INTERNATIONAL STANDARD

ISO 23411

First edition
2020-12

Small craft — Steering wheels

Petits navires — Barres à roues

Reference number
ISO 23411:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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,* 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 first edition of ISO 23411, together with ISO 8848:2020, cancels and replaces ISO 8848:1990, ISO 9775:1990 and ISO 15652:2003, which have been technically revised.

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

— the steering wheel requirements from ISO 8848:1990, ISO 9775:1990 and ISO 15652:2003 have been consolidated into this document;

— the requirements have been updated to meet current industry practices.

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.

Introduction

Previously, steering wheels were addressed in ISO 8848:1990, ISO 9775:1990 and ISO 15652:2003. A review of the steering standards for a merge project found that updates were needed for consistency and to meet current industry practices. This document thus provides a consistent approach for the design and testing of steering wheels for small craft.

Steering wheel size and application was considered in the development of this document for small craft under foreseeable operating conditions. It is recognized that high speed craft experience additional impact loads and these are addressed in the document.

Small craft — Steering wheels

1 Scope

This document specifies design and testing requirements for steering wheels for small 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 25197:2020, *Small craft — Electrical/electronic control systems for steering, shift and throttle*

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
steering mechanism
device, to which a control element is attached for manual application of a controlling force, and by which the controlling force is fed into a steering system

3.2
minimum retained system performance
system performance after testing, such that at least 90 % of the engine steering arm travel normally available to each side of the mid-position is obtained by exertion of no more than 27 Nm of torque at the *steering mechanism* (3.1) through the wheel or other normal control

Note 1 to entry: This criterion does not define the steering system performance while the craft is underway, but is rather intended to provide qualitative limits for design and test purposes.

3.3
steering wheel diameter
actual diameter
D_a
diameter of the circle formed by the outermost sections of the steering wheel

Note 1 to entry: See Figure 1.

3.4
steering wheel dish
distance between the two parallel planes formed by the aft rim surface and the forward hub surface of a steering wheel

Note 1 to entry: See Figure 1.

3.5
pinch point
location at which a moving part comes into contact with, or in close proximity to, another part, so that another object at that location would be cut or crushed

3.6
craft
small craft
recreational boat, and other watercraft using similar equipment, of up to 24 m length of hull (L_H)

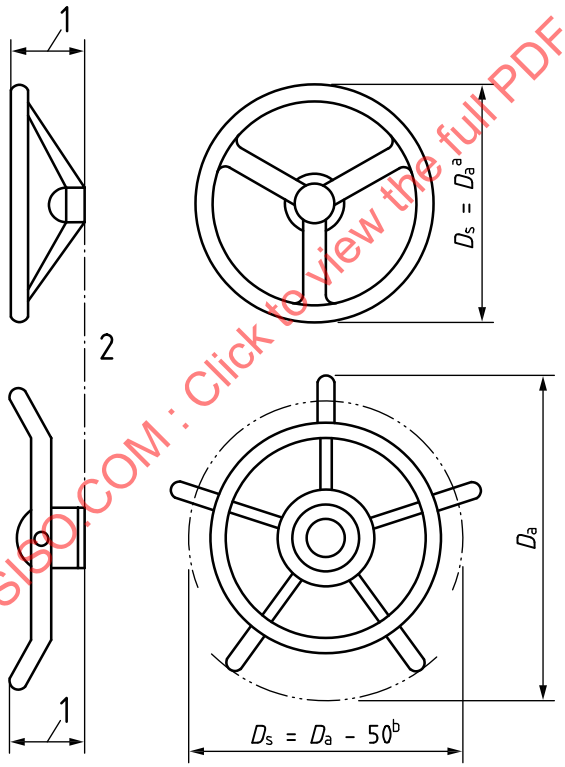
Note 1 to entry: The measurement methodology for the length of hull is defined in ISO 8666.

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

4 General requirements

4.1 Steering wheels shall be permanently marked by their manufacturer with the steering wheel diameter and the steering wheel dish measurements (see Figure 1).

Dimensions in millimetres



Key

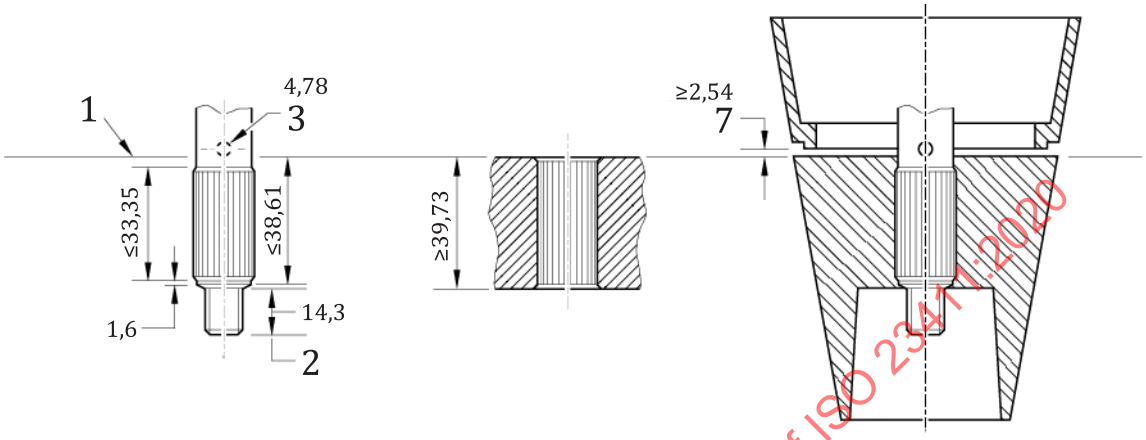
1 steering wheel dish
2 forward hub surface
D_a actual diameter
D_s standard diameter for the application of loads
[a] For steering wheels without handgrips, $D_s = D_a$.
[b] For external spoke steering wheels, $D_s = D_a - 50$ mm.

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

Figure 1 — Steering wheel terms

4.2 Steering wheels and steering mechanism shafts shall be selected to fit each other. Current fit configurations are shown in Figure 2a, 2b, 2c.

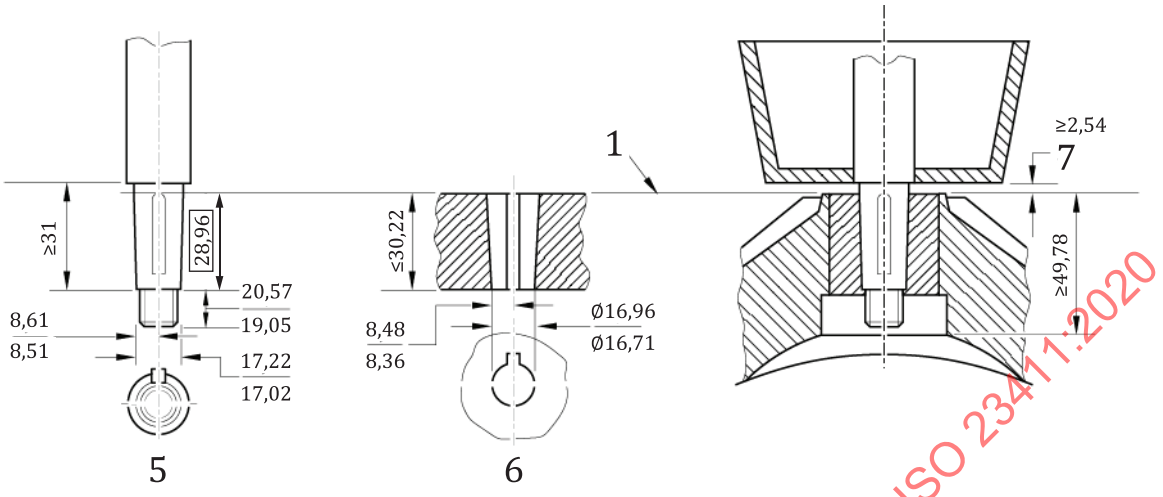
Dimensions in millimetres



Spline data – Shaft		**Spline data –Hub**	
Module	1.14	Module	1.14
# of teeth	19	# of teeth	19
Pressure angle	45°	Pressure angle	45°
Outside diameter	17,78 – 17,45	Outside diameter	17,86 – 17,81
Minor diameter	15,77 – 15,66	Minor diameter	16,15 – 16,00
Pitch diameter	16,64	Pitch diameter	16,64
Tooth thickness @ P.D.	1,47 – 1,44	Tooth thickness @ P.D.	1,47 – 1,44
Base circle diameter	11,77	Base circle diameter	11,77

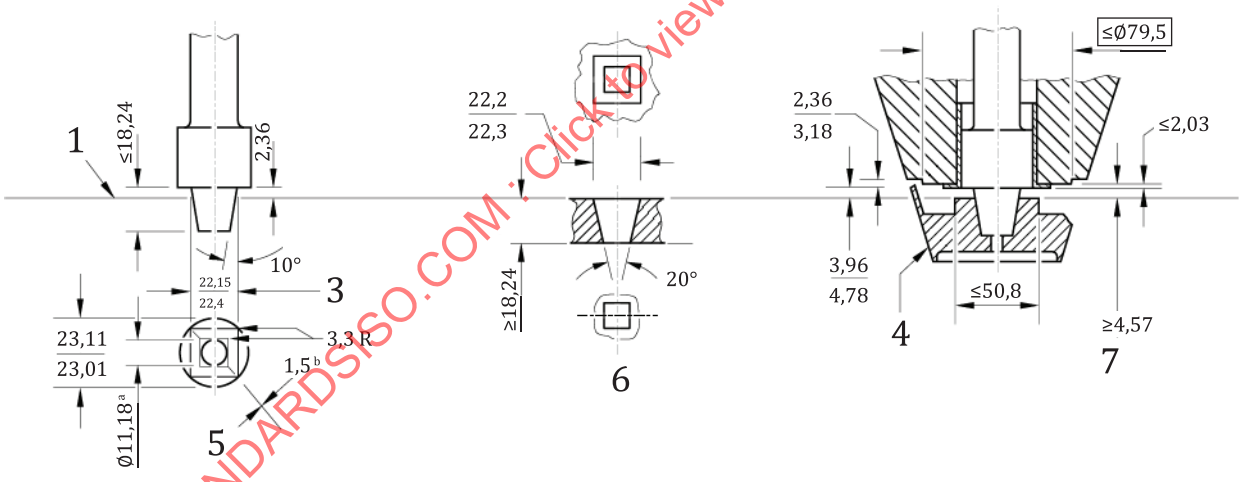
a) Spine shaft and steering wheel hub

Dimensions in millimetres



Taper data – Shaft		Taper data – Hub	
Shaft taper equals	(4,77°+0,1°/–0)	Hub taper equals	(4,77° 0/–0,1°)
Key height above shaft	2 286 min.	Hub key	4,79 min., 5,07 max.

b) Tapered shaft and steering wheel hub



c) Tapered square shaft and steering wheel hub

Key

1 forward hub surface
2 minimum full thread
3 pin diameter
4 optional skirt
5 core diameter
6 square hub gauging dimensions
7 clearance

Figure 2 — Steering wheels and steering mechanism shafts current fit configurations

4.3 Consideration shall be given to the design and construction of steering wheels and their components to prevent injury to the operator, i.e. sharp edges, pinch points, etc.

4.4 Electronic devices contained within a steering wheel that control steering, shift, throttle or dynamic positioning shall meet the requirements of ISO 25197:2020.

4.5 Non-structural devices intended to be installed within a steering wheel may be excluded from the mechanical, impact load and fatigue tests.

5 Tests

5.1 Conditioning

5.1.1 For steering wheels that rely on plastics for structural integrity, at least two steering wheels that are identical shall be subjected to three cycles of thermal conditioning in 5.1.2 followed by the ultraviolet exposure in 5.1.3 prior to tests set out in 5.2, 5.3 and Clause 6. Steering wheels that rely only on metal or wood for structural integrity require no conditioning. Cosmetic steering wheel coatings made of plastic that are not relied on for structural integrity are not required to be conditioned.

5.1.2 One cycle of thermal conditioning is defined as:

— three hours at 21 °C ± 2 °C, followed by

— three hours at -34 °C ± 2 °C, followed by

— three hours at 21 °C ± 2 °C, followed by

— three hours at 71 °C ± 2 °C.

5.1.3 At the completion of the thermal conditioning in 5.1.2, the steering-wheels shall be subjected to 110 h of exposure to ultraviolet rays of one reflector spot (RS) sunlamp or equivalent ultraviolet (UV) lamps, at a distance of 480 mm ± 25 mm and at a temperature of 60 °C ± 2 °C.

5.2 Mechanical tests

5.2.1 Prior to the mechanical tests, all steering wheels shall be maintained at a temperature of 21 °C ± 2 °C for at least 3 h. All steering wheels shall be tested with the steering wheel at 21 °C ± 2 °C in sequence, to withstand the mechanical tests specified in 5.2.2 and 5.2.3, see Table 1.

For 5.2.2 and 5.2.3 tests, a cycle is defined as a load application in one direction for 5 s, followed immediately by a load reversal in the opposite direction for 5 s, followed by an unload. Thus, a cycle is slightly over 10 s in duration.

5.2.2 Axial load test: while the steering wheel is installed on a stationary steering mechanism shaft, a force of at least 670 N

— distributed over not more than 100 mm on D_s

— shall be applied in a direction parallel to the axis of the steering mechanism shaft for ten cycles at a duration of 5 s per loading.

There shall be no fracture of the steering wheel structure or permanent deformation in excess of

— 25 mm, for steering wheels with diameters of 610 mm or less, or

— 50 mm, for steering wheels with diameters over 610 mm,

at the rim or spoke's handgrip such that the required loads cannot be achieved.

5.2.3 Tangential load test: while the steering wheel is installed on a stationary steering mechanism shaft, a force of at least 450 N in each direction shall be applied at any point on D_s

— for ten cycles, at a duration of 5 s per loading.

5.2.4 Upon completion of 5.2.2 and 5.2.3, there shall be no fracture of the steering wheel structure or permanent deformation such that the required loads cannot be achieved.

Table 1 — Axial and tangential tests

Type	Thermal conditioning	UV conditioning	Axial load test	Tangential load test
Plastic ≤61 cm	YES	YES	YES	YES
Metal and/or wood ≤61cm	NA	NA	YES	YES
Plastic >61 cm	YES	YES	YES	YES
Metal and/or wood >61 cm	NA	NA	YES	YES
NA: not applicable.				

5.3 Impact load tests

5.3.1 The requirements of 5.3.2 to 5.3.4 shall be applied to all steering wheels 61 cm in diameter or less, see Table 2.

5.3.2 Impact load test No.1: the steering wheel shall be tested with the steering wheel at 21 °C ± 2 °C; it shall withstand a single impact energy of at least 160 Nm at any location on D_s, without

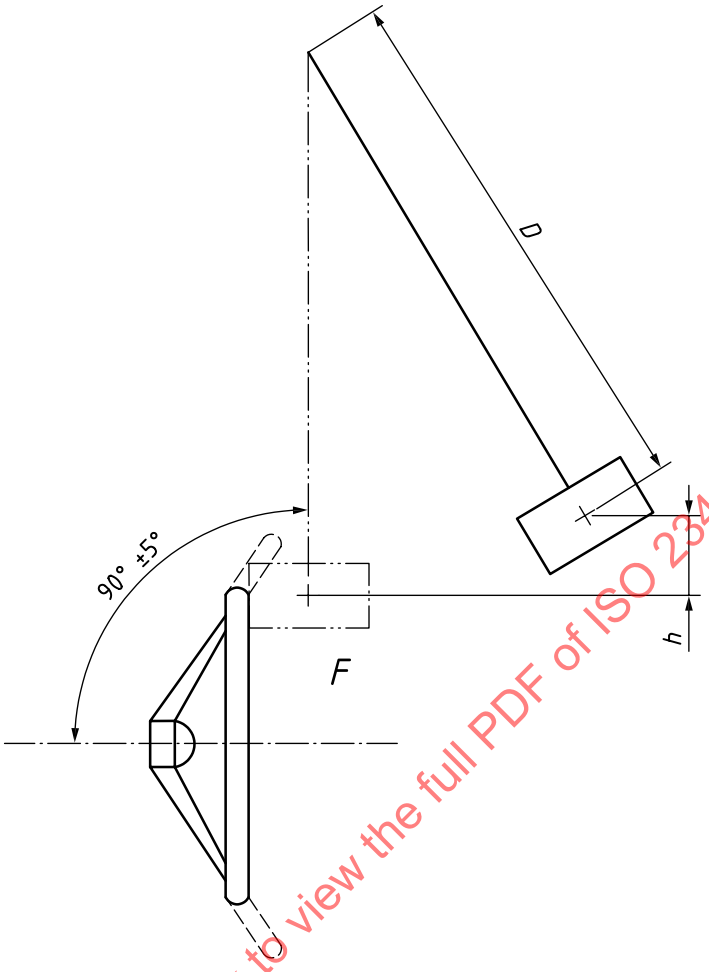
— deformation that would cause loss of minimum retained system performance when installed on a steering system, and

— propagation of any cracks existing before the test, and

— the appearance of new cracks.

5.3.3 Impact load test No.2: the steering wheel shall be tested with the steering wheel at 21 °C ± 2 °C; it shall withstand a single impact energy of at least 270 Nm at any location on D_s without complete separation of the rim and the hub.

The impact test fixture to be used (see Figure 3) shall be a completely filled 250 mm ± 5 mm diameter leather bag, containing lead, weighing 80 ± 1 kg in total and suspended on a free swinging cable, such that the centre of mass is 2 250 mm to 2 300 mm from a supporting pivot. The impact face of the bag shall be a 250 mm ± 5 mm diameter end. The bag shall be elevated through sufficient arc to achieve the desired impact value upon a rigidly mounted steering-wheel test fixture by swinging the bag as indicated in Figure 3. The test fixture shall be rigidly secured against movement. Devices other than that specified, such as a falling weight bag, may be used provided that an equivalent impact energy can be achieved.



Impact load test (see 5.3.2 and 5.3.3)	*T* Nm	*h* mm
No. 1	160	204
No. 2	270	345

Key

D 2 250 mm min., 2 300 mm max.

F 785 N

T impact value, Nm

h $\frac{1000T}{F}$ (mm)

Figure 3 — Steering wheel impact test fixture

5.3.4 Steering wheels that rely on plastic for structural integrity shall be tested as per 5.3.2 and 5.3.3. One test shall be performed with the steering wheel conditioned at (–7 ± 2) °C, and the other test shall be performed with the steering wheel conditioned at (52 ± 2) °C.

Note that separate, identical steering wheels may be used for each test of 5.3.4.

Table 2 — Impact tests

Type	Thermal conditioning	UV conditioning	Impact load No 1	Impact load No 2
Plastic ≤61 cm	YES	YES	YES	YES
Metal and/or wood ≤61cm	NA	NA	YES	YES
NA: not applicable.				

6 Fatigue tests

6.1 The requirements of Clause 6 shall be applied to all steering wheels 61 cm in diameter or less, see Table 3.

6.1.1 Steering wheels shall meet the conditioning requirements of 5.1.1 to 5.1.3 prior to the fatigue test.

6.1.2 Steering wheels can be at ambient temperature for the fatigue test.

6.1.3 Steering wheels shall withstand the tests in 6.2 to 6.6 while installed on a stationary steering mechanism shaft.

6.2 Test variables.

6.2.1 For all steering wheels relying on metal or wood for structural integrity:

fatigue force, F_{Fa} = 534 N ± 5 N;

number of cycles per minute, n= 40 to 60.

6.2.2 For all steering wheels relying on plastic for structural integrity:

fatigue force, F_{Fa} = 334 N ± 5 N;

number of cycles per minute, n= 10 to 15.

6.3 A push-pull force F_{Fa} shall be applied at the weakest point in a direction parallel to the axis of the steering mechanism shaft.

6.4 The load shall be either distributed over not more than 31,75 mm of the steering wheel rim, or centred at any handgrip of an external spoke steering wheel, or centred at the handgrip at the point of maximum leverage of other steering devices.

6.5 The wheel shall be subjected to 50 000 cycles at a rate of n cycles per minute.

6.6 Following either fatigue test, the steering wheel shall have a minimum retained system performance.