

E3. Marine-type products - additional routine / special test recommendations

Standard Approach

For marine products, the electrical part of the product is tested according to its own main standard: the IEC/EN 60076 series for transformers, IEC/EN 61558 for small LV products, IEC/EN 60076-6 for reactors, and IEC/EN 61439 if a panel/enclosure is present. On the marine side, the IEC 60092 series should be considered. IEC 60092-101 covers general definitions and requirements for electrical installations in ships; IEC 60092-303 applies to transformers up to 36 kV used on ships and offshore units, and its 2023 edition updated topics such as environmental conditions, harmonic load currents, special-application transformers, and essential services.

1. Additional Routine / Special Test Recommendations

1	Salt mist test	
	Main standard	IEC 60068-2-52; ISO 9227 may be used as an alternative/project-based reference
	Construction / method standard	IEC 60068-2-52 Test Kb - cyclic salt mist
	For marine product	In marine and coastal environments, metal parts, fasteners, paint systems, terminal areas, and galvanized/stainless parts are exposed to a salty atmosphere. IEC 60068-2-52 describes the cyclic salt mist test for components/equipment expected to withstand salt-laden atmospheres.
2	Humidity test / moisture resistance	
	Main standard	IEC 60068 series; IEC 60092 / IEC 60076 / IEC 61558 as product standards
	Construction / method standard	IEC 60068-2-30 or IEC 60068-2-78
	For marine product	In marine environments, condensation, high relative humidity, and salt contamination may reduce insulation resistance. After the test, insulation resistance and, if necessary, dielectric withstand should be measured again. The OMSAN technical glossary notes that insulation resistance may decrease due to humidity, contamination, and aging.
3	Vibration test	
	Main standard	IEC 60068-2-6; IACS UR E10 / classification society specification for ship type approval
	Construction / method standard	IEC 60068-2-6 Test Fc - sinusoidal vibration
	For marine product	On board ships, winding, core, connection bars, terminals, and mechanical fixing should be checked due to machine, generator, pump, and hull vibration. IEC 60068-2-6 provides the standard method for evaluating a specimen against specified sinusoidal vibration levels.
4	IP test	
	Main standard	IEC 60529; IEC 61439 as a supporting reference for panels/enclosures
	Construction / method standard	IEC 60529 IP code test
	For marine product	For enclosed products, it is applied if IP23, IP44, IP54, IP55, or similar ratings are declared. IEC 60529 classifies the degree of protection provided by enclosures against dust, water, and access to hazardous parts using the IP code.

5	Corrosion protection system check	
	Main standard	ISO 12944 series; especially ISO 12944-9 may be considered for offshore/marine atmosphere
	Construction / method standard	Paint system document check, surface preparation, layer structure, C5/CX environmental class assessment
	For marine product	For marine products, checking only whether paint exists is not sufficient. The paint system should be filed together with the environment class, primer/intermediate/top coat, dry film thickness, and corrosion resistance target. ISO 12944 is the main standard family used for corrosion protection of steel structures by protective paint systems.
6	Paint thickness check	
	Main standard	ISO 2808; ISO 19840 as a supporting reference on rough steel surfaces
	Construction / method standard	Dry film thickness measurement, paint layer and acceptance criteria check
	For marine product	Dry film thickness should be checked on every surface and especially at edges, corners, and weld areas. ISO 2808 defines methods for measuring coating film thickness and includes methods for wet film, dry film, and uncured powder layer thickness.
7	Stainless fastener check	
	Main standard	Customer/classification specification; EN ISO 3506 may be used as a supporting reference for material
	Construction / method standard	Material certificate, grade check, visual check, magnet/markings check
	For marine product	Bolts, nuts, washers, terminal screws, and cover fasteners used outdoors or in salty atmospheres should be stainless or suitably coated. A2/A4 grade, galvanic corrosion risk, and contact between dissimilar metals should also be checked.
8	Insulation resistance - repeat measurement after humidity conditioning	
	Main standard	IEC 60092 product approach; IEC 60076 / IEC 61558 / IEC 60076-6; IEC 61557-2 as supporting reference for measurement
	Construction / method standard	Comparison of insulation resistance before/after humidity conditioning
	For marine product	This test is very valuable for marine products. Even if the initial insulation result is good, the decrease after humidity provides information about varnish/resin penetration, cable entries, and terminal insulation quality.
9	Dielectric withstand - repeat after environmental test	
	Main standard	IEC 60076-3, IEC 61558-1, or IEC 60076-6 according to the product
	Construction / method standard	Hipot or relevant dielectric test after salt/humidity conditioning
	For marine product	If required by the classification society or customer, the dielectric test is repeated after humidity/salt conditioning. The purpose is to show that the main insulation remains safe after environmental aging.
10	Noise check	
	Main standard	IEC 60076-10; classification/customer specification
	Construction / method standard	Sound pressure or sound intensity method
	For marine product	In enclosed technical spaces on ships, hum and mechanical vibration may indicate disturbance or loose connections. The OMSAN technical glossary states that transformer noise originates from core magnetostriction and structural vibrations.

11	Mechanical tightness and transport strength check	
	Main standard	IEC 60068-2-6; product standard; customer/classification specification
	Construction / method standard	Visual inspection, torque check, lifting lug and mounting foot check
	For marine product	Marine products should be verified more strictly from a mechanical perspective due to transport, ship vibration, and service conditions. The OMSAN glossary defines mechanical strength as the ability of windings and clamping elements to maintain their geometry under vibration, short-circuit forces, and transport loads.
12	Cable gland / gland / terminal box check	
	Main standard	IEC 60529; IEC 60092 series; classification specification
	Construction / method standard	IP, material, tightness, cable entry direction, and sealing check
	For marine product	In marine enclosures, cable entries are the most common points of IP loss. Gland material, gasket, drainage, cable diameter compatibility, and terminal box cover gasket should be checked.
13	Grounding / bonding continuity	
	Main standard	IEC 60092 series; IEC 61439; IEC 60204-1 as supporting reference
	Construction / method standard	Low-resistance continuity measurement
	For marine product	Body, cover, mounting chassis, terminal box, shield connection, and PE/bonding points should be checked separately. In marine environments, it is important that bonding lugs are not left under painted surfaces.
14	Classification society test plan	
	Main standard	IACS UR E10; BV / DNV / ABS / LR / Türk Loydu rules
	Construction / method standard	Type approval test plan, witness test, document review, environmental and EMC test matrix
	For marine product	For ship-class projects, the test plan should be prepared from the beginning according to the classification society. IACS UR E10 is the type approval test specification for electrical/electronic/programmable equipment used for control, monitoring, alarm, and protection systems on ships and was published as current Rev.10 in August 2024.
15	EMC test - if electronic control is present	
	Main standard	IACS UR E10; IEC 61000 series; IEC 60092-504 as supporting reference
	Construction / method standard	ESD, EFT/burst, surge, conducted/radiated emission, and immunity tests
	For marine product	If the marine product is only a passive transformer/reactor, EMC is usually limited; however, if fan control, temperature monitoring, active filter, SVG, static regulator, or communication is present, an EMC test plan should be added.
16	Temperature rise / high ambient temperature check	
	Main standard	IEC 60076-11, IEC 61558, IEC 60076-6 depending on the product; IEC 60092 / classification specification for ship conditions
	Construction / method standard	Steady-state temperature measurement at nominal load or under customer environmental conditions
	For marine product	Ambient temperature may be high in ship engine rooms and enclosed spaces. The OMSAN technical glossary states that the hot spot is the critical area determining insulation life.

2. Lines Recommended to Add to the Test Report

Report line	Recommended content
Application type	Marine-type transformer / reactor / filter / regulator / panel
Main product standard	IEC 60076, IEC 61558, IEC 60076-6 or IEC 61439
Marine reference	IEC 60092 series, classification society specification, IACS UR E10 if applicable
Salt mist	IEC 60068-2-52, test severity/duration, specimen condition, corrosion observation
Humidity test	IEC 60068-2-30 or IEC 60068-2-78, insulation result after test
Vibration	IEC 60068-2-6 or classification profile, axes, frequency range, result
IP	IEC 60529, target IP class, cable entries and terminal box result
Paint system	ISO 12944 environment class, primer/intermediate/top coat, color, DFT target
Paint thickness	ISO 2808 or ISO 19840, measured dry film thickness
Fasteners	Stainless/coated material grade, certificate and visual check
Bonding / PE	Continuity of body, cover, terminal box, shield, and mounting chassis
Electrical test after environmental test	Insulation resistance, dielectric withstand, function check
Classification file	BV, DNV, ABS, LR, Türk Loydu etc. test plan, witness, certificate no.