests and routine tests are given in the table below:

No.	Tests (see 4-8-3/8.7)	Type Test	Routine Test	MVR Reference	IEC Test Reference
1	Visual inspection	X	X	4-8-3/8.7.1	61800-5-1/5.2.1
2	Insulation test (AC or DC voltage test)	X	X	4-8-3/8.7.2	61800-5-1/5.2.3.2
3	Insulation resistance test	X	X	4-8-3/8.7.4	60146-1-1/7.2.3.1
4	Impulse voltage test	X		4-8-3/8.7.3	61800-5-1/5.2.3.1
5	Cooling system test	X	X	4-8-3/8.7.5	61800-5-1/5.2.4.5
6	Breakdown of components test	X		4-8-3/8.7.6	61800-5-1/5.2.3.6.4
7	Light load and functional test	X	X	4-8-3/8.7.7	60146-1-1/7.3.1
8	Rated current test	X		4-8-3/8.7.8	60146-1-1/7.3.2
9	Temperature rise test	X		4-8-3/8.7.9	61800-5-1/5.2.3.8
10	Capacitor discharge test	X		4-8-3/8.7.10	61800-5-1/5.2.3.7

8.7.1 Visual Inspection

Semiconductor assemblies are subject to visual inspection for the following aspects:

i. Verify enclosure integrity, alignment of different cabinets in the assembly as per system drawings.
ii. Verify if nameplate is present as per
iii. Check if adequate and visible warning and safety labels are present.
iv. General hardware and electrical point-to-point wire check.
v. Verify correct routing and connections of fiber optic cables and ethernet cables.
vi. Verify correct connection of grounding wires on the assembly.
vii. Point-to-point inspection of cooling system, if applicable. For drive assemblies with liquid cooling, verification of proper installation of piping and hoses, correct orientation of flow restrictors and related coolant liquid monitoring instrumentation.
viii. Door interlocks, if any

8.7.2 Insulation Test (AC or DC Voltage Test)

Semiconductor assemblies are to be subject to insulation tests to verify adequate dielectric strength of insulation of its components and to verify that clearance distances have not been compromised during manufacturing operations. The insulation test is to be performed with the appropriate AC or DC voltage (equal to the peak value of the specified AC rms voltage) mentioned in Table 21/ Table 22/Table 23 of IEC 61800-5-1(2007). The AC test voltage is to be voltage of sinusoidal wave form and a frequency of 50 Hz/60 Hz. The duration of the test is to be at least 5 sec for the Type Test and 1 sec for the Routine Test. All main power, control power and logic circuits have to be subject to the Insulation test.

8.7.3 Impulse Voltage Test

Semiconductor assemblies are to be subject to an Impulse voltage test to simulate the impact of impulse transient over voltages generated in the mains supply or those caused by switching of equipment. The impulse voltage test is to be done as per 5.2.3.1 of IEC 61800-5-1(2007). For purposes of selection of test voltages, the semiconductor assembly is to be treated as belonging to overvoltage category III.

Impulse voltage tests are to be done as a routine test on assemblies that do not satisfy the clearance and creepage distance requirements of 4-8-3/8.5.11.

8.7.4 Insulation Resistance Test

One minute after the insulation test, insulation resistance is to be measured by applying a direct voltage of at least 500 V.

8.7.5 Cooling System Test

Semiconductor assemblies are to be subject to cooling system tests that test for failure of the cooling system and the associated response of the semiconductor assembly to these cooling system failures as per 5.2.4.5 of IEC 61800-5-1 (2007).

In addition, for liquid cooled semiconductor assemblies, the cooling piping system is to be subject to a coolant leak pressure test. The cooling system piping is to be hydrostatically tested to 1.5 times the design pressure for a period of 30 minutes. The pressure relief mechanism is to also be checked for proper calibration and operation. The cooling system is to be verified as having no leakage by monitoring the pressure and by visual inspection.

The instrumentation critical to the operation of the cooling system such as valve positions, programming of level switch sensors, flow sensors, pressure sensors, temperature sensors, pressure relief valve operation, coolant conductivity sensor, etc., are to be checked to verify correct calibration and functionality.

8.7.6 Breakdown of Components Test

Components which have been identified by circuit analysis could result in a thermal or electric shock hazard are to be subject to a breakdown test as per 5.2.3.6.4 of IEC 61800-5-1.

8.7.7 Light Load and Functional Test

Semiconductor assemblies are to be subject to a light load and functional test to verity that all parts of the electrical circuit and the cooling system work properly together and that the assembly meets the required proof of performance as per customer requirements. The main things to be checked include, but are not limited to:

i. Verify that the control equipment, auxiliaries, protection equipment and main circuit are operating properly together.
ii. Check power supplies to different power and control circuits of the assembly and associated communication control interfaces.
iii. Check pre-charge circuit settings.
iv. Verify the various software parameters.
v. Check for voltage/current sharing in the semiconductor devices used in the arms of the converter.
vi. Testing of the converter for scenarios like, but not limited to, emergency trip of the assembly, input fault protection, loss of cooling, local and remote control operation, etc..
vii. Testing of the converter for any specific customer defined scenario like output power ramp- down on loss of input power, ability of the converter to catch a spinning motor after recovering from a trip or from automatic restart, etc..

8.7.8 Rated Current Test

The test is carried out to verify that the equipment will operate satisfactorily at rated current. The DC terminals are to be short-circuited directly or with a reactor and an alternating voltage of sufficient value, to cause at least the rated continuous direct current to flow, are to be connected to the AC terminals of the converter and operation of the assembly is to be checked.

8.7.9 Temperature Rise Test

The test is carried out to verify that parts and accessible surfaces of the semiconductor assembly do not exceed temperature limits specified below and the manufacturer's temperature limits of safety-relevant parts. The temperature rise test is to be conducted at worst-case conditions of rated power and rated output current.

Materials and Components	Thermometer Method (°C)	Resistance Method (°C)
Rubber/Thermoplastic-insulated conductors	55	–
User terminals	Note 1	–
Copper bus bars and connecting straps	120	–
Winding Insulation Class A Class E Class B Class F Class H Class N	95 100 105 115 135 175	105 115 125 135 155 195
Phenolic composition	145	–
Bare resistor material	395	–
Capacitor	Note 2	–
Power switching semiconductors	Note 2	–
Printed wiring boards (PWB's)	Note 2	–
Liquid cooling medium	Note 2	–

Notes:

1. Maximum terminal temperature is not to exceed 15°C more than the insulation temperature rating of the conductor or cable specified by the manufacturer.
2. Maximum temperature is to be as specified by the manufacturer.

8.7.10 Capacitor Discharge Test

Verification of the capacitor discharge time as required in 4-8-3/8.7.7 is required to be done by a test and/or by calculation.

13 Certified Safe Equipment

13.1 General

Certified safe equipment is equipment intended for installation in hazardous areas where flammable or explosive gases, vapors, or dust are normally or likely to be present. The equipment is to be type-tested and certified by a competent, independent testing laboratory for complying with IEC Publication 60079 series or equivalent standard, and rated according to its enclosure and the types of flammable atmosphere in which it is safe to install. If desired, the manufacturer may have such equipment type approved (see 1A-1-A3/1 of the ABS *Rules for Conditions of Classification (Part 1A)*).

13.3 Acceptable Types of Certified Safe Equipment

The following type of electrical equipment, expressed in IEC Publication 60079 series nomenclature, is acceptable for installation in hazardous areas identified in the Rules. Other types, as well as equipment complying with another recognized standard, will also be considered.

13.3.1 Intrinsically Safe Equipment - 'Ex ia' and 'Ex ib'

An intrinsically safe equipment is one which is supplied by a low energy circuit which when sparking, produced normally by breaking or making the circuit or produced accidentally (i.e., by short circuit or earth-fault), is incapable under prescribed test conditions of causing ignition of a prescribed gas or vapor.

13.3.2 Flameproof (Explosion-proof) Equipment - 'Ex d'

Flameproof equipment is one which possesses an enclosure capable of withstanding, without damage, an explosion of a prescribed flammable gas or vapor within the enclosure and prevent the transmission of flame or sparks which would ignite the external prescribed flammable gas or vapor for which it is designed, and which normally operates at an external temperature that will not ignite the external prescribed flammable gas or vapor. A flameproof enclosure may not necessarily or ordinarily be weatherproof or dustproof.

13.3.3 Increased Safety Equipment - 'Ex e'

Increased safety equipment is designed with a method of protection in which measures additional to those adopted on ordinary industrial practice are applied, so as to give increased security against the possibility of excessive temperatures and the occurrence of arcs or sparks in electrical apparatus which does not produce arcs or sparks in normal service.

13.3.4 Pressurized or Purged Equipment - 'Ex p'

Pressured equipment is designed with an enclosure in which the entry of flammable gases or vapors is prevented by maintaining the air (or other non-flammable gas) within the enclosure at a specified pressure above that of the external atmosphere. Purged equipment is designed with an enclosure in which a sufficient flow of fresh air or inert gas is maintained through the enclosure to prevent the entry of any flammable gas or vapor which may be present in the ambient atmosphere.

13.5 Flammable Gas Groups and Temperature Classes **(2020)**

Certified safe equipment is to be rated for the flammable atmosphere in which it is safe to install. Each flammable atmosphere is to be identified with respect to the flammable gas, vapor or dust and its self-ignition temperature; the latter is used to limit the maximum permissible external surface temperature of the equipment. The following tables show the typical flammable gas groups and the temperature classes as in ISO/IEC 80079-20-1:

Gas Group	*Representative Gas*
I	Methane (see note below)
IIA	Propane
IIB	Ethylene
IIC	Hydrogen

Temperature Class	*Maximum Surface Temperature, °C.*
T1	≤450
T2	≤300
T3	≤200
T4	≤135
T5	≤100
T6	≤85

Note: While methane of firedamp and mining applications, such as methane generated from coal, is classified as Group I, industrial methane, such as natural gas, is to be classified as Group IIA with temperature Class T1, if it does not contain more than 15% (V/V) of hydrogen. A mixture of industrial methane with other compounds from Group IIA, in any proportion, is also classified as Group IIA with temperature Class T1.

3 High Voltage Systems

3.7 Equipment Design

3.7.1 Air Clearance and Creepage Distance

3.7.1(a) *Air Clearance*. Phase-to-phase air clearances and phase-to-earth air clearances between non-insulated parts are to be not less than the minimum as specified below. **(2019)**

Nominal Voltage kV	Minimum Air Clearance mm (in.)
3 - 3.3	55 (2.2)
6 - 6.6	90 (3.6)
10 - 11	120 (4.8)
15	160 (6.3)

Where intermediate values of nominal voltages are accepted, the next higher air clearance is to be observed.

3.7.1(b) *Reduction*. Alternatively, reduced clearance distances may be used provided: **(2019)**

i. The equipment is not installed in 'Machinery Spaces of Category A' or in areas affected by a Local Fixed Pressure Water-spraying or Local Water-mist Fire Extinguishing System.
ii. The equipment is subject to an impulse voltage test with test voltage values shown in Table below. Where intermediate values of rated operational voltage are used, the next higher rated impulse withstand test voltage is to be used. The impulse voltage test reports are to be submitted to ABS for review.

Rated Voltage kV	Rated Impulse Withstand Voltage kV (peak value)
3.6	40
7.2	60
12	75
15	95

3.7.1(c) *Isulating Material*. Any insulating material that is used to cover live parts of equipment used to comply with clearance distance requirements is to be suitable for the application. The equipment manufacturer is to submit documentation which demonstrates the suitability of such insulation material. **(2019)**

3.7.1(d) *Creepage Distance.* Distances between live parts and between live parts and earthed metal parts are to be in accordance with IEC 60092-503 for the nominal voltage of the system, the nature of the insulation material, and the transient overvoltage developed by switch and fault conditions. **(2019)**

i. The minimum creepage distances for main switchboards and generators are given in the Table below:

Nominal VoltageV	Minimum Creepage Distance for Proof Tracking Indexmm (in.)			
	300 V	375 V	500 V	> 600 V
1000 - 1100	26 (1.02) (1)	24 (0.94) (1)	22 (0.87) (1)	20 (0.79) (1)
< 3300	63 (2.48)	59 (2.32)	53 (2.09)	48 (1.89)
< 6600	113 (4.45)	108 (4.25)	99 (3.9)	90 (3.54)
≤ 11000 (2)	183 (7.20)	175 (6.89)	162 (6.38)	150 (5.91)

Notes:

1 A distance of 35 mm is required for busbars and other bare conductors in main switchboards
2 Creepage distances for equipment with nominal voltage above 11 kV are to be subject to consideration.

ii. *Creepage Distances.* The minimum creepage distances for equipment other than main switchboards and generators are given in the Table below:

Nominal VoltageV	Minimum Creepage Distance for Proof Tracking Indexmm (in.)			
	300 V	375 V	500 V	> 600 V
1000 - 1100	18 (0.71)	17 (0.67)	15 (0.59)	14 (0.55)
< 3300	42 (1.65)	41 (1.61)	38 (1.50)	26 (1.02)
< 6600	83 (3.27)	80 (3.15)	75 (2.95)	70 (2.76)
≤ 11000*	146 (5.75)	140 (5.51)	130 (5.11)	120 (4.72)

* *Note:* Creepage distances for equipment with nominal voltage above 11 kV are to be subject to consideration.

3.7.3 Rotating Machines

3.7.3(a) *Protection*. Refer to 4-8-5/3 TABLE 1 for ingress protection (IP) requirements. **(2019)**

3.7.3(b) *Windings*. Generator stator windings are to have all phase ends brought out for the installation of the differential protection. **(2019)**

3.7.3(c) *Temperature Detectors*. Rotating machines are to be provided with temperature detectors in their stator windings to actuate a visual and audible alarm in a normally attended position whenever the temperature exceeds the permissible limit. If embedded temperature detectors are used, means are to be provided to protect the circuit against overvoltage. **(2019)**

3.7.3(d) *Space Heater*. Effective means are to be provided to prevent the accumulation of moisture and condensation within the machines when they are idle. **(2019)**

5 Electric Propulsion Systems

5.17 Equipment Requirements

5.17.5 Rotating Machines for Propulsion

The following requirements are applicable to propulsion generators and propulsion motors.

5.17.6 Direct-current (DC) Propulsion Motors

5.17.6(a) *Rotors*. The rotors of DC propulsion motors are to be capable of withstanding overspeeding up to the limit reached in accordance with the characteristics of the overspeed protection device at its normal operational setting.

5.17.6(b) *Overspeed protection*. An overspeed protection device is to be provided to prevent excessive overspeeding of the propulsion motors due to light loads, loss of propeller, etc.