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Ships and marine technology — Marine wind vane and anemometers

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10596 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

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Ships and marine technology — Marine wind vane and anemometers

1 Scope

This International Standard specifies the type, structure, function, performance and testing method of marine wind vane and anemometers (hereafter referred to as “wind vane/anemometer”) to be installed on a ship for measurement and indication of wind direction and velocity at sea for the purpose of navigation, as recommended by Regulation 5 of Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended.

It does not apply to wind vanes and anemometers used for the purposes of meteorological or scientific measurement and observation.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

IEC 61162-1, *Maritime navigation and radiocommunication equipment and systems — Digital interfaces — Part 1: Single talker and multiple listeners*

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3 Terms and definitions

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

3.1
distance constant
distance the air flows past a rotating anemometer during the time it takes the propeller to reach (1–1/e) or 63% of the equilibrium speed after a step increase change in air speed

3.2
index error
amount by which a wind vane/anemometer exceeds or falls short of the true value

3.3
operating temperature range
range of airflow temperatures in which wind speed can be measured within the accuracy specified in this International Standard

3.4
wind direction
direction from which the wind is blowing

3.5
wind speed
magnitude of straight-line moving distance of airflow per unit time

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3.6
wind speed measurement range
range of measurable wind speed within the accuracy specified in this International Standard

4 Type

The types of wind vanes and anemometers shall be classified as follows in accordance with methods of measuring wind direction and wind speed.

4.1 Using wind force on a rotor

4.1.1 Windmill wind vane/anemometer

A rotation anemometer whose axis of rotation is horizontal. The instrument has either flat vanes or helicoidal vanes.

4.1.2 Cup anemometer with wind vane

A rotation anemometer whose axis of rotation is vertical. Cup anemometers with wind vane usually consist of three or four hemispherical or conical cups mounted with their diametrical planes vertical and distributed symmetrically about the axis of rotation.

A wind vane consists basically of an asymmetrically-shaped object mounted at its centre of gravity about a vertical axis.

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4.2 Using ultrasonic waves

An anemometer which measures ultrasonic wave propagation in the air.

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5 Composition

A wind vane/anemometer is composed of the wind vane/anemometer sensor (hereafter simply referred to as “sensor”), display, etc. The sensor shall have measurement functions for wind direction and velocity, and the display shall be capable of indicating the measured wind direction and velocity.

6 Functionality

A wind vane/anemometer shall have the following functions.

6.1 The sensor shall have measurement functions for wind direction and velocity, whose range and accuracy are specified in 7.1 and 7.2 respectively, and the display shall be capable of indicating the measured wind direction and velocity.

6.2 The wind vane/anemometer shall be capable of outputting analogue or digital signals, which shall be able to be distributed to the bridge and other necessary locations. Where digital signals are used, at least one of them shall satisfy IEC 61162-1.

7 Performance and accuracy

The performance and accuracy required for a wind vane/anemometer shall be as indicated below.

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7.1 Measurement range and minimum measurement unit

The measurement ranges and minimum measurement units for a wind vane/anemometer shall be as indicated in Table 1.

Table 1 — Measurement ranges and minimum measurement units for a wind vane/anemometer

	Measurement range	Minimum measurement unit
Wind speed	2 m/s to 60 m/s or more	0,5 m/s or less
Wind direction	0° to 359°	10° or less

7.2 Measurement accuracy

The measurement accuracy for a wind vane/anemometer shall satisfy the values indicated in Table 2.

Table 2 — Accuracy of wind vane/anemometer

Wind direction accuracy	Wind speed accuracy
Tolerance of index error at each measurement point shall be ± 5°	When the measurement velocity is less than 10 m/s, tolerance for index error shall be ± 0,5 m/s for each measurement. When the measurement velocity exceeds 10 m/s, tolerance for index error shall be ± 5 % for each measurement.

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7.3 **Starting wind speed** (limited to types using wind force on a rotor)

A wind vane/anemometer shall satisfy the following requirements.

a) At the minimum level of the wind speed measurement range, the wind-receiving part [propeller (impeller) or cup] of an anemometer shall start and maintain rotation from any position.

b) At the minimum level of the wind speed measurement range, the wind-receiving part (blades in windmill types, and tails in cup types) of a wind vane shall remain parallel to the airflow.

7.4 **Sampling frequency** (limited to types using ultrasonic waves)

For an ultrasonic wind vane/anemometer, the sampling frequency shall be equal to or greater than four times per second.

7.5 **Distance constant** (limited to types using wind force on a rotor)

The distance constant for a wind vane/anemometer shall be 9 m or less.

8 Tests and inspections for wind vanes/anemometers

8.1 Test for measurement accuracy

8.1.1 Wind vanes

Testing for measurement accuracy of wind vanes shall be conducted as specified in 8.1.1.1. and 8.1.1.2.

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8.1.1.1 Wind vane using wind force on a rotor

a) Set a sensor (wind vane in the case of a cup type) vertically at the centre of the horizontally placed wind direction inspection board specified in 8.5.4.

b) Align the base scale (0°) of the wind direction inspection board correctly with the mark on the sensor indicating the direction of the bow.

c) Rotate the sensor clockwise or counter-clockwise as indicated, set the value of the indicator correctly in the given direction then read the scale of the wind direction inspection board at that moment to determine the index error. The inspection points shall be at 0°, 90°, 180°, 360° (0°).

d) The value at each measurement point shall satisfy the accuracy specified in Table 2.

8.1.1.2 Ultrasonic type

a) Set a wind direction inspection board that can rotate 360° on the inspection table of a wind tunnel as specified in 8.5.2, and set the sensor on the top.

b) Align the direction of the wind tunnel wind speed axis and the mark on the sensor indicating the direction of the bow.

c) Reduce the wind speed of the wind tunnel to below 2 m/s, rotate the sensor and change the value of the indicator by 90°, take the reading on the wind direction inspection board then determine the index error. This inspection shall be conducted both clockwise and counter-clockwise.

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d) The value at each measurement point shall satisfy the accuracy specified in Table 2.

8.1.2 Anemometers

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Anemometers shall be tested as follows, using the wind tunnel specified in 8.5.2.

a) Wind velocities to be measured shall be the lower limit of the measurement range, 5 m/s, 10 m/s, and 30 m/s, and the upper limit of the measurement range. However, the wind speed of the wind tunnel does not need to reflect these figures exactly; inspections can be conducted using approximate values.

b) Indications of the wind speed of the wind tunnel and the anemometer shall be measured under stable wind speed in increments of 0,1 m/s. Tolerance below 10 m/s is $\pm 0{,}5$ m/s and above 10 m/s is $v \times 5$ %.

c) The value at each measurement point shall satisfy the accuracy specified in Table 2.

8.2 Inspection on starting wind speed (applies only to types using wind force on a rotor)

An inspection on start wind speed of a wind vane/anemometer shall be conducted as follows, at less than the lower limit of the wind speed measurement range, to confirm that the following conditions are satisfied.

8.2.1 Wind vane

a) Use a wind tunnel meeting the requirements in 8.5.2 and set the wind speed below the lower limit of the measurement range of the anemometer.

b) Hold the wind-receiving part of the wind vane at a right angle to the airflow for a period, and then release. Confirm that this part sets itself and remains stationary in parallel with the airflow. This inspection shall be conducted clockwise and counter-clockwise.

c) The wind-receiving part of the wind vane shall remain stationary in parallel with the airflow whether facing clockwise or counter-clockwise.

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8.2.2 Anemometer

a) Use a wind tunnel meeting the requirements in 8.5.2 and set the wind speed below the lower limit of the anemometer.

b) Hold the wind-receiving part of the anemometer at a given position and then release. Confirm that it resumes rotation from several initial positions.

c) The wind-receiving part of the anemometer [propeller (impeller) or cups] shall remain rotating from whichever position it starts rotation.

8.3 Distance constant inspection (limited to types using wind force on a rotor)

Distance constant inspections shall be conducted as follows, using the wind tunnel specified in 8.5.2.

a) The velocity, v, of the wind tunnel specified in 8.5.2 shall be set at approximately 10 m/s.

b) Hold the wind-receiving part of the anemometer in a stationary position and then release it. Record the elapsed time in seconds to reach 0,63 v (m/s). This is the time constant of the anemometer.

c) The distance constant can be calculated by multiplying the measured wind speed v (m/s) by the time constant S (s).

d) The calculated distance constant shall satisfy the value specified in 7.5.

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8.4 Test methods in which a wind tunnel is not used

For an anemometer certified by a public or a quasi-public body and whose wind speed as well as velocity of the windmill or wind-cup rotation are expressly verified, the wind speed test may be conducted on rotational testing equipment meeting the requirements in 8.5.3.

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As for the start wind speed and wind direction, if the relevant starting torque of the equipment has been clearly verified, measurements on the starting torque can be utilized as replacements of the above-mentioned inspection.

8.5 Test facilities

8.5.1 General

Requirements for facilities used for the test and inspection of a wind vane/anemometer are as specified in 8.5.2 to 8.5.4.

8.5.2 Wind tunnel

The wind tunnel utilized for inspection of a wind vane/anemometer shall generate sufficiently regulated airflow, enable various inspections to be conducted without affecting the sensor of the wind vane/anemometer, remain traceable to national standards, and shall be appropriately maintained.

However, the wind tunnel may include equipment that generates relative airflows in a stationary atmosphere by moving an object (e.g. running vehicles).

8.5.3 Rotary testing equipment

The equipment shall be capable of providing stable rotation to the rotating axis of an anemometer and shall allow reading of rotational velocity.

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