MILITARY STANDARD

DEFINITIONS OF AND BASIC REQUIREMENTS FOR ENCLOSURES FOR ELECTRIC AND ELECTRONIC EQUIPMENT

TO THE HOLDERS OF MIL-STD-108E:

1. THE FOLLOWING PAGES OF THIS STANDARD HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
1	19 September 1985	1	4 August 1966
1a	19 September 1985	1	4 August 1966
2	19 September 1985	2	REPRINTED WITHOUT CHANGE
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10	19 September 1985	10	4 August 1966
10a	19 September 1985	10	4 August 1966
11	19 September 1985	11	4 August 1966
12	19 September 1985	12	4 August 1966

2. RETAIN THIS NOTICE PAGE AND INSERT BEFORE THE TABLE OF CONTENTS.

3. Holders of MIL-STD-108 will verify that page changes and additions indicated above has been entered. This notice page will be retained as a check sheet. This issuance, together with the appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or canceled.

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(Project ENVR-0018)

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DEFINITIONS OF AND BASIC REQUIREMENTS FOR ENCLOSURES FOR ELECTRIC AND ELECTRONIC EQUIPMENT

1. SCOPE

1.1 Scope. This standard establishes definitions and basic requirements for enclosures for environmental protection of electrical and electronic equipment. The use of these definitions for parts intended for mounting in enclosures is also described (see 6.1).

2. REFERENCED DOCUMENTS

2.1 The issues of the following documents in effect on the date of invitation for bids form a part of this standard to the extent specified herein:

SPECIFICATIONS

MILITARY
MIL-E-2036 - Enclosures for Electric and Electronic Equipment, Naval Shipboard.

STANDARDS

MILITARY
MIL-STD-810 - Environmental Test Methods.

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE
International Electrotechnical Commission Publication 144

(Application for copies should be addressed to American National Standards Institute, 1430 Broadway, New York, NY 10018.)

NATIONAL FIRE PROTECTION ASSOCIATION
National Electric Code

(Application for copies should be addressed to the National Fire Protection Association, Battery-march Park, Quincy, MA 02269.)

3. REQUIREMENTS

3.1 Definitions, basic requirements and tests. Degrees of enclosures for environmental protection of electrical and electronic equipment are defined in Table I. The basic design requirements and tests applicable to a particular degree of enclosure shall be as specified in Table I. Enclosures are defined by either of two general methods which are consistent with industry practice:

Supersedes page 1 of 4 August 1966.

(a) Enclosures defined solely in terms of protection provided by the enclosure itself; the function of the enclosure being to exclude the undesirable or harmful element. All degrees of enclosure having the suffix "tight" fall in this category.

(b) Enclosures defined in terms of specified environmental conditions under which the enclosed equipment (equipment with its enclosure) will operate satisfactorily. The ability of such enclosed equipment to perform under the specified conditions is not necessarily wholly dependent on the

Supersedes page 1 of 4 August 1966.

enclosure itself, but may also depend upon the characteristics of the equipment. All degrees of enclosure having the suffix "proof" fall in this category.

3.2 Supplementary enclosure identification by cooling method. The degrees of enclosure listed in Table I are commonly used without supplementary identification, but it is also a frequent practice to further identify enclosed equipment by the method of cooling. Standard terms used for this purpose are listed below. When these terms are used with reference to enclosures, they should be in combination with and following the degree of environmental protection (example: totally enclosed, fan-cooled).

(a) Air-to-air cooled. Equipment is cooled by circulating the internal air through a heat exchanger which, in turn, is cooled by circulating external air. An air-to-air heat exchanger, a fan or fans for circulation of internal air and a fan for circulation of external air are provided.

(b) Fan-cooled (used for rotating equipment only). Equipment is cooled by air flow over the enclosed machine. Air flow is produced by a fan or fans attached to the equipment shaft. Protective covers are provided for fans (see 3.4).

(c) Ventilated. Equipment is cooled by air passing through the enclosure. Specific terms used to describe ventilated equipment are:

(1) Natural-convection ventilated. Air circulation through the enclosure by natural convection.

(2) Self-ventilated (generally used for rotating machines such as motors and generators). Air is circulated through the enclosure by a means integral with the equipment.

(3) Forced-air-ventilated, Forced-draft-ventilated. (Generally used for other than rotating equipment) Air is circulated through the enclosure by a fan or blower located within the enclosure.

(4) Separately ventilated. Equipment is intended for cooling by separately supplied forced air from a source other than the atmosphere surrounding the enclosure. Enclosure is provided with inlet and outlet air duct connections.

(d) Non-ventilated (generally used for rotating equipment such as motors and generators). Enclosure has no ventilation openings or provisions for air flow other than natural air convection over the enclosed equipment. Rotating equipment may be provided with an internal fan (or fans) attached to the shaft to recirculate air within the enclosure.

(e) Water-cooled. Equipment is cooled by circulating water, the water or water conductors coming in direct contact with parts to be cooled.

(f) Water-air-cooled. Equipment is cooled by circulating air which, in turn, is cooled by circulating water. A water-cooled heat exchanger and a fan or fans for circulating the air are provided.

TABLE II. Water repellent tests using hose. - Continued

Enclosure	Rate of water flow (gal/min)	Form of water flow	Nozzle type	Water head (feet)	Approx. distance from nozzle to enclosure (feet)	Time of test (min)	Test details 2/ 3/
		(large drops)					test. Water stream shall be directed at all exposed enclosure surfaces and at surface at which enclosed equipment is mounted.
Spray-tight	65	solid stream	solid stream nozzle, 1 inch diameter tip opening	as required	10	5	Rotating equipment (motors, generators, etc.) shall be operating during the first 1/3 of the test, at standstill during the second 1/3 of the test and operating during the final 1/3 of the test.
							Non-rotating equipment need not be operated during the test unless movable parts such as switches and solenoids penetrate the enclosure. Where movable parts penetrate the enclosure, each movable part shall be operated at least 3 times during the test.
Water-tight (water repellent test optional see 4.13)						60	Water stream shall be directed at all surfaces of enclosed equipment. Enclosed equipment shall be inclined for part of the test if necessary to expose surfaces such as the underside which would not otherwise be accessible to the water stream.

See footnotes at top of next page.

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1/ Water heat - If the test stream is directed vertically (straight upward) for determination of adequate head, the stream shall rise to a height of not less than 10 feet.

2/ In testing spraytight and watertight equipment, caution shall be observed during the tests and subsequent inspection to avoid conditions that might produce condensation that could be confused with leakage.

3/ Test conditions:

a. Type of water - either fresh or salt.
b. Ambient (air) temperature - between 40°F and 100°F.
c. Water temperature - not to exceed air temperature.

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TABLE III. Submergence tests.

Enclosure	Submergence depth[1/] (feet) or equivalent pressure (psi)	Time of test (minimum)	Test details[3/4/5/]
Spraytight (submergence test optional see 4.10)	covered	5 minutes	Rotating equipment (motors, generators, etc.) shall be operating during the first 1/3 of the test, at standstill during the second 1/3 of the test and operating during the final 1/3 of the test.
Watertight	3 feet (1.3 psi)	1 hour	Non-rotating equipment need not be operated during the test unless movable parts such as switches and solenoids penetrate the enclosure. Where movable parts penetrate the enclosure, each movable part shall be operated at least 3 times during the test.
Submersible (15 ft.) Open-submersible (15 ft.)	15 feet (6.5 psi)	24 hours	Equipment shall be operating during the first 1/3 of the test, at standstill during the second 1/3 of the test and operating during the final 1/3 of the test.
Submersible (50 ft.) Open-submersible (50 ft.)	50 feet (21.7 psi)		
Submersible (1600 ft.) Open-submersible (1600 ft.)	1600 feet (694 psi)		

1/ For convenience in conducting tests on watertight, submersible and open-submersible enclosed equipment, external pressure, internal vacuum or combination thereof may be employed to create a pressure difference equivalent to the submergence depth or pressure specified. In such cases, the enclosed equipment shall be covered with a minimum of 3 inches of water.

2/ The 24 hour submergence test shall be considered as a design test for proving the ability of a particular equipment design to operate satisfactorily under the specified conditions. For production (quality assurance) testing, once the design has been proven, the minimum time of test shall be 1 hour.

3/ Tests may be conducted in either fresh water or salt water, except that for tests of open-submersible equipment, the water shall be that in which the equipment is designed to operate. Water temperature shall be (73 ± 18°F).

4/ Before conducting tests, doors and covers on enclosures shall be removed and replaced 3 times.

5/ Caution shall be observed during tests and subsequent inspection to avoid conditions that might produce condensation which could be confused with leakage.

Supersedes page 10 of 4 August 1966.

4.12 Totally enclosed. Enclosure shall be visually examined for absence of openings. Joints need not be sealed or provided with gaskets; however joined parts shall fit as tightly as expected with good manufacturing practice and workmanship.

4.13 Watertight. Testing shall be in accordance with Table III, except that at the option of the contractor, the water repellent test of Table II may be substituted in the following cases, unless submergence testing

Supersedes page 10 of 4 August 1966.

is specifically required by equipment specification or the contract or order.

(a) For convenience in testing equipment having one or more dimensions (length, width or height) exceeding 5 feet.
(b) For testing motors, generators and similar rotating equipment (note: Fans of fan-cooled watertight motors must be removed if submergence testing is used.)

Entry of water during test by either method shall be cause for rejection except that for rotating equipment, water leakage of less than 0.25 cubic inch per inch of shaft diameter into any bearing housing is permissible.

5. NOTES

5.1 Use of definitions for parts. The definitions of this standard may be applied to parts (example: fuseholders) designed for mounting in, and projecting through, an equipment enclosure wall or panel. A part so defined is intended for use in a similarly defined enclosure (example: a watertight fuseholder in a watertight enclosure) and when properly installed shall prevent the entry of the undesirable or harmful environmental element into the enclosure and the enclosed portions of the part.

5.1.1 Testing of parts. Testing of parts shall be conducted to the extent required by the parts specification. Where parts specifications do not cover test conditions and procedures, the test conditions and procedures of this standard apply to the part when mounted in a test enclosure that, except for the openings for part mounting, is known to prevent the entry of the undesirable or harmful environmental element (water, dust, etc.). In the case of dripproof parts, the following accelerated test shall apply instead of the drip test described in 4.3(b):

Drip source: Sprinkler discharging water vertically downward at a minimum rate of 2 gallons per minute.
Sprinkling pattern: Circular pattern not more than 12 inches in diameter, 3 feet below sprinkler.
Sprinkling distribution: Approximately uniform.
Distance from sprinkler to part: 3 feet below.
Orientation of part: Mounting surface inclined 15 degrees from vertical maximum exposure of part at that angle.
Total test time: 5 minutes

6. INTERNATIONAL

6.1 International standardization agreement. Certain provisions of this standard are the subject of international standardization agreement ABCA-NAVY-STD-21A. When amendment, revision, or cancellation of this standard is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

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