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Small craft — Electrical/electronic control systems for steering, shift and throttle

Petits navires — Systèmes électriques/électroniques pour le contrôle de la direction, de l'inverseur et des gaz

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 188, *Small craft.*

This second edition cancels and replaces the first edition (ISO 25197:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the terms and definitions have been revised to give coherency with other standard definitions; new terms, such as input device and output device, have been introduced;

— the figures have been revised to clarify the concepts illustrated;

— 7.2, on portable helms, has been revised to make it coherent when an electric propulsion motor is used;

— 9.1 has been revised to include the fail-safe mode and the alarm policy;

— the main change is in 10.1: the request to use three different samples for all tests (except for EMC test) has been deleted because it would have involved a great expense without having significant improvement; only one sample is used for all tests described on the subsequent subclauses;

— the durability test on joystick described in 10.4 has been made an operational test;

— Table 1 in 10.5.1 has been updated introducing the column “immersion” to handle test on immerged components;

— in 10.5.2, all ways to conduct the salt mist test, based on different standards, have been homogenized;

— in 10.7, the shock test has been revised;

— in 10.8, the free fall test has become the drop test with the addiction of the UV test;

— the UV test, described in 10.9, has been clarified;

— in 10.10, there are many changes due to the revision of IEC 60533 and the forthcoming release of IEC 62742; to avoid any direct link to those standards, all tests previously required by IEC 60533 have been embedded and all standards cited have been added to the normative reference list.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Small craft — Electrical/electronic control systems for steering, shift and throttle

1 Scope

This document establishes the requirements for the design, construction and testing of electrical/electronic steering, shift and throttle systems and dynamic positioning control systems, or combinations thereof, on small craft of up to 24 m length of hull.

This document does not apply to electric trolling motors and autopilot systems on sailing craft.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4892-1:2016, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-3:2016, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 4892-4:2013, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ISO 8846:1990, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases*

ISO 8848:1990, *Small craft — Remote steering systems*

ISO 10133:2012, *Small craft — Electrical systems — Extra-low-voltage d.c. installations*

ISO 10240:2004/Amd1:2015, *Small craft — Owner's manual*

ISO 10592:1994, *Small craft — Hydraulic steering systems*

ISO 11591:2019, *Small craft — Field of vision from the steering position*

ISO 13297:2014, *Small craft — Electrical systems — Alternating current installations*

ISO 16750-2:2012, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

ISO 16750-3:2012, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

ISO 16750-4:2010, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

ASTM B117:2016, *Practice for operating salt spray (fog) apparatus*

IEC 60068-2-27:2008, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60068-2-52:2017, *Environmental testing — Part 2-52: Tests — Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60092-507:2014, *Electrical installations in ships — Part 507: Small vessels*

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 2: Electrostatic discharge immunity test — Basic EMC publication*

IEC 61000-4-3:2006+Amd1:2007+Amd2:2010, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 3: Radiated, radio frequency, electromagnetic field immunity test*

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 4: Electrical fast transient/burst immunity test — Basic EMC publication*

IEC 61000-4-5:2014+Amd1:2017, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 5: Surge immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11:2004+Amd1:2017, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 11: Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-16:2015, *Electromagnetic compatibility (EMC) — Part 4: Testing and measurement techniques — Section 16: Test for immunity to conducted, common mode disturbance in the frequency range 0 Hz to 150 KHz*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
electrical steering system
electronic steering system
all components, including CPU (central processing unit) and cable harnesses, from the manual steering *input device* (3.11) up to and including the device [*actuator* (3.22) or electrical motor] regulating the rudder or propulsion unit steering angle

Note 1 to entry: It includes the *joystick* (3.15) and components, i.e. GPS antennas for dynamic positioning, if installed.

3.2
dynamic-positioning system
computer-controlled system to automatically maintain a craft's position and heading by using the craft's own propulsion systems with or without the assistance of bow or stern thrusters

3.3
electrical shift and throttle system
electronic shift and throttle system
all components, including CPU (central processing unit) and cable harnesses, from the shift and throttle *input device* (3.11) up to and including the device controlling the shift and speed of engines

3.4
ignition-protected equipment
electrical equipment designed and tested for use in explosive atmospheres without igniting surrounding flammable gases

3.5
nominal voltage
commonly used voltage, such as 12 V, 24 V, or 36 V DC

3.6
manoeuvring mode
reduced power mode for manoeuvring, determined by the manufacturer of the steering/control systems

3.7
cruising mode
power mode above *manoeuvring mode* (3.6) up to full power, determined by the manufacturer

3.8
X axis
direction of a craft fore or aft, longitudinally

3.9
Y axis
direction of a craft port or starboard, transversely

3.10
Z axis
axis perpendicular to the X-Y plane

3.11
input device
device that transmits commands to a system

3.12
output device
device that operates from commands coming from an *input device(s)* (3.11)

EXAMPLE Electromechanical or electrohydraulic *actuator* (3.22).

3.13
control head
operator *input device* (3.11), other than a steering wheel, for the simultaneous control of steering and *propulsion* (3.20)

EXAMPLE *Joystick* (3.15), track-ball or slide levers.

3.14
control lever
operator *input device* (3.11) for the control of *thrust* (3.23) and/or *propulsion* (3.20)

3.15
joystick
operator *input device* (3.11) for the simultaneous control of *thrust* (3.23), steering and *propulsion* (3.20)

3.16
helm station
location from which steering, *propulsion* (3.20) and *thrust* (3.23) can be controlled

3.17
multiple helm stations
more than one location in the boat from which steering, *propulsion* (3.20) and *thrust* (3.23) can be controlled

3.18
command station
helm station (3.16) location that is in active control

3.19
portable helm
helm providing a combination of shift or throttle or steering, not permanently affixed to the craft's structure, communicating with the system through wired or *wireless* (3.24) means

3.20
propulsion
component or components of *thrust* (3.23) that permit a craft's movement in any direction

Note 1 to entry: Examples of propulsion-generating devices include outboards, stern drives, pod drives, jet drives, inboards and thrusters.

3.21
radio-frequency
RF
frequency within the range of frequencies suitable for utilization in radio communication

3.22
actuator
electromechanical, electropneumatic and/or electrohydraulic device that converts an electrical signal into a mechanical displacement

3.23
thrust
propulsive force from craft's propulsion system, including bow or stern thrusters or a combination thereof in order to move or rotate the craft

3.24
wireless
mode of communication, monitoring and/or control through the use of electromagnetic, acoustic or optical transmission through atmospheric space

3.25
damp area
area where moisture is either permanently or intermittently present

EXAMPLE Bilge, head, galley.

3.26
wet area
area exposed to weather

3.27
interior
protected area inside the craft

3.28
immersion
area totally or partially under water

3.29
EUT
equipment under test
representative system, or part of it, used on tests

3.30
performance criterion
standard by which the functional status of an *EUT* (3.29) during and after testing is judged

3.31
failure modes and effects analysis
FMEA
procedure in product development and operations development for analysis of potential failure modes

3.32
fail-safe mode
device or feature which, in the event of failure, responds in a way that causes no harm, or minimizes the harm, to other devices, and causes no danger, or minimizes the danger, to personnel

3.33
trolling motor
electric propulsion unit that produces less than 500 N *thrust* (3.23), that includes an electric motor, propeller and controls

3.34
autopilot system
system used to control the craft without constant hands on control by a human operator

4 General requirements

4.1 All electrical/electronic components shall be designed to withstand a reversed polarity connection of the power leads. This shall not render the component inoperable when subsequently connected to the power correctly.

NOTE Replacement of an external fuse, after reverse connection of power supply, is acceptable.

4.2 All electrical/electronic components shall be designed with reverse polarity protection from internal surges.

4.3 DC systems shall comply with ISO 10133:2012. AC systems shall comply with ISO 13297:2014. An acceptable alternative to ISO 10133:2012 and ISO 13297:2014 is given in IEC 60092-507:2014.

4.4 The system shall be energized whenever the propulsion engine(s) are running.

4.5 The system, except for dynamic positioning and displays, shall be fully operational within 5 s after being turned on (powered).

4.6 In multi-installed engine control systems, the craft manoeuvrability shall be possible in presence of a control system fault. System performance may be at a reduced speed.

4.7 Each helm station shall give a visual indication when active. A main steering position shall be designated and meet the applicable requirements of ISO 11591:2019, with the location included in the owner's manual.

4.8 Each helm station shall, by visible and/or audible means, alert the operator when the system enters the fail-safe mode.

4.9 The A-weighted sound pressure level of an audible alarm 1 m from the command station shall be at least 75 dB, but not greater than 85 dB. Systems incorporating a mute feature shall maintain the visual alert as long as the failure persists.

If an audible-only alert system is utilized, muting of the alarm is not allowed.

4.10 Instructions for proper installation and use of the steering system shall be made available by the manufacturer.

4.11 Operational characteristics, instructions and warnings for proper use shall be described in the owner's manual and/or by on-product labelling.

4.12 With the exception of an optional temporary override for emergency situations, it shall only be possible to start propulsion equipment in neutral.

NOTE This includes any equipment that drives the propeller or water-jet drive.

4.13 The steering, shift and throttle actuators shall react/adjust input on a physical input command within 0,5 s.

4.14 Steering wheels shall comply with the requirements of ISO 8848:1990.

4.15 Hydraulic systems shall comply with the requirements of ISO 10592:1994.

4.16 Electrical components intended to be installed in petrol engine or petrol tank compartments shall be ignition-protected in accordance with ISO 8846:1990.

4.17 A risk identification/analysis, using an established method, shall be carried out for each system design.

EXAMPLES Failure modes and effects analysis (FMEA), fault-tree analysis (FTA).

Risk identification and functional safety may be carried out as given in the relevant part of IEC 61508:2010.

4.18 Systems that provide both cruising and manoeuvring modes shall provide an indication to the operator at the command station of which mode the system is in, and shall not change modes without input from the operator.

5 Control head

5.1 Control head operation is permitted for both cruising-mode and manoeuvring-mode operation.

5.2 In manoeuvring mode, the control head position shall return to the neutral X, Y and Z axis when the operator's grip is released. See Figure 1. A visual indication when propulsion system is in neutral position shall be provided at the active helm station.

