INTERNATIONAL STANDARD

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Small craft — Hydraulic steering systems

Navires de plaisance — Appareils à gouverner hydrauliques

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Contents

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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.

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.

International Standard ISO 10592 was prepared by Technical Committee ISO/TC 188, *Small craft*.

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Small craft — Hydraulic steering systems

1 Scope

This International Standard specifies requirements, test methods, manuals for both the owner and the installer, and the designation for hydraulic steering systems and components from the wheel to the interface point for outboard motor, inboard motor and inboard-outdrive steering arrangements, used on small craft of up to 24 m length of hull.

Accessories connecting output rams to tiller arms or equivalent are not included.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10240:—[1], *Small craft — Owner's manual.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 system maximum working pressure: Relief valve pressure setting.

3.2 system test pressure: Non-destructive test pressure, at least one and half times the system maximum operating pressure.

3.3 minimum retained system performance: System capability after test(s) such that at least 90 % of the steering arc normally available to each side of the mid-position may be obtained by exertion of no more than 27 Nm of torque at the helm, through the wheel or other normal control.

NOTE 1 This criterion does not define steering system performance while a boat is underway but is intended to provide quantitative limits for design and test purposes.

3.4 craft-mounted hydraulic system: System in which a cylinder is secured to the boat.

3.5 motor-mounted hydraulic system: System in which a cylinder is secured to the engine.

3.6 drag link: Link in a motor-mounted steering system by which the linear force of the output ram is transmitted to the motor steering arm.

4 Outboard motor and inboard-outdrive requirements

4.1 Steering stops on an outboard motor shall permit at least 30° of angular movement to either side. The design torque at the rudder stock shall be sufficient to put the helm from hard over to hard over (30° port to 30° starboard or vice versa) in not more than 30 s.

4.2 Outboard motors shall meet the applicable dimensional requirements indicated in figures 1 and 2.

4.3 Necessary fittings to attach an outboard motor to the cylinder output rod shall be supplied with the outboard motor.

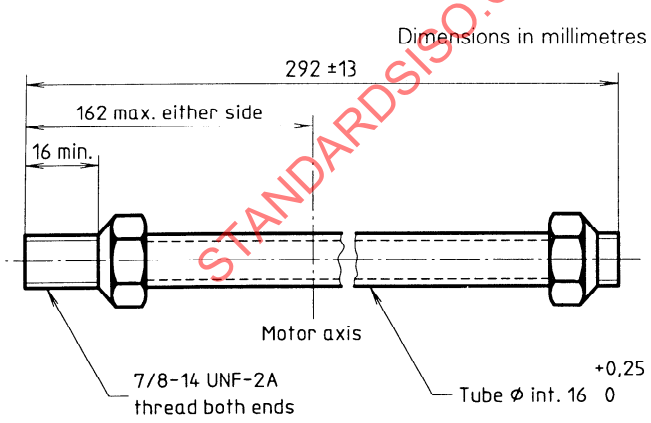
1) To be published.

4.4 Outboard motors shall be designed so that, with any combination of motor turn and tilt, there shall be no damaging interference between the motor, its accessories, and both the craft-mounted and the motor-mounted system, if the motor is designed for both systems. Appropriate written information and installation instructions shall be provided, clearly indicating the type of steering system(s) that should be used.

4.5 Outboard motors shall be designed so that the geometry ensures that a static force of 3 300 N, applied at the steering arm connection point normal to the steering arm in its normal plane of operation throughout the maximum steering arc, will not result in steering output ram loadings greater than those specified in 9.3.1.

4.6 The steering arm of an outboard motor shall be provided with a 3/8 in-24 UNF thread, or a plain hole of 9,65 mm to 9,9 mm diameter at the connection point.

4.7 Inboard-outdrives shall be designed with proper geometry to ensure that a torque of 680 Nm applied on the outdrive steering axis will not result in a steering component loading greater that that specified in 9.3.2.



NOTE — The tube may be threaded equal length on both ends or reversible for port steering installation.

Figure 1 — Motor-mounted steering tube

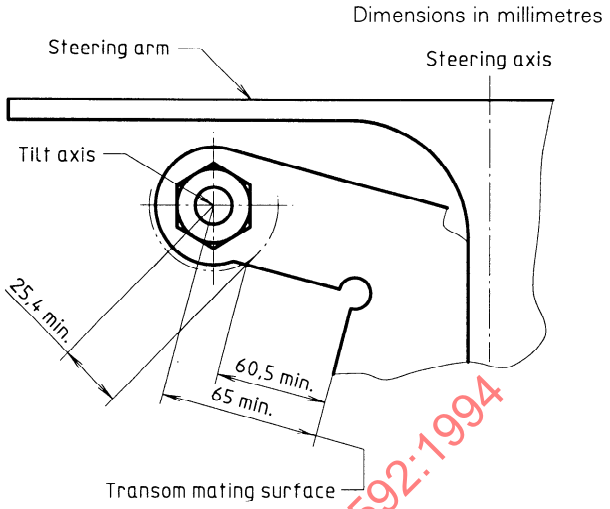


Figure 2 — Motor-mounted steering tilt axis

5 General requirements for hydraulic steering systems

5.1 The components of hydraulic steering systems shall be compatible with each other in order to be used as a complete system.

5.2 All component parts shall be supported independently of the connecting tubes.

5.3 Connections, fittings, oil fill openings and air bleeders shall be accessible.

5.4 Components in the system shall be externally protected against corrosion. The complete hydraulic steering system shall be designed to withstand conditions of pressure, vibration, shock and movement without failure or leakage.

5.5 Hydraulic systems with a non-functional autopilot shall be capable of operation throughout an ambient temperature range of − 10 °C to + 60 °C and be capable of withstanding storage at − 30 °C to + 60 °C.

5.6 Fittings, hoses, piping and components shall be capable of withstanding the system test pressure without permanent deformation, external leakage or other malfunction.

5.7 Materials used in hydraulic steering systems shall be resistant to deterioration by liquids or compounds with which the material may come in contact under normal marine service, e.g. grease, lubricating

oil, hydraulic fluid, common bilge solvents, salt and fresh water.

5.8 In vessels over 12,5 m in length, the hydraulic steering system shall be capable of putting the rudder over from 30° on one side to 30° on the other in not more than 30 s when the vessel is at maximum forward service speed with the rudder totally submerged, and, if normally operated, shall be designed to prevent violent recoil of the steering-wheel.

6 Hydraulic fluid

The type of hydraulic fluid to be used in a hydraulic steering system shall be specified by the manufacturer of the steering system and shall be stated in the owner's manual.

The hydraulic fluid shall be non-flammable or have a flash point of 157 °C or over.

7 Materials

In addition to the general requirements of clause 5 the following requirements shall be met.

7.1 Components of different materials shall be galvanically compatible or separated by a galvanic barrier.

7.2 Plastics and elastomers which may be exposed to sunlight shall be chosen to resist degradation by ultraviolet radiation.

7.3 Plastics and elastomers which may be installed in engine compartments shall be chosen to resist degradation by saline atmospheres, fuel, oil, heat and fire.

8 Installation

8.1 The installation shall be carried out following the directions of the manufacturers of the system. Hydraulic lines shall be supported by clips, straps or other means to prevent chafing or vibration damage. The clips, straps or other devices shall be corrosion-resistant and shall be designed to prevent cutting, abrading or damage to the lines and shall be compatible with hydraulic line materials.

A flexible section shall be installed between rigid piping and cylinder(s).

8.2 Hoses and piping shall be protected from contact with hot objects and from abrasion. There shall be no joints or connections directly above hot objects.

8.3 Hydraulic components shall be secured to the craft's structure considering the potential forces to be transmitted. Specifically, the mounting location for hydraulic cylinders shall provide a rigid attachment.

8.4 All threaded fasteners whose integrity affects safe operation of the hydraulic steering system shall be provided with a locking means.

8.5 Steering wheels and helm shafts shall be selected to fit each other. Current configurations are shown in figure 3.

8.6 Threaded fasteners whose integrity affects safe operation of the steering system, and which are intended to be mounted or adjusted at the installation of the steering system in the craft and which may be expected to be disturbed by installation or adjustment procedures, shall be locked by locking devices referenced by instructions for correct assembly and complying with the following requirements.

8.6.1 Loose lock-washers, fasteners with metallic distorting threads and adhesive are prohibited.

8.6.2 A locking device shall be so designed that its presence can be determined by visual inspection or felt by a layman after installation.

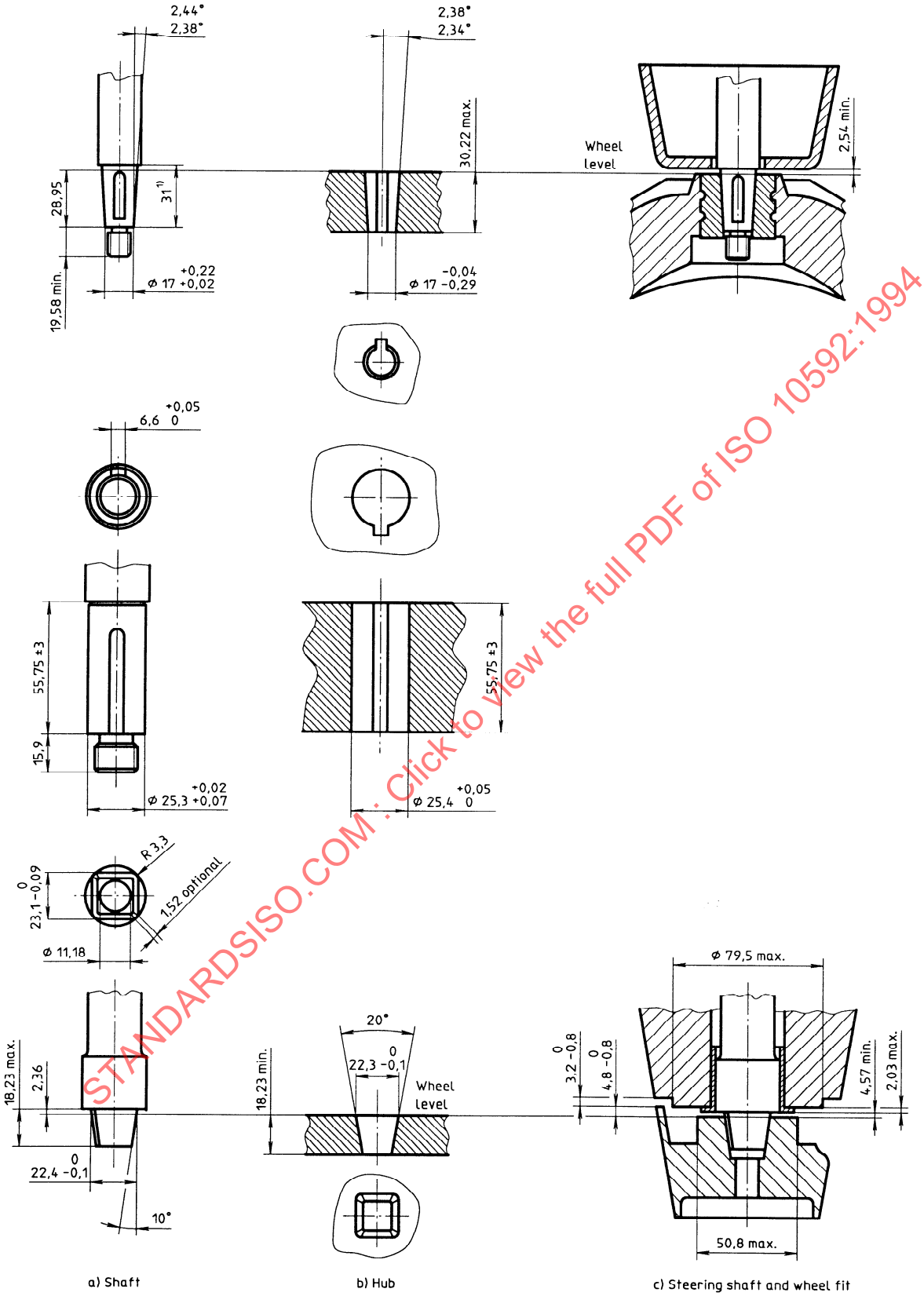
9 Test requirements

The following tests are intended to establish the acceptability of the design strength of hydraulic steering systems as installed in a craft to the interface point with the motor.

9.1 Static force

If the relief valve of the hydraulic steering system does not open earlier, the hydraulic steering system shall withstand a static force, in either direction, of 3 300 N applied at the connection hole of the cylinder output rod along the axis of the cylinder output rod without any loss in steering capability.

Dimensions in millimetres



1) Clearance to shoulder, if any.

Figure 3 — Steering shafts and steering-wheel hubs

9.2 Tangential and axial forces

Hydraulic steering systems shall withstand a single tangential force of 450 N in either direction applied as appropriate:

— at any point on the steering-wheel rim,

— at the centre-point of any handgrip of an external spoke steering-wheel, or

— at the point of maximum leverage on other steering devices,

and a subsequent single axial force of 670 N, in each direction, distributed over not more than 100 mm of the rim, spoke or handgrip.

Upon application of the indicated forces, the following shall be verified.

a) The minimum retained system performance shall be maintained at any position of the steering-wheel.

b) The complete installation shall not show any leaks.

c) There shall be no fracture or deformation of the mounting surface or craft structure.

9.3 Component tests

These tests are intended to establish minimum acceptable design criteria for components of hydraulic steering systems.

9.3.1 Each hydraulic cylinder assembly (including craft-mounted system hardware) and integral fittings shall withstand an axial force of 9 000 N in tension and compression, applied at the interface point throughout its travel range, without severance of components or other malfunction.

9.3.2 A separate cantilever force of 900 N shall be applied at the centreline of the interface point of the output rod end with at least 190 mm of the rod unsupported, without more than 1,25 mm of permanent deflection at the rod hole.

Upon application of the indicated force, the minimum retained system performance shall be maintained at any location.

9.3.3 The output rod of a hydraulic cylinder shall withstand, for 50 000 reversals, a cyclic force of 1 670 N applied as shown in figure 4 without causing separation of components or other malfunction.

9.4 Helm assembly tests

9.4.1 General

Helm assemblies shall incur no loss of operating function after the tests in 9.4.2 and 9.4.3, when equipped with the largest diameter and deepest dish steering-wheel for which the helm is rated.

9.4.2 Axial force test

A 670 N push-pull force distributed over not more than 100 mm of

— the steering-wheel rim,

— the handgrip of an external spoke steering-wheel,

— the handgrip at the point of maximum leverage on other steering devices,

shall be applied, at any single location, in a direction parallel to the steering shaft axis for 10 cycles, each with a duration of 5 s.

9.4.3 Tangential force test

A 450 N force in each direction shall be applied

— at any point on the steering-wheel rim,

— at the centre point of any handgrip of an external spoke steering-wheel, or

— at the point of maximum leverage on any other steering devices,

at any single location, tangential to the plane of the steering-wheel rim or in the plane of motion of other steering devices, at any point in its total steering range, for 10 cycles, each with a duration of 5 s.

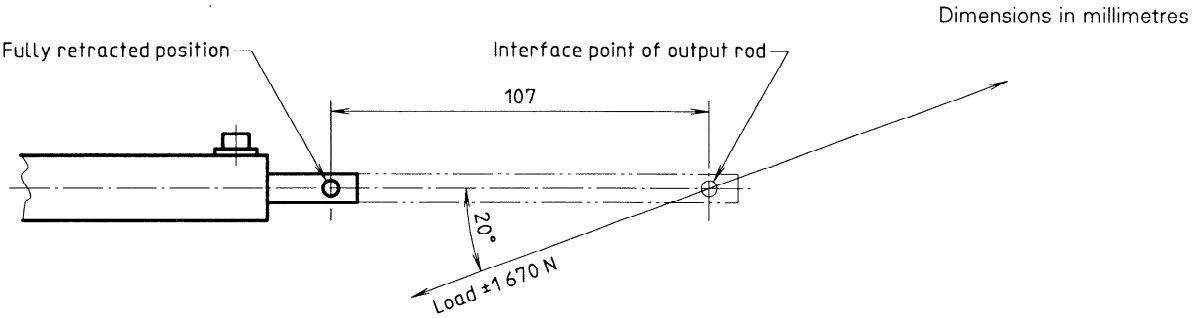


Figure 4 — Output ram fatigue test

9.5 Steering-wheel tests

NOTE 2 The thermal conditioning (9.5.1.1) and ultraviolet exposure (9.5.1.2) may be omitted on wheels of all metal and/or wood construction and wheels the plastics parts of which are not structural.

9.5.1 Preliminary conditioning

9.5.1.1 Steering-wheels shall be subjected to three cycles of thermal conditioning before mechanical tests are performed. One cycle of thermal conditioning is defined as

— 3 h at 21 °C ± 2 °C

— 3 h at − 34 °C ± 2 °C

— 3 h at 21 °C ± 2 °C

— 3 h at 71 °C ± 2 °C

9.5.1.2 At the completion of thermal conditioning, the steering-wheels shall be subjected to 110 h of exposure to ultraviolet rays of one RS sunlamp or equivalent UV lamps at a distance of 480 mm and a temperature of 60 °C.

9.5.2 Tests

At the completion of the thermal conditioning and ultraviolet exposure, the wheel shall be maintained at a temperature of 20 °C to 24 °C for at least 3 h. It shall then, in sequence, withstand the mechanical tests in 9.5.2.1 to 9.5.2.3.

9.5.2.1 Axial force test

Apply a 670 N push-pull force, distributed over not more than 100 mm of

— the steering-wheel rim, or

— the handgrip of an external spoke steering-wheel,

at any single location, in a direction parallel to the steering shaft axis for 10 cycles, each of a duration of 5 s, without fracture or permanent deformation in excess of 25,4 mm at the rim, or spoke handgrip.

9.5.2.2 Tangential force test

Apply a 450 N force in each direction:

— at any point on the steering-wheel rim, or

— at the centre-point of any handgrip of an external spoke steering-wheel,

at any single location, tangentially in the plane of the steering-wheel rim, for 10 cycles, each with a duration of 5 s, without fracture.

9.5.2.3 Impact tests

Use the fixture shown in figure 5 and the following procedure.

9.5.2.3.1 The impact test apparatus to be used (see figure 5) shall be a completely filled 250 mm diameter leather bag, containing lead, producing a force of 785 N 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 diameter end. The bag shall be elevated through sufficient arc to create the desired impact value upon a rigidly mounted steering-wheel by swinging the bag as indicated in figure 5.

The fixture shall be rigidly secured against movement. Devices other than that specified such as a falling weight bag may be used provided that equivalence can be verified.

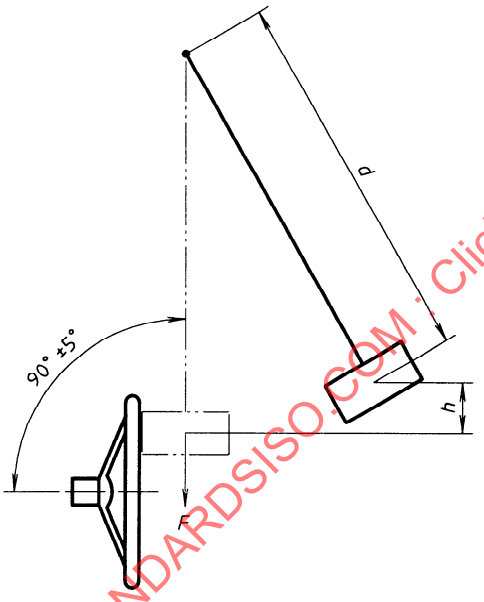
9.5.2.3.2 Impact test No. 1: With $h = 204$ mm, the steering-wheel shall withstand a single impact of 160 Nm at any location on the rim, without

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

— spreading of any cracks existing before this test, or

— the appearance of new cracks.

9.5.2.3.3 Impact test No. 2: With $h = 345$ mm, the steering-wheel shall withstand a single impact of 270 Nm at any location on the rim without complete separation of the rim and the hub.



d = 2 250 mm min., 2 300 mm max.

F = 785 N

T = Impact value, in Nm

$h = \frac{1\,000T}{F}$

Impact test (see 9.5.2.3)	T Nm	h mm
No. 1	160	204
No. 2	270	345

Figure 5 — Steering-wheel impact test fixture

9.6 Fittings

All the fittings (hoses and piping) shall withstand the system test pressure without leaks.

9.7 Piping

Piping shall comply with current International Standards.

10 Owner's manual

An owner's manual conforming to ISO 10240 shall be provided with the system, including at least the following information:

a) operating instructions;

b) filling and bleeding procedures;

c) alternative means of operation, if so equipped, in the event of failure;

d) maintenance procedures;

e) trouble correction guidelines including warnings;

f) specifications for hydraulic fluid;

g) system diagram showing typical installation;

h) list (part number and designation) of frequent and easily replaceable component parts.

11 Installer's manual

An installer's manual shall be provided with the steering system, including at least the following information:

a) installation instructions;

b) operating instructions;

c) recommended installation test procedures;

d) system maximum operating pressure;

e) filling and bleeding procedures;

f) alternative means of operation, if so equipped, in the event of failure;

g) maintenance procedures;

h) trouble correction guidelines including warnings;

i) specifications for hydraulic fluid;

j) system cleaning procedures;

k) recommendations for thread sealant;

l) specifications or part numbers for piping and fittings suitable for the hydraulic steering system;

m) system diagram showing typical installations.

12 Designation

A hydraulic steering system in accordance with this International Standard shall be designated as follows:

a) "steering system";

b) number of this International Standard;

c) speed of the craft and length of hull;

d) type of hull: P — planing or D — displacement;

e) number and type of boat engine(s): (I = inboard motor, I/O = inboard/outboard motor, O = outboard motor);

f) number of control stations;

g) number of cylinder(s);

h) maximum torque to be applied to the steering axle;

i) maximum working pressure.

EXAMPLE

Designation of a hydraulic steering system in accordance with this International Standard, for a craft capable of 40 knots, of 10 m length of hull, planing hull, one inboard engine, two control stations, two cylinders, maximum torque 2,5 Nm, maximum working pressure 15 MPa (150 bar):

Steering system ISO 10592 40/10-P - 1I - 2 - 2 - 2,5 - 15

13 Marking of components

13.1 Pumps

Pumps complying with this International Standard shall be permanently marked with the following information:

— number of this International Standard;

— name or trademark of manufacturer;

— type;

— system maximum operating pressure in pascals;

— year of production.

13.2 Cylinders

Cylinder(s) complying with this International Standard shall be permanently marked with the following information:

— number of this International Standard;

— name or trademark of manufacturer;

— type;

— cylinder maximum operating pressure in pascals;

— year of production.