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Small craft — Steering gear — Cable over pulley systems

Petits navires — Appareils à gouverner — Systèmes à drosses et réas

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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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This document was prepared by Technical Committee ISO/TC 188, *Small craft*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 464, *Small craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 8847:2004), which has been technically revised.

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

- update of the scope to clarify application on small craft with and without propulsion engine(s);
- addition to the scope of small craft with outboard engines up to and including 37 kW total power;
- update of the definitions;
- update of requirements to meet state of the art.

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 — Steering gear — Cable over pulley systems

1 Scope

This document specifies the requirements for the design, installation and testing of cable over pulley steering systems on small craft with or without a propulsion engine(s), and on small craft with outboard engine(s) up to and including 37 kW total power.

It specifies the requirements for the design and testing of all components of a cable over pulley steering system, from the steering mechanism to the mechanical interface with the rudder shaft or the outboard engine. It applies to cable over pulley steering systems, whether for pedestal or bulkhead types.

This document does not address emergency means of steering the 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 2408:2017, *Steel wire ropes — Requirements*

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

accessible

capable of being reached for operation, inspection or maintenance without removal of permanent structure of the craft

3.2

cable

flexible mechanical means of transmitting tension forces from one location to another

Note 1 to entry: This cable can be metallic or non-metallic.

3.3

cable drum

circular feature of the *steering mechanism* (3.10) over which the steering *cable* (3.2) is routed to provide the required cable travel

3.4

cable over pulley steering system

steering system in which rotation of the steering wheel transmits movement to either the steering arm quadrant fastened to the rudder shaft, or to the outboard engine steering arm, by mechanical means including flexible cable over pulleys mounted to the structure of the craft

3.5

cable load

force applied to the *cable* (3.2) providing the necessary torque to move either the rudder through the rudder shaft/steering arm or the outboard engine while the craft is underway

3.6

cable-in conduit-steering system

steering system in which rotation of the steering wheel transmits movement to either the steering arm quadrant fastened to the rudder shaft, or to the outboard engine steering arm, by mechanical means including flexible *cable* (3.2) and conduits with or without use of pulleys

3.7

fairlead

ring, eye or loop that guides a *cable* (3.2) in the desired direction

Note 1 to entry: A pulley can also perform the function of a fairlead.

3.8

swivel pulley

pulley whose attachment feature is designed to allow the pulley to rotate freely about the swivel centreline

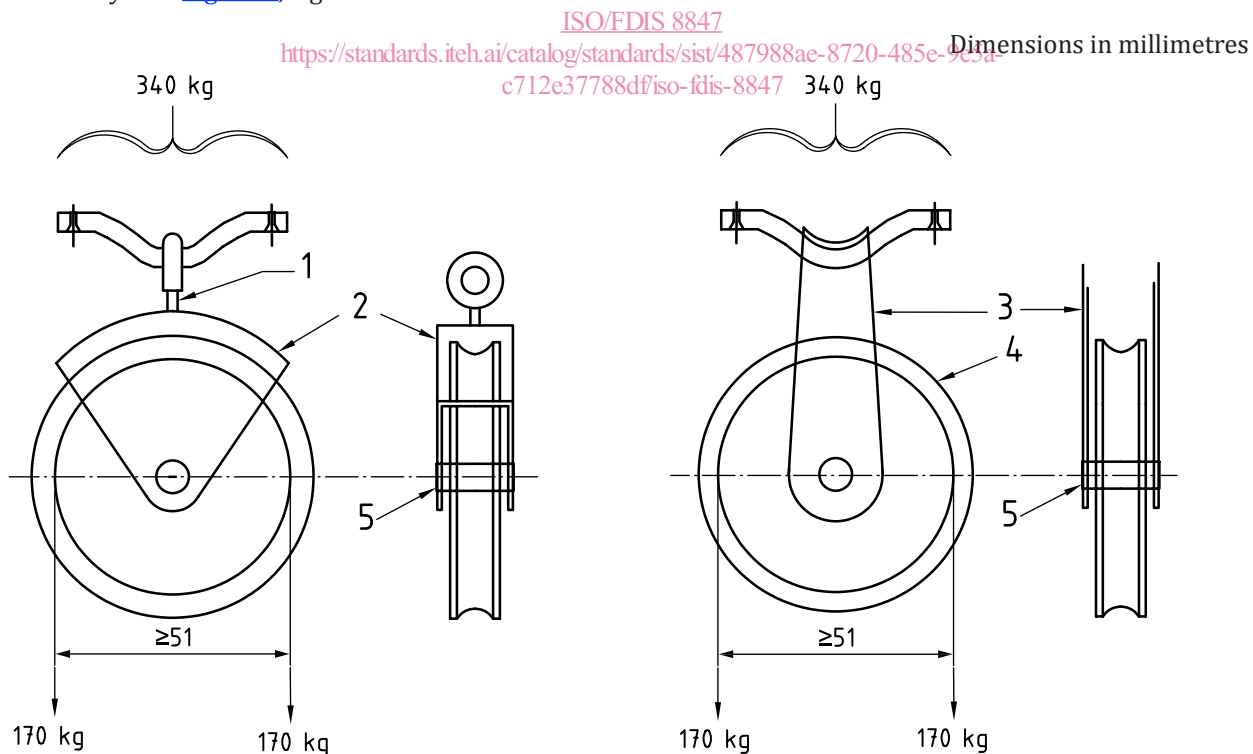
Note 1 to entry: See [Figure 1](#), left side.

3.9

fixed strap pulley

pulley whose attachment is designed for minimum, if any, rotation of the pulley assembly about the fixed strap axis

Note 1 to entry: See [Figure 1](#), right side.



Key

- 1 swivel
- 2 cheek strap
- 3 fixed strap
- 4 sheave
- 5 pulley pin

Figure 1 — Swivel and fixed strap pulleys cable over pulley systems**3.10****steering mechanism**

device to which a *control element* (3.20) is attached for manual application of a controlling force, and by which the controlling force is fed into a *steering system* (3.14)

3.11**helm station**

location from which steering, propulsion and thrust can be controlled

3.12**minimum retained system performance**

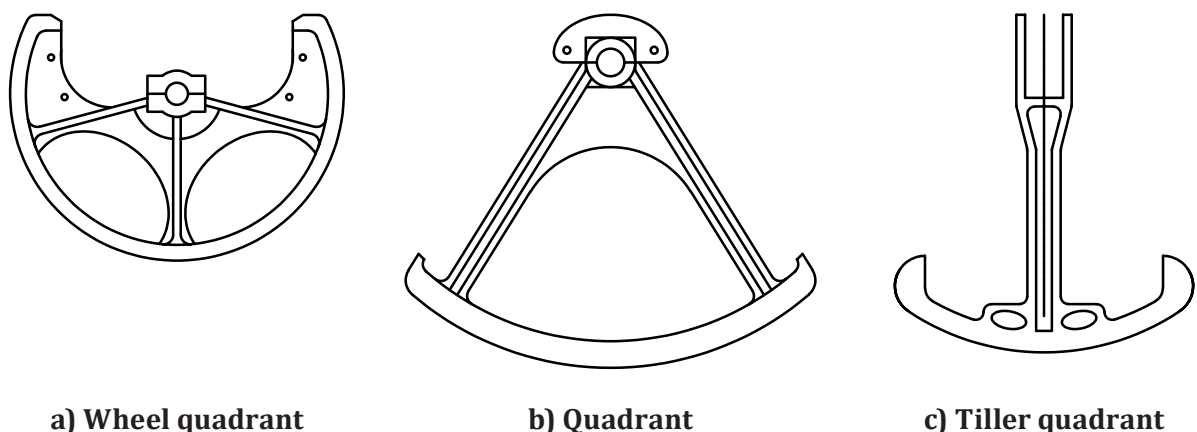
system capability after test(s) such that at least 90 % of the outboard engine steering arm travel normally available each side of the mid-position can be attained by exertion of no more than 27 Nm of torque at the helm through the *steering mechanism* (3.10), through the *control element* (3.20)

Note 1 to entry: These limits are not intended to define a condition under which a craft can or cannot be safely operated but are intended to provide quantitative limits for design and testing purposes.

3.13**steering arm**

component fixed to the rudder shaft with at least one groove for the *cable* (3.2) concentric to the shaft centre or for outboard engines, the portion of the outboard engine that the steering system makes *mechanical interface* (3.21) with

Note 1 to entry: The steering arm can be a wheel quadrant (see Figure 2a), a quadrant (see Figure 2b) or a tiller quadrant (see Figure 2c).

**Figure 2 — Examples of steering arm types****3.14****steering system**

assembly including all components necessary to transmit remote manual effort to the rudder blade steering arm quadrant or to the outboard engine steering arm

3.15

total steering loss

complete loss of the ability to steer the craft from the *helm station* (3.11) by application of manual effort to the *control element* (3.20)

3.16

steering wheel

mechanical means for applying manual steering effort to the helm, normally a circular configuration with a continuous loop at the distal end of support spokes with the *steering mechanism* (3.10) connected at the rotational axis

3.17

steering wheel diameter actual diameter

D_a

diameter of the circle formed by the outermost sections of the *steering wheel* (3.16)

Note 1 to entry: See [Figure 3](#).

3.18

steering wheel dish

distance between the two parallel planes formed by the aft rim surface and the forward hub surface of a *steering wheel* (3.16)

Note 1 to entry: see [Figure 3](#).

3.19

craft small craft

recreational boat, and other watercraft using similar equipment, of up to 24 m length of hull (L_H)

Note 1 to entry: The measurement methodology for the length of hull is defined in ISO 8666.

[SOURCE: ISO 8666:2020, 3.15, modified – Note 1 to entry has been added.]

3.20

control element

device connected to the *steering mechanism* (3.10) that allows the operator to apply manual steering effort to the *steering system* (3.14)

3.21

mechanical interface

interface where force and motion are transmitted mechanically

3.22

sailing boat

craft (3.19) for which the primary means of propulsion is by wind power, having reference sail (A_S) $\geq 0,07 (m_{LDC})^{2/3}$

[SOURCE: ISO 8666:2020, 3.11]

4 General requirements

4.1 Components of the steering system shall be fastened securely to the structure of the craft, reinforced where necessary, especially at the steering mechanism bulkhead/pedestal mounting and at pulleys.

4.2 On a sailing boat, the steering arm connection to the rudder shaft shall be capable of transmitting the required steering torque to the rudder.

NOTE Rudder requirements are addressed in ISO 12215-8.

4.3 Cable over pulley steering systems designed to meet the requirements of this document shall not be used to steer craft having outboard engine(s) in excess of 37 kW total power.

4.4 All threaded fasteners whose integrity affects safe operation of the steering system so that separation or loss of the fasteners can cause total steering loss without warning shall be provided with a locking means.

4.4.1 Threaded fasteners that can be expected to be disturbed by installation or adjustment procedures shall be referenced by instructions for correct assembly and:

- a) shall be locked by a device whose presence is determined by visual inspection or by feel following assembly, or
- b) shall incorporate an integral locking means, provided the fastener cannot be omitted or substituted without making the steering system inoperable.

NOTE Self-locking nuts with plastic inserts that create mechanical plastic interference meet the above stated requirements.

4.5 Loose lock washers, distorted thread nuts or separately applied adhesives shall not be used.

4.6 Plain threaded jam nuts may be used to permit adjustments and shall be designed so that total separation of parts or other complete loss of steering will not occur should they loosen.

4.7 Plastics and elastomers shall be designed to resist degradation from ultraviolet radiation, salt water, hydrocarbons and ozone.

4.8 Components of the steering system shall be resistant to corrosion, either by virtue of material or coating thereof, and shall be galvanically compatible with adjoining components.

4.9 Components of the steering system shall be sized to prevent derailing or jamming of the cable.

4.10 Components of the steering system shall be accessible for inspection and maintenance.

4.11 Compass interference — Materials used in the various components of the steering system as supplied shall not affect the accuracy and reliability of a compass mounted on the pedestal, if used, whatever steering angle is used.

5 Steering system requirements

5.1 Steering stops for the outboard engine shall permit at least 30° of angular movement either side of centre. Stops for the rudder blade steering arm quadrant shall be set by the sailing boat manufacturer.

5.2 When used with an outboard engine, the cable over pulley steering system attachment to the engine shall be designed so that with any combination of engine turn and tilt, there will be no damaging interference between the engine, its accessories, the steering system and the craft.

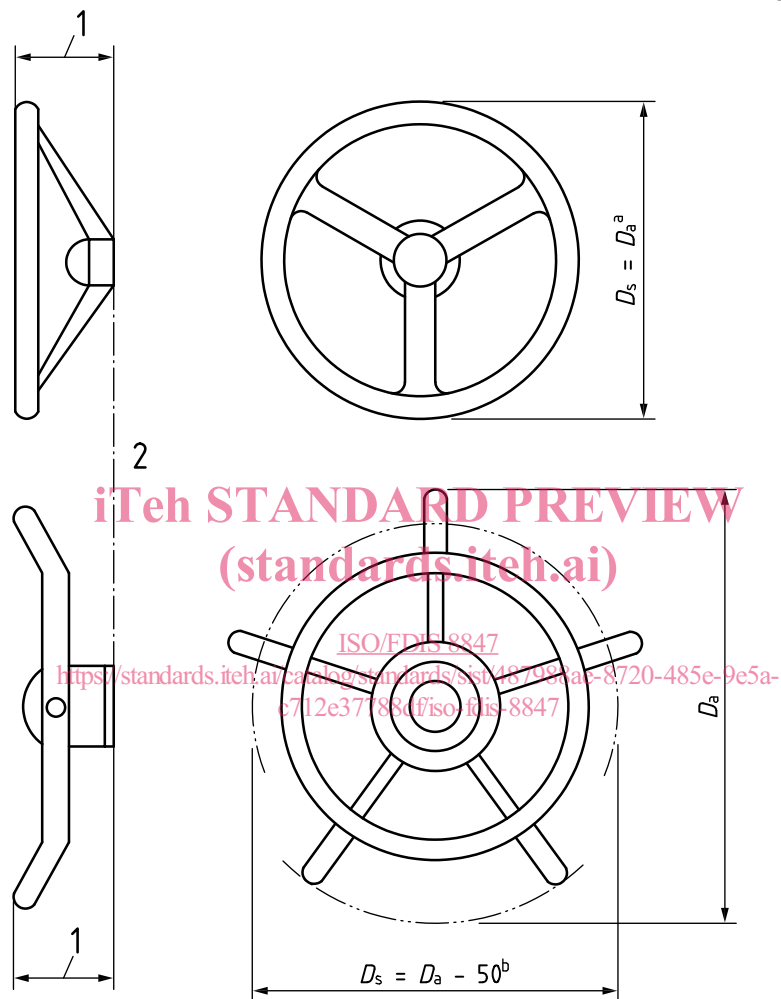
5.3 Steering wheels and helm shafts shall be selected to fit each other. See [Annex A, Figure A.1](#) a), b), c).

NOTE Steering wheel requirements are addressed in ISO 23411.

5.3.1 The largest diameter D_s and deepest dish steering wheel information shall be permanently marked by the component manufacturer on the steering mechanism so as to be visible with the steering mechanism installed, and the wheel removed. See [Figure 3](#).

5.3.2 When equipped with the largest diameter D_s and deepest dish steering wheel for which the helm is rated, all steering components shall be of sufficient strength to successfully pass the testing requirements of [Clause 7](#).

Dimensions in millimetres



Key

- 1 steering wheel dish
- 2 forward hub surface

D_a actual diameter

D_s standard diameter for the application of loads

^a For steering wheels without handgrips, $D_s = D_a$.

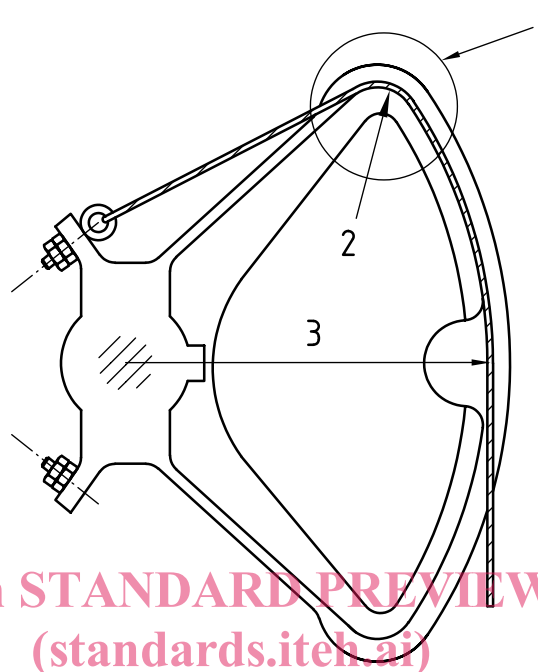
^b For external spoke steering wheels, $D_s = D_a - 50$ mm.

NOTE For non-circular steering wheels, D_s is the largest diameter that can be inscribed in the steering wheel shape.

Figure 3 — Steering wheel terms

5.4 Steering arm

The radius of the steering arm and cable diameter shall be chosen so that the cable load is less than 25 % of the cable breaking strength. The arc generated by the steering arm radius shall be concentric with the rudder shaft centre. The radius at the end of the groove where the cable is led out shall be at least 5 times the diameter of the cable used. See [Figure 4](#).



Key

- 1 end of groove
- 2 radius $\geq 5 \times$ cable diameter
- 3 steering arm radius

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Figure 4 — Steering arm terms

5.5 Cables

5.5.1 Cables used on sailing boat steering systems with or without a propulsion engine(s) shall meet the following requirements a) to e):

- a) the cables shall be of flexible construction;
- b) the wire rope characteristics shall meet the specifications given in ISO 2408:2017;
- c) the wire rope tension shall be adjustable by means of an appropriate tensioner (e.g. a rigging screw) to tension the system initially and when the craft is not in use;
- d) the cable shall be aligned with the grooves when leaving a steering arm;
- e) the cable termination shall be appropriate to transfer the cable loads.

EXAMPLE Wire rope thimble and two cable clamps; swaged terminals; splicing with thimble.

5.5.2 Cables used on steering systems of craft with outboard engine(s) shall meet the requirements of [7.1.2](#), a) and b).

5.6 Pulleys

5.6.1 Pulleys used on sailing boat steering systems with or without a propulsion engine(s) shall meet the following requirements a) to c):

- a) the pulley tread diameter and groove width shall be suitable for the cable used or recommended;

NOTE 1 The generally accepted minimum pulley tread diameter is 16 times the diameter of a 7 x 19 cable.

NOTE 2 The 7 x 19 reference refers to the braid of the cable within the wire rope. There are seven twisted stands, each made up of 19 wires.

- b) a means to secure the swivel pulley in the correct position shall be provided;
- c) the pulleys shall be fitted with a means to guide the cables into and out of the sheaves to prevent the cable from jamming between the sheave and pulley frame.

5.6.2 Pulleys used on steering systems of craft with outboard engine(s) shall meet the following requirements a) to d):

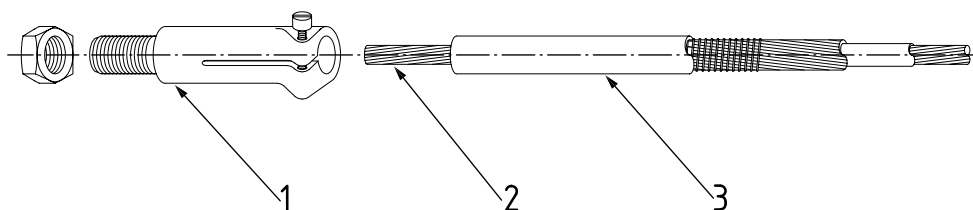
- a) the steering cable pulleys shall be located so that the cable comes off the steering cable drum at $90^\circ \pm 5^\circ$ to the steering axis at the centre of travel. Clear space shall be provided behind the dash or pedestal to route the steering cables to pulleys;
- b) the angle formed between the pulley pin axis and the axis of both cables shall be $90^\circ \pm 5^\circ$;
- c) all pulleys, mounting and cable straps shall be through bolted or may be solid riveted to withstand a minimum force of 3 340 N without permanent deformation;
- d) swivel pulleys shall not be used at the outboard engine connection or where the pulley changes the cable direction more than 135° .

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5.7 Conduit

The conduit used on sailing boat steering systems with or without a propulsion engine(s) shall meet the following requirements a) and b):

- a) the conduit shall be of sufficient flexibility to permit a minimum bend radius of 50 times the smallest diameter of cable specified for use;
- b) the conduit shall be finished at each end with a conduit fitting which provides a method of clamping the conduit securely and permitting the assembly to be locked onto a plate, pulley of terminal unit which connects the cable onto a chain assembly, intermediate sheave or steering arm; see [Figures 5](#) and [6](#).



Key

- 1 conduit fitting
2 cable
3 conduit

Figure 5 — Example of a conduit fitting