DRAFT INTERNATIONAL STANDARD

ISO/DIS 20650

ISO/TC **8**/SC **7**

Secretariat: **DIN**

Voting begins on:
2023-12-19

Voting terminates on:
2024-03-12

Inland navigation vessels — Small floating working machines — Requirements and test methods

ICS: 47.060

Reference number
ISO/DIS 20650:2023(E)

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Published in Switzerland

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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 8, *Ships and marine technology*, Subcommittee SC 7, *Inland navigation vessels*.

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

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Inland navigation vessels — Small floating working machines — Requirements and test methods

1 Scope

This document is applicable to small floating working machines used for work in, over or on inland waters. This document specifies safety-related requirements and test methods.

This document specifies minimum requirements for small floating working machines. with a length < 10 m and a product of L x W x D < 30 m^3 with temporarily or permanently installed work equipment or machines used on inland waters.

With their help, work is carried out in, on or over bodies of water. These are, for example, extraction work, lifting work, sampling, mowing and clearing work or comparable work tasks.

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 630-2, *Structural steels — Part 2: Technical delivery conditions for structural steels for general purposes*

ISO 1035-1, *Hot-rolled steel bars — Part 1: Dimensions of round bars*

ISO 1035-2, *Hot-rolled steel bars — Part 2: Dimensions of square bars*

ISO 1035-3, *Hot-rolled steel bars — Part 3: Dimensions of flat bars*

ISO 2922, *Acoustics — Measurement of airborne sound emitted by vessels on inland waterways and harbours*

ISO 2923, *Acoustics — Measurement of noise on board vessels*

ISO 4254-1, *Agricultural machinery — Safety — Part 1: General requirements*

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 7165, *Fire fighting — Portable fire extinguishers — Performance and construction*

ISO 9519, *Shipbuilding and marine structures — Rungs for dog-step ladders*

ISO 10240, *Small craft — Owner's manual*

ISO 11102-1, *Reciprocating internal combustion engines — Handle starting equipment — Part 1: Safety requirements and tests*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12402-2, *Personal flotation devices — Part 2: Lifejackets, performance level 275 — Safety requirements*

ISO 12402-3, *Personal flotation devices — Part 3: Lifejackets, performance level 150 — Safety requirements*

ISO 13297, *Small craft — Electrical systems — Alternating and direct current installations*

ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14895, *Small craft — Liquid-fuelled galley stoves and heating appliances*

ISO 16180, *Small craft — Navigation lights — Installation, placement and visibility*

ISO 17631, *Ships and marine technology — Shipboard plans for fire control, damage control, life-saving appliances and means of escape*

ISO 18422, *Ships and marine technology — Inland navigation vessels — Plate with instructions for rescue, resuscitation and first aid for drowning persons*

IEC 60092-504, *Electrical installations in ships — Part 504: Automation, control and Instrumentation (IEC 60092-504:2016, modified)*

IEC 60364-5-54, *Low-voltage electrical installations — Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

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

IEC 62619, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

IEC 62620, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Secondary lithium cells and batteries for use in industrial applications*

3 Terms and definitions

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

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

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

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

3.1
Small floating working machine
watercraft used on inland waters with a hull whose length is less than 10 m and whose product of L x W x D < 30 m^3 with temporarily or permanently installed working equipment or machinery

EXAMPLE Mowing boats, watercraft for sampling, extraction work, keeping waters clean, lifting work.

3.2
residual safety clearance
shortest vertical distance between surface of the water and the lowest part of the small floating working machine beyond which it is no longer watertight taking into account trim and heel resulting from the moments

3.3
residual freeboard
smallest vertical distance between the surface of the water and the upper surface of the deck at its edge taking into account trim and heel

3.4
working area
area of inland water, where the work is carried out

3.5
operating range
driving range from the berth to the working area and the working area itself

3.6
propulsion system
system consisting of internal combustion engine and/or electric drive engine with power source including power electronics, gearbox, shaft, propeller, etc., used to move the craft in the water

3.7
propulsion
diesel, LPG, electric or diesel or gas-electric propulsion system of a small floating working machine containing at least one propulsion engine

3.8
main propulsion
propulsion used to achieve the manoeuvring characteristics

3.9
propulsion engine
engine for driving the propeller shaft or the shaft of comparable drive systems such as water jet drives

3.10
expert
a person recognised by the competent authority or by an authorised institution, having specialist knowledge in the relevant area on the basis of his or her professional training and experience, fully conversant with the relevant rules and regulations and the generally accepted technical rules (e.g. ISO Standards, relevant regulations, technical rules), and able to examine and give an expert assessment of the relevant systems and equipment

3.11
competent person
a person who has acquired sufficient knowledge in the relevant area on the basis of his or her professional training and experience and is sufficiently conversant with the relevant rules and regulations and the generally accepted technical rules (such as ISO Standards, relevant regulations, technical rules) to be able to assess the operational safety of the relevant systems and equipment

4 General Requirements

4.1 General Requirements

Small floating working machines shall be built in accordance with good shipbuilding practices.

At least one watertight collision bulkhead and one machinery space bulkhead shall be fitted up to the deck or to the upper edge of the ship's side. The collision bulkhead shall be installed at an appropriate distance from the bow so that when the watertight compartment forward of the collision bulkhead is flooded, the buoyancy of the fully loaded vessel is maintained and a residual safety clearance of not less than 300 mm is maintained.

4.2 Strength

The strength of small floating machines shall be sufficient to withstand the stresses to which it is exposed under the conditions of use specified by the manufacturer.

When using steel S 235 B according to ISO 630-2, this requirement is fulfilled if the thickness of the bottom and side plates is at least 3 mm. If other materials or lower material thicknesses are used, a mathematical verification is required.

4.3 Stability

The stability of small floating machines shall withstand the stresses to which it is exposed under the conditions of use specified by the manufacturer.

The stability of small floating machinery shall be sufficient for the loads to which it is subjected under the conditions of use specified by the manufacturer. It shall be demonstrated mathematically by the test conditions given in Annex A.

In the case of small floating working machines for which no change in heel or trim can be caused by their working equipment and for which a shift in the centre of gravity can be ruled out as far as possible, a mathematical verification may be dispensed with.

4.4 Residual safety clearance

The residual safety clearance shall be at least 300 mm.

4.5 Residual freeboard

The residual freeboard shall be at least 300 mm.

4.6 Sinking resistance

Small floating working machines shall be safe against sinking in the event of flooding of one watertight compartment.

The residual buoyancy force at the end of flooding of any compartment of the small floating working machine shall be at least 100 N for each designated crew member.

4.7 Draught marks

The plane of maximum draught shall be marked on each side at each end of the small floating working machine by indelible draught marks in a contrasting colour. These shall consist of a rectangle measuring 150 mm x 30 mm (L x H) with the base line horizontal and coinciding with the plane of the maximum allowed draught.

4.8 Manoeuvring characteristics

Small floating working machines shall

— have adequate driving and manoeuvring characteristics in accordance with Annex B;

— be able to reach a minimum speed of 4 km/h in relation to the water in the travel range.

4.9 Driving noise of the small floating working machine

The noise emitted by a small floating working machine under way at a lateral distance of 25 m from the craft's side shall not exceed 75 dB(A) measured according to ISO 2922.

4.10 Alarm signal

There shall be an alarm signal with which all persons on board can be warned.

The alarm signal shall be clearly distinguishable from other signals. It shall produce a sound pressure level at all workstations that is at least 5 dB(A) higher than the maximum local sound pressure level.

4.11 Stability and strength of working equipment

The stability and strength of working equipment and, where appropriate, its attachments, shall be sufficient to withstand the forces resulting from the expected heel, trim and movement of the floating equipment.

5 Steering system

5.1 General

Small floating working machines shall be fitted with a reliable steering system which provides at least the manoeuvrability required by Annex B.

The steering systems shall be designed in such a way that the rudder cannot change position unintentionally.

The steering system as a whole shall be designed for permanent lists of up to 15° and ambient temperatures from 20 °C to +50 °C.

The components of the steering system shall be robust enough to always be able to withstand the stresses to which they may be subjected during normal operation.

5.2 Drive unit of the steering system

The steering system shall incorporate a manual drive or a powered drive unit if so required by the forces needed to actuate the rudder.

Regardless of rudder position, a kick-back of the steering wheel shall be prevented when the manual drive is engaged.

A steering apparatus with a powered drive unit shall be protected against overloads by means of a system that restricts the torque applied by the drive unit.

Hydraulic steering apparatus drive units shall have:

— an emergency mode such as manual operation; and

— a level alarm for the hydraulic tank;

— the pipework designed, dimensioned and arranged in such a manner to exclude as far as possible mechanical damage or damage resulting from fire.

5.3 Indicators and monitoring devices

The rudder position shall be clearly displayed at the steering position. If the rudder-position indicator is electric it shall have its own power supply.

An optical and acoustic alarm shall be present at the steering position to signal the following:

— the oil level of the hydraulic tanks falling under the lowest content level;

— failure of the electrical supply for the steering control.

5.4 Penetrations for the rudder stocks

The penetrations for the rudder stocks shall be so designed as to prevent the spread of water polluting lubricants.

6 Helm station

6.1 General

Helm stations shall be arranged in such a way that the helmsman (oarsman, operator) may at all times perform his task while the vessel is under way.

In driving mode, sound pressure generated by the vessel and measured at the level of the helmsman's head at the steering position shall not exceed 70 dB(A).

The operator's workstation shall be equipped with technical protection against UV radiation and precipitation which is sufficient for the expected demand.

6.2 Unobstructed view

There shall be an adequately unobstructed view in all directions from the helm position for safe operation.

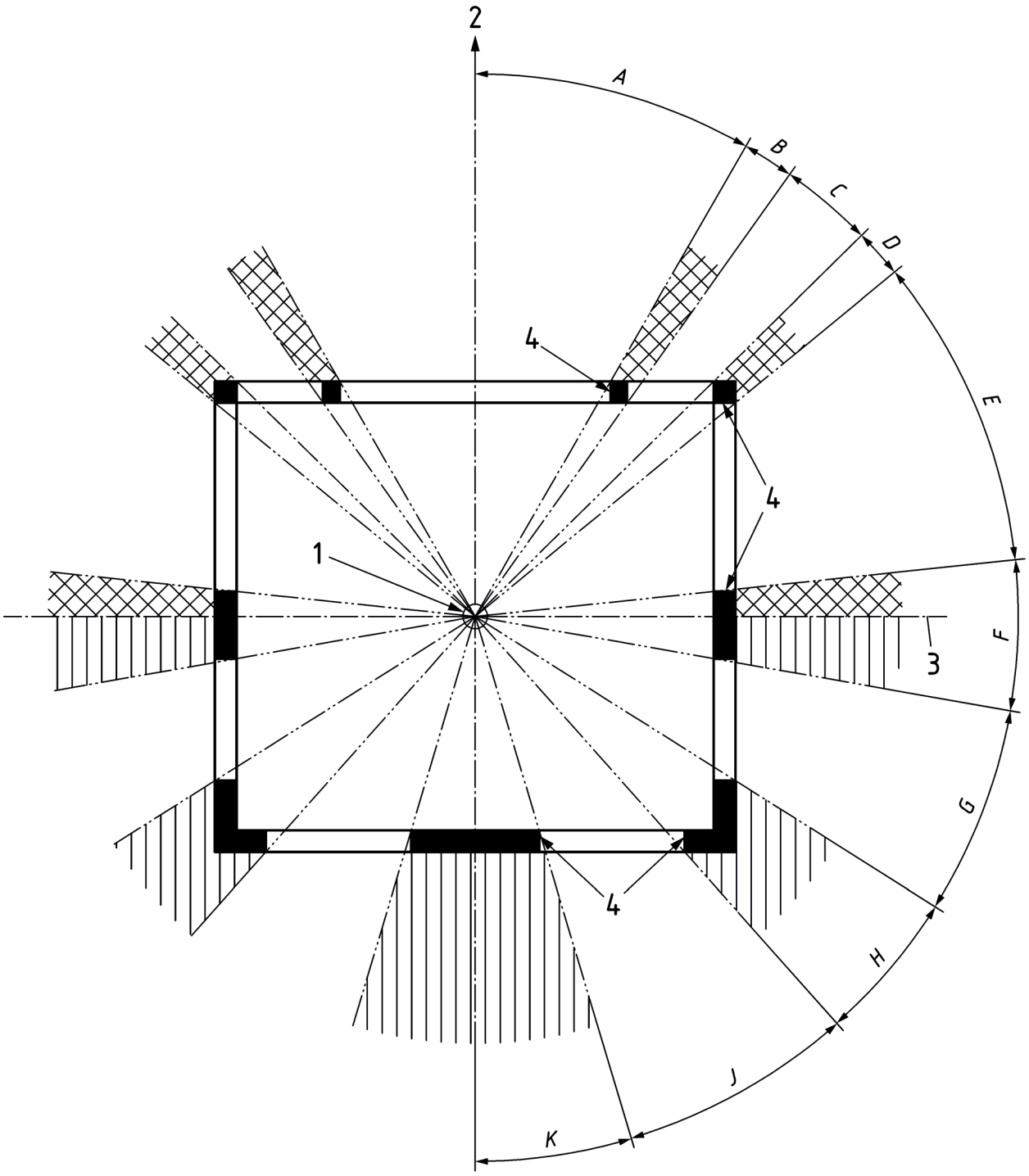
The equipment shall be under visual control in all positions from the helm position to the water surface.

The upper edge of the forward-facing windows of the helm station shall be high enough to allow a person at the helm station (eye level: seated person 1 324 mm and/or standing person 1 800 mm each above the floor) a clear forward view (to the horizon and an angle of 10°upwards) of at least 120° within the forward semicircle. At the rear, a field of vision of at least 30° shall be possible.

For an example of the design of the unobstructed view, see Figure 1.

Clear vision through these windows shall be ensured by suitable means in all weather conditions.

Windowpanes used in the helm station shall have a minimum light transmission of 75 %. If they are made of glass, safety glass shall be used. To avoid reflections, the helm station front windows shall be glare-free or fitted so as to exclude reflections effectively.



Key

1 midpoint of the visual axis

2 mid of small floating equipment, the field of view ahead

3 plane of shoulder

4 frame of the helm station

Starboard (S) illustrated, port (P) shall be correspondingly

$A \geq 30°$

$A + C + E \geq 60°$

$B, D \leq 6°$

$A + C + E + G + J \geq 120°$

Figure 1 — Minimum requirements for the unobstructed view

6.3 Control, indicating and monitoring equipment

6.3.1 General requirements

Control equipment needed to operate the small floating working machine and its working equipment shall be brought into its operating position easily. That position shall be unambiguously clear.

Monitoring instruments shall be easily legible. Light sources shall be neither intrusive nor impair the legibility of the monitoring.

There shall be a system for testing the warning and indicating lights.

It shall be possible to clearly establish whether a system is in operation. If its functioning is indicated by means of an indicating light, this shall be green.

Any malfunctioning or failure of systems that require monitoring shall be indicated by means of red warning lights.

An audible warning shall sound while a red warning light lights up. Audible warnings may be given by a single, collective signal. The sound pressure level of that signal shall exceed the maximum sound pressure level of the ambient noise at the steering position by at least 5 dB(A).

The audible warning shall be capable of being switched off after a malfunction or failure has been acknowledged. Such shutdown shall not prevent the alarm signal from being triggered by other malfunctions. The red warning lights shall only go out when the malfunction has been corrected.

A clinometer for monitoring heel and trim shall be provided.

6.3.2 Specific requirements concerning control and monitoring equipment of main engines

It shall be possible to control and monitor the main engines and steering systems from the helm position.

For each main engine there shall be only one operating device (e.g. lever or pedal) for machine control.

The direction of the propulsion thrust imparted to the vessel and the rotational speed of the propeller or main engines shall be displayed.

The indicating and monitoring devices required by 5.3, 8.3 and 10.2 shall be located at the steering position.

6.4 Elevating helm stations

Elevating helm stations shall be designed in such a way that the safety of persons on board is not endangered by crushing and shearing points when the helm stations are raised or lowered. An elevating helm station shall not endanger the stability of the small floating working machine.

Operations carried out from the helm station shall not be hindered during lifting and lowering. It shall be possible to enter and leave the helm station safely, whatever its position.

The lifting mechanism shall:

— be operable from within the helm station

— allow the helm station to be stopped in any position

— be designed in such a way that exceeding the terminal positions is not possible.

If the possibility exists to lock the wheelhouse in a certain position, the lifting mechanism shall be automatically disabled when locking takes place. Releasing the locks shall be possible under all operating conditions.

Arrangements shall be provided to avoid uncontrolled lowering of the wheelhouse. Appropriate protection features shall be installed to prevent the risk of injury which may result from lowering. All lowering operations shall automatically trigger an optical and a clearly audible acoustic warning signal.

Hydraulic hoses are:

— only permissible, if vibration absorption or freedom of movement of components makes their use inevitable;

— to be designed for at least the maximum service pressure.

7 Engine rooms

7.1 General

The machine room shall be sealed gas-tight from the helm station so that no flammable and/or toxic vapours can reach the helm station.

It shall be possible to ventilate engine rooms in which flammable or toxic gases can develop with sufficient safety.

Rooms in which machinery and its accessories are installed shall be designed and equipped in such a way that operation and maintenance of the equipment is easy and safe.

Ladders and stairs leading into engine rooms shall be firmly attached.

7.2 Fire protection

Walls, ceilings and doors of engine rooms shall be made of steel or an equivalent non-combustible material. Insulation material used in engine rooms shall fireproof and be protected against the intrusion of fuel and fuel vapours.

7.3 Heat detector

Engine rooms shall be provided with suitable heat detectors.

8 Requirements on engine design

8.1 General

Engines and their ancillaries shall be designed, built, and installed in accordance with best practice.

If internal-combustion engines are installed, they shall run with burning fuels having a flashpoint of more than 55 °C or with LPG.

8.2 Safety equipment

Engines shall be installed and fitted in such a way as to be adequately accessible for operation and maintenance and shall not endanger the persons assigned to those tasks. It shall be possible to make them secure against unintentional starting.

Machines shall have easily accessible and readily accessible EMERGENCY STOP devices at permanently manned workplaces and where required.

8.3 Propulsion systems

It shall be possible to start, stop or reverse the ship's propulsion reliably and quickly.

The parameters necessary for safe machine operation, e.g. oil pressure, temperature of cooling water, condition of the accumulators, shall be monitored by suitable devices that trigger an alarm when critical values are reached.

8.4 Engine exhaust systems of internal combustion engines

The exhaust gases shall be completely ducted to the outside.

All suitable measures shall be taken to avoid ingress of the exhaust gases into the various compartments. Exhaust pipes passing through accommodation, or the wheelhouse shall, within these, be covered by protective gas-tight sheathing. The gap between the exhaust pipe and this sheathing shall be open to the outside air.

The exhaust pipes shall be arranged and protected in such a way that they cannot cause a fire.

The exhaust pipes shall be suitably insulated or cooled in the engine rooms. Outside the engine rooms shall be at least a protection against physical contact.

8.5 Fuel tanks, pipes and accessories for Liquid fuels or hydraulic oils

Hydraulic oils in excess of 25 litres and liquid fuels shall be contained in tanks forming part of or permanently attached to the hull and made of steel or a material equivalent in respect of fire resistance.

No tanks may be located forward of the collision bulkhead.

Fuel tanks shall not have common partitions with drinking-water tanks.

Fuel tanks and their pipework and other accessories shall be laid out and arranged in such a way that neither fuel nor fuel vapours may accidentally reach the inside of the vessel.

Fuel tanks and their fittings shall not be located directly above engines or exhaust pipes.

The filler orifices for fuel tanks shall be marked distinctly.

Fuel tanks shall be provided with a suitable capacity-gauging device.

Fuel tanks shall be provided with openings having leak-proof closures that are intended to permit cleaning and inspection.

Directly at tank outlets, the pipework for the distribution of fuels shall be fitted with a quick-closing valve that can be operated from the helm position, even when the rooms in question are closed.

The actuating device for the quick-closing valve shall be marked with red colour. If it is concealed, the cover shall not be lockable and shall be marked with the symbol “Quick-closing valve operating device” in accordance with ISO 17631.

Valves on liquid fuel tanks used for fuel withdrawal or drainage shall be self-closing.

Fuel pipes, their connections, seals, and fittings shall be made of materials that are able to withstand the mechanical, chemical, and thermal stresses to which they are likely to be subjected. The fuel pipes shall not be subjected to any adverse influence of heat and it shall be possible to inspect them throughout their length.

8.6 Tanks, pipes and accessories for LPG

8.6.1 General

Individual components of the system, and the system as whole, shall be designed to withstand the combined conditions of pressure, vibrations, shocks, corrosion and movement encountered under normal operation.

All materials used in LPG systems shall be compatible with LPG and with other liquids and compounds with which it might come into contact under normal operation conditions, e.g. grease, lubrication oil, bilge solvents, fresh water and sea water.

Efforts should be made to prevent grease, lubrication oil bilge solvents and other chemicals from contaminating the marine environment.

8.6.2 Cylinders

LPG Cylinders can be used in the liquid or gas/vapour phase to fuel the main engine depending on the choice of technology and the required power.

The quantity of LPG fuel on board shall be indicated using cylinders fitted with contents gauges and/or by the provision of additional reserve cylinders of known weight.

8.6.3 Fuel system components

8.6.3.1 Pressure regulator/vaporizer

Pressure regulators/vaporizers shall be suitable for use onboard.

The materials of the pressure regulators/vaporizers which are in contact with the coolant, shall be compatible with the coolant and shall be designed to withstand a pressure of 200 kPa of the heat exchange medium.

Pressure regulators/vaporizers shall be resistant against corrosion.

8.6.3.2 Other components

The following components of the fuel system where used, shall be suitable for use on board:

a) shut-off valve;

b) gas injection device or injector;

c) gas mixing unit;

d) gas dosage unit;

e) flexible hoses and gas pipes;

f) hydrostatic relieve valve;

g) LPG filter unit;

h) pressure and/or temperature sensor;

i) service coupling;

j) electronic control unit;

k) fuel rail;

l) filler unit;

m) fuel pump;

n) quick connector.

Additional equipment required for the effective operation of the engine shall only be installed in parts of the LPG system where the pressure is less than 20 kPa.

8.6.4 Installation

8.6.4.1 General

All parts of the LPG System, apart from the cylinders, shall be permanently installed and securely fastened.

The LPG System shall be adequately protected against corrosion.

The LPG system shall function in such a manner, that the pressure for which it has been assigned and approved cannot be exceeded.

8.6.4.2 Location

All valves and other components intended to be manually operated or observed during the normal operation of the small floating machine, or for emergency purposes shall be readily accessible.

No component of the LPG System shall be located within 100 mm of the engine exhaust or similar heat source, unless adequate shielding against heat is provided. By way of derogation, the clearance between components of LPG systems and LPG cylinders shall not be less than 250 mm unless an equivalent thermal barrier is provided.

LPG cylinders and components of LPG systems shall not be installed directly above batteries, unless the batteries are protected against the effects of fuel leakage.

The distance between engine exhaust system components and an LPG cylinder shall be at least 250 mm unless an adequate thermal barrier is provided.

8.6.4.3 Fire fighting

A firefighting system shall be provided for the engine compartment

8.6.4.4 Labelling

Permanent and clearly visible labels indicating LPG shall be fixed on one or more of the following locations:

— on or close to the engine;

— on or adjacent to the cylinder housing;

— on the exterior of the small floating working machine.

8.6.5 Installation of cylinders

8.6.5.1 General

The LPG Cylinders shall:

— be stored in a specific compartment with its own overboard drain;

— securely fastened by a dedicated system to the structure of the small floating machine; this requirement also applies to unconnected cylinders;

— be installed in the correct orientation according to the cylinder manufacturer's instruction;

— be installed in such a manner that it is easily accessible and does not form an obstruction and that the emergency exit routes are not impaired.

— the extent of any cylinder movement shall not cause any pulling of pipework or hose connection.

8.6.5.2 Cylinders

Cylinders designed to be used on their sides (e.g. forklift truck type) shall be secured at the correct rotational angle (to ensure liquid off-take and pressure relief valve position).

For cylinders working on a vapour/gas phase, the pressure regulator shall be installed directly after the cylinder’s valve outlet.

8.6.5.3 Cylinder lockers

Cylinder lockers openable from inside the cockpit shall only be able to be opened upwards.

Cylinder lockers, when closed, shall be gas-tight to the interior of the small floating working machine and vented at the bottom by a drain with sufficient capacity.

The locker drain shall be run overboard. It shall either:

a) have an outlet at a level lower than the locker bottom and as high as practical, but not less than 75 mm above the at rest water line; or

b) be fitted with a forced ventilation meeting the following requirements:

   — a sensor is fitted in the locker at the lowest level where gas could accumulate;

   — the ventilation system is explosion proof;

   — the ventilation fan is flameproof and runs for a minimum of 60 seconds before the engine can be started; and

   — have at least one outlet duct situated at the base of the locker.

The outlet duct shall be

— at least 250 mm away from the engine exhaust system;

— protected from blockage by virtue of its position or other means; and

— located at least 500 mm from any hull opening to the interior of the small floating working machine.

All hoses or piping penetrating the locker walls shall be sealed at the wall to maintain gas tightness in the interior of the small floating working machine.

A sign shall be attached to the cylinder cabinet stating that no loose components shall be stored inside the cylinder cabinet that could damage the cylinder, pressure regulator and pipe or hose assembly and the mechanical ventilation (if fitted) or interfere with cabinet drainage/ventilation.

8.6.5.4 Installation of more than one cylinders

Where more than on cylinder is connected to the engine fuel line, the cylinder shall be installed so that no hydrostatic pressure built up can take place in the fuel line and that LPG cannot flow from one cylinder into the other.

8.6.6 Gas pipes and hoses

All gas piping and hoses shall be accessible for inspection, of the correct type, secure and in good condition.

Gas piping and hoses shall:

— be installed as high as practicable above the highest bilge water level;

— be routed at least 30 mm away from electrical conductors; unless the piping passes through a conduit with no joints or the conductors are sheathed or in a conduit or trunking in accordance with ISO 13297;

— be supported by fixing devices or other means, such as inside vented, non-metallic, supported conduit or piping, to prevent chafing or vibration damage;

— be secured so that they are not subject to excessive stress;

— not be in direct contact with metallic parts of the small floating working machine

— be fitted with a protective sleeve at the fixing points in order to prevent abrasion;

— be secured by clamps to the main structure of the small floating working machine or to parts rigidly connected to the main structure;

— when passing though bulkheads intended to maintain watertight integrity in the small floating working machine at the level of penetration be sealed by suitable materials or fittings at the point of penetration;

— be protected against abrasion or chafing at the point where they pass through walls or bulkheads.

Only seamless copper piping, copper nickel piping or drawn stainless steel piping, which are galvanically compatible, shall be used for rigid supply lines. The minimum wall thickness for piping up to DN/OD 12 shall be 0,8 mm and 1,5 for piping greater than DN/OD 12.

If rigid pipelines are used in parts that can move against each other, they shall be connected by flexible hose lines.

Metallic piping shall be

— protected by a rubber or plastic sleeve or coating;

— at least 100 mm from exposed terminals of electric devices or accessories.

Metallic piping routed through engine compartments shall be protected by conduit or trunking or be supported by non-abrasive attachments no more than 500 mm apart.

8.6.7 Electro installation

Fuel system electrical components shall be installed in accordance with ISO 13297.

There shall be no potential sources of ignition in LPG cylinder lockers or compartments.

Electrical devices shall be intrinsically safe when located in

— cylinder lockers;

— compartments containing valves, fittings or connections of the LPG system; or

— compartments containing appliances of the LPG system.

8.6.8 Gas detection

8.6.8.1 General

Where the engine and/or the LPG System are below deck and there is a possibility of gas accumulation, an intrinsically safe gas detection system shall be installed.

The gas detection system shall be permanently fixed to the small floating working machine and shall comply with all the following requirements:

a) be suitable for the use on board, resistant to corrosion and the entry of dust;

b) be capable of continuous operation from a low voltage source (e.g. wired directly to a battery via fuses) and indicate the operational status within 30 s after power is supplied;

c) have at least two electrical outlets for the connection of external equipment (e.g. audible alarms, bilge blowers, etc.);

d) have a latching system that continues to indicate an alarm condition until cancelled;

e) be self-checking and indicate both normal and fault conditions;

f) have fully serviceable units and be supplied with full installation and operating instructions;

g) have switches that indicate their operational condition (permanently marked);

h) have all markings visible on the unit, including the manufacturer's name and address (permanently marked),

When gas is detected at 20 % of the Lower Explosive Limit (LEL), an audible and visual warning alarm shall begin and the ventilation system described in 8.6.9 shall start automatically. The visual alarm shall not be overridden other than by turning off the electrical supply of the fuel system.

8.6.8.2 Alarm position

The alarm on the gas detection system shall be positioned to ensure that it is audible and visible from the helm position under normal operating conditions.

8.6.8.3 Sensor position

At least one sensor shall be installed in the engine compartment and one in the bilge at the lowest level where gas could accumulate, but above the highest bilge water level. If the engine compartment is also the lowest point above the highest bilge water level, only one sensor is required there.

8.6.9 Forced ventilation

Engine compartments shall have forced ventilation in accordance with ISO 11105. This ventilation system shall be explosion-proof.

The ventilation fan shall run for a minimum of 60 s before the engine can be started.

The gas detector shall be turned on at all times.

8.7 Bilge pumping and draining systems

There shall be at least one independent and self-priming bilge pump with a minimum pumping capacity of 125 l/min.

It shall be possible to pump out each watertight compartment.

8.8 Penetrations for the propeller shafts

The penetrations for the propeller shafts shall be so designed as to prevent the spread of water polluting substances.

9 Electrical equipment and installations

9.1 General

Electrical equipment and installations as well as the associated parts shall be designed, constructed, and installed in accordance with the rules of technology.

In addition, electrical equipment and installations shall

— be designed for a permanent list of the craft of up to 15° and ambient temperatures from –20 °C to +40 °C.

— be easily accessible and easy to maintain,

— be designed and installed in such a way that vibrations occurring during normal on-board operation do not lead to malfunctions or damage.

For electrical equipment and installations the following document shall be available:

— general plans concerning the entire electrical installation;

— plans of the main switchboards, the emergency switchboards, the distribution;

— plans of electronic steering control, regulating, alarm and safety systems;

— indications of power requirements for electrical service equipment;

— types of cables indicating conductor cross-sections;

— additional for electric vessel propulsion systems,

  — switchboard plans

  — documentation on the electric propulsion engines.

9.2 Protection against access to hazardous parts, against solid foreign objects, against ingress of water

The type of minimum protection in accordance with IEC 60529 for parts of a permanent electrical installation shall be

— on unroofed deck and open steering positions IP55;

— enclosed rooms IP22;

— sanitary and wet rooms IP 44.

9.3 Maximum permissible voltages

The following voltages shall not be exceeded:

— 250 V for direct and alternating current,

— 400 V for three-phase current.

Higher voltages are permissible if the following protective measures are taken:

— all HV cables (> 50 V DC) shall be orange in colour;

— all live parts shall be protected against access and marked accordingly;

— no galvanic connection between HV cables and HV conducting parts and the vehicle ground/chassis. This shall be metrologically checked before delivery of the machine;

— during operation of the machine, the galvanic isolation shall be continuously monitored by a system (insulation monitoring);

— checking the potential equalisation between the HV components (low impedance) before delivery;

— protection of the HV system by contactors and high-voltage interlock (HVIL).

For electrical installations with voltages above 50 V, protective earthing is required.

Metal parts which are not live during operation and which are accessible to contact, such as base frames and housings of electrical installations and stationary electrical equipment, shall be earthed separately, unless they are metallically conductively connected to the small floating working machine by the way they are installed in it.

Enclosures of portable electrical equipment shall be earthed by an additional protective earth conductor in the connecting cable which does not carry current during operation. This does not apply when using isolating transformers and devices with protective insulation (double insulation).

The cross-section of the protective conductors shall be in accordance with IEC 60364-5-54.

9.4 Generators, engines and transformers

Generators driven by the main engine, the propeller shaft or by an auxiliary set intended for another function shall be designed as a function of the range of rotational speeds which can occur during operation.

Transformers shall be installed in well-ventilated locations or in well-ventilated rooms.

Primary and secondary windings of transformers shall be executed in an electrically isolated manner. Autotransformers are excluded hereof.

Corresponding taps of the nominal voltage shall be provided for setting the secondary voltage of transformers. Autotransformers are excluded hereof.

Engines, generators, and transformers shall be provided by the manufacturer with a plate, which in addition to the company name, the machine's serial number and the rated power shall contain the essential rating data.

9.5 Accumulators (batteries) and their charging devices

Accumulators shall be accessible and so arranged as not to shift with movements of the craft. They shall not be placed where they will be exposed to excessive heat, extreme cold, spray, steam or vapour.

Accumulators shall not be installed in the helm station. This does not apply for accumulators:

— in mobile equipment; or

— with charging power of less than 0,2 kW.

Accumulators requiring a charging power of more than 2,0 kW shall, if gas can escape from them, be installed in a room or a cupboard which is mechanically ventilated to the open deck (supply and exhaust air). The air shall enter at the bottom and be discharged at the top so that a total evacuation of gases is

ensured. Ventilation ducts may not contain devices such as gate valves that obstruct the free passage of air.

The charging power is calculated based on the maximum charging current and the nominal voltage of the accumulator, taking into account the characteristic charging curves of the charging device.

Accumulators requiring a charging power not exceeding 2,0 kW shall be installed at well-ventilated places; they shall be protected against falling objects and dripping water.

Where mechanical ventilation is used, a fan shall be provided, preferably with an exhauster device; its motor shall be clear of the gas stream and the air stream. Fans shall be of a construction precluding the production of sparks through contact between a blade and the fan casing and shall avoid any electrostatic charges.

A symbol for 'No open fire, open ignition source and smoking prohibited' in accordance with ISO 7010, P003with a diameter of at least 10 cm shall be affixed to the doors or covers of accumulator rooms, cupboards or chests.

Charging devices shall be designed so that discharged accumulators can be recharged within a maximum of 15 hours to 80 % of their nominal capacity, without exceeding the amperage of the maximum permissible charge rate.

Only automatic charging devices which correspond to the charging characteristics of the accumulator type shall be used.

For the simultaneous supply of consumer equipment, while charging, the power requirements of the consumer equipment shall be taken into account when selecting the charger. A charging voltage of up to a maximum of 120 % of the rated voltage shall be observed irrespective of the current power requirements.

Lithium-ion accumulators shall meet the requirements of IEC 62619 and IEC 62620. Lithium-ion accumulators shall be equipped with accumulator management systems. These systems shall at a minimum comprise the following functionality:

— cell protection (short-circuit, external, internal, overcurrent, deep discharge, etc.);

— charge control, provided this is not through the charger;

— load management;

— determination of the charge level;

— balancing of the cells;

— thermal management.

Depending on use, the management system should additionally comprise the following functionality:

— determination of ageing, remaining capacity, internal resistance etc.;

— communication (e.g. with inverters and control devices);

— authentication and identification;

— history.

Other accumulator systems should be equipped with comparable accumulator management systems.

9.6 Switchgears

9.6.1 Switchboards

Equipment, switches, fuses, and switchboard instruments shall be arranged visibly and shall be accessible for maintenance and repair. Terminals for voltages up to 50 V and for voltages greater than 50 V shall be kept separate and marked appropriately.

For all switches and equipment, marker plates indicating the circuit shall be affixed to switchboards.

The nominal amperage and the circuit shall be indicated for fuses.

When equipment with an operating voltage greater than 50 V is installed behind doors, the current-carrying components of this equipment shall be protected against accidental contact while the doors are open.

The materials of switchboards shall have suitable mechanical strength, be durable, flame retardant, self-extinguishing and not be hygroscopic.

9.6.2 Switches, protective devices

Generator circuits and consumer equipment circuits shall be protected against short circuits and overcurrent on all non-earthed conductors. Switching devices triggered by short-circuiting and overload or fuses (with fuselinks) may be used for this purpose. Circuits supplying the steering system and their control circuits shall be protected only against short circuits. When circuit-breaker includes thermal release, these shall be neutralised or set at not less than twice the nominal amperage.

Consumer equipment required for propelling the small floating working machine, for the steering systems, for the rudder position indicators, for navigation or for safety systems shall be supplied by separate circuits.

The circuits of consumer equipment required for propelling and manoeuvring the small floating working machine shall be supplied directly by the main switchboard.

Switching devices shall be selected based on nominal amperage, thermal or dynamic strength and their breaking capacity. Switches shall simultaneously cut off all live conductors. The switching position shall be easily identifiable.

9.6.3 Placement of switchboards

Switchboards shall be placed in accessible and sufficiently ventilated rooms, to be protected against water and mechanical damage. Piping and air ducts shall be so arranged that in the event of a leakage the switchgear and control gear cannot be damaged. If they have imperatively to be installed near switchboards, pipes shall not have removable connections in the vicinity.

When the voltage is greater than 50 V, gratings or insulating mats shall be placed in front of the main switchboard.

9.7 Installation fittings

Cable entries shall be sized as a function of the cables to be connected and be appropriate to the types of cable used.

Sockets for distribution circuits at different voltages or frequencies shall be impossible to confuse.

9.8 Cables, insulated cables and cable systems

Cables shall be flame-retardant, self-extinguishing and resistant to water and oil.

Conductors wires of cables used for power and lighting circuits shall have a minimum cross-section of 1,5 mm^2 per conductor.

Metal armouring, shielding, and sheathing of cables shall not, under normal operating conditions, be used as conductors or for earthing.

The cross-section of conductor wires for power and lighting installations shall comply with the final permissible maximum temperature of conductor wires (maximum permissible amperage) but shall be minimum 1,5 mm^2 per conductor.

Cables shall be protected against mechanical damage.

Cable connections must be protected against mechanical load and against pulling load.

When cables pass through bulkheads or decks, the mechanical strength, water tightness and required fire protection properties (e.g. non-combustible, flame-retardant, fire-resistant) of these bulkheads and decks shall not be affected by these cable penetrations.

Cables connected to elevating wheelhouses shall be sufficiently flexible and be fitted with insulation with sufficient flexibility at temperatures down to -20 °C and resistant to steam and vapour, ultraviolet rays and ozone.

When setting up cable harness penetrations, the fire protection properties of the partition shall not be impaired.

The running of cables through areas with high ambient temperatures should be avoided. If this is not possible,

— the ambient temperatures must be taken into account when determining the maximum permissible amperage or

— the cable must be protected against damage by heat and fire.

9.9 Lighting installations

Lighting appliances shall be so installed that the heat they emit cannot set fire to nearby flammable objects or components.

Lighting appliances on open decks shall be so installed as not to impede the recognition of signal lights.

9.10 Navigation lights

If navigation lights are installed, they shall

— comply with ISO 16180;

— be supplied by a separate cable from the main switchboard;

— be supplied, protected, and controlled separately from the navigation lights switchboard, the switchboard shall be located at the helm position.

9.11 Additional requirements for electronic Installations

Only electronic devices that meet the requirements of IEC 60092-504, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4 at test degree number 3 may be installed.

10 Special provisions applicable to electric vessel propulsion motor

10.1 General

The electric main propulsion motor of the small floating machine shall consist of at least

— Two electrical power sources, irrespective of the number of main propulsion motors,

— a switchgear,

— an electric propulsion motor,

— steering positions and

— depending on the design of the electric main propulsion, the corresponding power electronics.

If the electric propulsion engines are fed by accumulators, their capacity shall be monitored and displayed. It shall be ensured that the capacity accumulators shall enable the safe reaching of a berth under the craft's own power at all times and under all conditions. In the event of a drop in the capacity of accumulators to the minimum residual capacity required pursuant, an optical and acoustic alarm is to be triggered and displayed in the helm position.

If the electric vessel propulsion is gas-electric or diesel-electric, the electrical components may not negatively affect the gas or diesel engines.

It shall be possible to shut down or deactivate electric propulsions manually in an emergency.

10.2 Generators, transformers and switchgear for electric vessel propulsion

The generators, transformers and switchgear shall be designed for

a) temporary overloads and

b) the effects of manoeuvres

according to their application and operating conditions.

The electrical power sources according to 10.1 shall be designed in such a way that it can compensate the reverse power occurring during reversing manoeuvres when considering the propulsion concept.

10.3 Electric propulsion engines for electric propulsion

According to their application and operating conditions, electric propulsion engines for electric vessel propulsion must be designed for

a) temporary overloads and

b) the effects of manoeuvres.

Electric propulsion engines shall be designed in such a way that harmonics of currents and voltages do not impair their safe operation.

The insulation of the windings shall be designed for overvoltages, which can occur due to manoeuvres and switching operations.

The main propulsion systems' propulsion engines, both electric and with external cooling, shall be dimensioned such that, should the external cooling fail, they are still capable of operating on reduced power so that the craft is at least capable of making steerageway under its own power. Electric propulsion engines shall withstand a short-circuit at their terminals and in the propulsion installation without damage under rated operating conditions until the protective device is triggered.

10.4 Power electronics for electric vessel propulsion

Power electronics shall be designed for the anticipated loads, including overload and short circuit, during all operating and manoeuvring conditions.

If power electronics are force-cooled, they shall, if their cooling system fails, be able to continue operating with reduced power while ensuring, at a minimum, in the case of electric main propulsion, that the craft is capable of making steerageway under its own power. In the event of a failure of the cooling system, an alarm is to be triggered and displayed in the wheelhouse.

10.5 Monitoring equipment

The operating state of the electric propulsion and its principal components shall be displayed at the helm position.

10.6 Control, regulation and automatic power limitation

To protect the onboard network from being overloaded, provision shall also be made for

— an automatic shutdown of the electrical equipment not relating to personal safety or safe navigation and

— where required, additional automatic power limitation of the electric propulsion engines.

In the event of individual propulsion units being shut down as a result of an automatic power limitation, the propulsion asymmetry is to be kept to a minimum.

10.7 Protection of the electric vessel propulsion

The automatic switching off of the electric vessel propulsion, which would affect the manoeuvrability of the craft, must be restricted to malfunctions that would result in significant damage within the propulsion installation.

Protective devices shall be set so that it is not triggered in the event of situations referred to in 10.2.1 and 10.3.1.

If a measured or reference value is lost or in the event of a power supply failure of the control or regulation system in accordance with Article 10.6:

— the propeller speed must not increase to inadmissible levels;

— the propulsion system must not reverse of its own accord;

— no other dangerous operating condition must arise.

If an electric vessel propulsion can be uncontrollably mechanically locked, it shall be equipped with a monitoring device, which protects the electric vessel propulsion against damage.

Each electric propulsion engine above 50 V AC or 120 V DC(see [1] for permissible contact voltage) shall be fitted with

— earth fault monitoring;

— differential protection or equivalent protective device and

— winding temperature monitoring system with an alarm trigger at high winding temperatures.

The following additional protective devices shall be provided for engines above the permissible contact voltage:

— overspeed protection;

— protection against overcurrent and short circuit;

— protection against harmful bearing currents on the electric propulsion engine by means of steep voltage edges.

It shall be ensured when protective devices are triggered that:

— the power is reduced or malfunctioning subsystems are selectively switched off;

— electric vessel propulsions are shut down in a controlled manner;

— the power stored in components and in the load circuit cannot have a detrimental impact when they are switched off.

11 Equipment

11.1 Lifebuoys and lifejackets

There shall be at least:

— one lifebuoy of recognized quality with a buoyant line of at least 30 m in length and 8 mm to 11 mm in diameter,

— for each person onboard one lifejacket in accordance with ISO 12402-2 or ISO 12402-3.

NOTE Examples for lifebuoys of recognized quality are lifebuoys according to EN 14144[2] or lifebuoys following the provisions of the 1974 International Convention for the Safety of Life at Sea[3].

11.2 Anchor equipment

Anchoring equipment, if required, shall be appropriate for the area of use.

11.3 Portable fire extinguishers

There shall be at least one 6 kg portable fire extinguisher of suitable for Class A and Class B fires in accordance with ISO 7165, if liquefied gas (Propane or LPG) is used, the fire extinguisher shall be suitable for Class C fires.

If equivalent portable fire extinguishers with a water-based extinguishing agent are used, they shall be designed for ambient temperatures of -20 °C to +50 °C.

All extinguishers shall be suitable to extinguish fires in electrical systems of up to 1 000 V.

If portable fire extinguishers are installed in such a way that they are out of sight, (e.g. in a cupboard) or poorly visible, a sign F001 “Fire extinguisher” according to ISO 7010 having a side length of at least 10 cm shall be attached.

11.4 Additional equipment

At least the following equipment shall be on board:

— a towing eye

— a rescue line

— a gaff hook

— a paddle or an oar

— a bailer

— a suitable first-aid kit; if the first-aid kit is stored under cover, the cover shall be marked by a sign E003 “First aid” according to ISO 7010 having a side length of at least 10 cm.

— a plate with instructions for rescue, resuscitation and first aid for drowning persons in accordance with ISO 18422.

12 Safety at workstations

12.1 General

Small floating working machines shall be built, arranged and equipped in such a way as to enable persons to work and move about in safety in passageways.

Permanently installed facilities that are necessary for working on board shall be arranged, laid out and secured in such a way as to permit safe and easy operation, use and maintenance. If necessary, mobile or high-temperature components shall be fitted with protective devices.

12.2 Protection against falling

Passageways shall be flat and at no point be likely to cause tripping; it shall be impossible for puddles to form.

Passageways, landings, and the top of bollards shall have non-slip surfaces.

The tops of bollards and obstacles in passageways, such as the edges of steps, shall be painted in a colour contrasting with the surrounding deck.

At work stations where persons might fall more than 1 m, or where there is a risk of falling into the water, suitable facilities and equipment shall be available for safe working.

The obligation to use the life jacket shall be indicated in at least one clearly visible place in the control station and on deck with the sign M053 “Wear personal flotation device” according to ISO 7010 with a diameter of at least 10 cm.

12.3 Access to workstations

Points of access and passageways for the movement of persons and objects shall be of sufficient size and so arranged that:

— in front of the access opening, there is sufficient room not to impede movement;

— the clear width of the passageway shall be at least 0,50 m;

— the clear height of the passageway including the sill shall not be less than 1,90 m or be safeguarded by equivalent measures.

Sentence 1 does not apply to inspection accesses that are rarely used and to accesses to the helm stations that are only equipped with seats.

Doors shall be so arranged that they can be opened and closed safely from either side. They shall be protected against accidental opening or closing.

Appropriate stairs, ladders or steps shall be installed in accesses, exits and passageways where there is more than a 0,50 m difference in floor level.

Workstations which are manned continuously shall be fitted with stairs if there is a difference in floor level of more than 1,00 m. This requirement shall not apply to emergency exits.

Small floating working machines with holds shall have at least one permanently installed means of access at each end of each hold.

12.4 Exits and emergency exits

The number, arrangement and dimensions of exits, including emergency exits, shall be in keeping with the purpose and dimensions of the relevant space. Where one of the exits is an emergency exit, it shall be clearly marked as such.

Emergency exits or windows or the covers of skylights to be used as emergency exits shall have a clear opening of not less than 0,60 m^2, whereby the smallest dimension shall be not less than 0,50 m.

12.5 Ladders, steps and similar devices

Stairs and ladders shall be securely fixed.

Stairs and ladders shall comply with the safety requirements according to Annex C.

Rungs for dog-step ladders shall comply with ISO 9519.

Ladders and separately attached rungs shall be clearly recognisable from above and shall be equipped with safety handles above exit openings.

12.6 Interior rooms

The dimensions, arrangement and layout of interior workstations shall be in keeping with the work to be carried out and shall meet the health and safety requirements. They shall be equipped with sufficient non-dazzle lighting and with sufficient ventilation arrangements. If necessary, they shall be fitted with heating appliances capable of maintaining an adequate temperature.

The floors of interior working spaces shall be solid and durable and shall be designed not to cause tripping or slipping. Openings in decks and floors shall, when open, be secured against the danger of falling.

Windows and skylights shall be so arranged and fitted that they can be operated and cleaned safely.

12.7 Protection against noise and vibration

Working spaces shall be so situated, equipped and designed that employees are not exposed to harmful vibrations.

Permanent working spaces shall, in addition, be so constructed and sound-proofed that the health and safety of employees are not affected by noise.

The protective measures against noise must be implemented in accordance with the state of the art to exclude any risk to the crew. In this context, noise emission at the point of origin must be prevented or reduced as far as possible.

The maximum permissible noise levels on board are

— at the helm station in driving mode: 70 dB(A),

— at the helm station in working mode and at other workplaces on deck: 80 dB(A),

— in the engine room if it is to be walked on while the machine is running:110 dB(A).

Individual hearing protection devices shall be available for employees who are likely to be exposed to noise levels of 80 dB(A) or more on a daily basis. At workplaces where these values reach or exceed 85 dB(A), the obligation to use hearing protection shall be indicated by the sign M003 “Wear ear protection” according to ISO 7010 with a diameter of at least 10 cm.

13 Working gear

13.1 Accessory equipment

The accessory equipment (e.g. tools, booms), shall at least comply with ISO 12100 and ISO 13857, this does not apply to the chassis and substructure of the equipment.

13.2 Mobile and temporary machinery/work equipment

When using mobile and temporary machinery/work equipment placed on the float, the stability shall comply with ISO 4254-1.

13.3 Winches

Winches shall comply with Annex D.

13.4 Cranes

Cranes shall be built in accordance with best practice. The forces arising during their operation shall be safely transmitted into the vessel's structure; they shall not impair its stability.

The maximum permissible loadings may not exceed 2 000 kg. The maximum permissible loadings shall be permanently marked in a clearly legible manner on cranes.

The presence of devices to protect against crushing or shearing hazards is mandatory. The outer parts of the crane shall leave a minimum safety clearance of 0,50 m relative to fixed superstructure in workstations and passageways.

Power driven cranes shall at least comply with the following requirements:

— it shall be possible to protect them against unauthorised use;

— It shall only be possible to start them up from the crane's driving position;

— the controls shall be of the automatic return type (buttons without stops); their operating direction shall be unambiguously clear;

— if the motive power fails, it shall not be possible for the load to drop in an uncontrolled manner;

— unintentional crane movements shall be prevented;

— any upward movement of the hoisting device and any exceeding of the safe working load shall be limited by an appropriate device;

— any downward movement of the hoisting device shall be limited if under any envisaged operating conditions at the moment of attaching the hook there can be less than two cable windings on the drum;

— The corresponding counter movement shall still be possible after the automatic limiting devices have been actuated;

— the breaking load of the cables for running rigging shall correspond to five times the cable's permissible loading. The cable construction shall be faultless and the design shall be suitable for use on cranes.

14 Fuel-fired heating equipment

Forced-air heating appliances consisting of a combustion chamber around which the heating air is conducted under pressure to a distribution system or to a room shall meet ISO 14895 and the following requirements:

— Only liquid fuels with a flash point above 55 °C may be used.

— If the fuel is atomised under pressure the combustion air shall be supplied by a blower.

— The combustion chamber shall be well ventilated before the burner can be lit. Ventilation may be considered complete when the combustion air blower continues to operate after the flame has gone out.

— The fuel supply shall be automatically cut off if:

  — the fire goes out;

  — the supply of combustion air is not sufficient;

  — the heated air exceeds a previously set temperature; or

  — the power supply of the safety devices fails.

  In the above cases, the fuel supply shall not be re-established automatically after being cut off.

— It shall be possible to switch off the combustion air and heating air blowers from outside the room where the heating appliance is located.

— Where heating air is drawn from outside, the intake vents shall be located as far as possible above the deck. They shall be installed in such a manner that rain and spray water cannot enter.

— It shall not be possible for forced-air heating appliances to draw their heating air from an engine room.

— Heating air pipes shall be made of metal.

— It shall not be possible to close the heating air outlet apertures completely.

— It shall not be possible for any leaking fuel to reach the heating air pipes.

15 Owner’s manual

15.1 Basics

The manufacturer of the small floating working machine shall supply an owner’s manual in accordance with ISO 10240.

15.2 Range of use

Manufacturer's statement regarding the maximum flow velocity of the water of use as follows:

“This small floating working machine is suitable for waters with a flow velocity up to ... km/h”.

Manufacturer's statement regarding maximum towing speed as follows:

“This small floating working machine may be towed at a maximum speed of ... km/h”.

15.3 References to tests to be carried out during operation

In the owner's manual it shall be pointed out that the small floating working machine shall be tested according to the manufacturer's instructions:

— after standstill periods of one year or more by a competent person,

— after substantial modifications by an expert and

— at regular intervals, at least once a year, by a competent person.

15.4 Cranes

15.4.1 Cranes operating instructions

The crane manufacturer shall provide operating instructions. These shall include at least the following information:

— operating range and function of the controls;

— maximum permissible safe working load as a function of the reach;

— maximum permissible inclination of the crane;

— assembly and maintenance instructions;

— general technical data.

15.4.2 Periodic inspection of cranes by an expert

The owner's manual shall state that cranes on small floating machines shall be inspected by an expert:

— before recommissioning after a major modification or maintenance, and

— at regular intervals, but at least every ten years.

In this inspection proof of adequate strength and stability shall be provided by calculations and an on-board load test. The expert may decide that the proof by calculation may be fully or partly replaced by a test with a load 1,25 times the safe working load carried out over the full working range.

15.4.3 Regularly checks of cranes by a competent person

The owner's manual shall state that the crane shall be checked regularly and in any case at least every year, by a competent person. During that inspection the safe working condition of the crane shall be determined by a visual check and an operating check.

15.5 Electric propulsion

The owner's manual shall state that the electric propulsion of a small floating working machine shall be checked by an expert

— before being put back into service after any major modification and

— according to the manufacturer's instructions at regular intervals, at least once a year.

16 Marking of small floating working machines (Data plate)

The following marking shall be at least attached permanently to the small floating working machine:

— ISO/DIS 20650:2023 (This standard);

— Company name and full address of the manufacturer or authorised representative;

— Designation of the machine;

— Series or type designation, serial number if applicable;

— year of construction;

— Number of persons for which the small floating working machine is equipped;

— Unladen weight and max. load.

17 Testing

17.1 General

17.1.1 Range

The testing of the safety requirements for small floating machinery shall be carried out in accordance with the specifications of this standard by visual inspection and measurement as well as presentation of manufacturer's certificates and practical testing by an expert.

17.1.2 Individual testing and type testing

In the case of individually manufactured small floating working machines, the test shall be in the form of an individual test. In the case of small floating working machines manufactured in series, the test shall be performed in the form of a type test.

17.1.3 Specimen selection for type testing

For each series, up to a maximum of 20 small floating working machines, one small floating working machine shall be selected at random.

17.2 Basic tests

17.2.1 Visual inspection and measurement

Verification of the fulfilment of any requirements of 17.3 to 17.9, which do not refer to a test, shall be done by visual inspection and measurement.

17.2.2 Presentation of manufacturer's certificates

Verification of the fulfilment of the requirements for materials, components and (partly completed) machinery used shall be demonstrated by manufacturer's certificates.

17.3 Strength

The test of adequate strength of small floating working machines shall be carried out by calculation.

The calculation of the strength of the float may be omitted if its bottom and side plates are made of S 235 B in accordance with ISO 630-2 or higher with a thickness of at least 3 mm.

17.4 Stability

Verification of the adequate stability of small floating working machines shall be carried out by calculation in accordance with the procedure specified in Annex A.

17.5 Safety against sinking

The verification of adequate safety against the sinking of small floating working machines shall be carried out by calculation.

17.6 Manoeuvring characteristics

The sufficient driving and manoeuvring characteristics, as well as the sufficient minimum speed of small floating working machines, shall be verified in accordance with the test requirements in Annex B.

17.7 Noise limit values

Adherence to the limit values for noise (intrinsic noise level at the operator's station, driving noise of the small floating working machine at a lateral distance of 25 m from the ship's side, identification of workplaces where there is a daily noise exposure of more than 80 dB(A); recreation rooms, if any) as well as for the sound pressure level of the warning signals shall be verified with the following test procedure:

The sound level measurements for the driving and working noise shall be measured at a lateral distance of 25 m between the ship's side of the small floating working machine and the microphone according to ISO 2922.

The sound levels for the measurements shall be

— at/ in the open helm station

— during operation of the working equipment (e.g. mower, grapple),

— during driving operations,

— at other workplaces on board,

— in recreation rooms (if any),

measured according to ISO 2923.

17.8 Cranes

Cranes shall be inspected before being put into service for the first time.

The following shall be demonstrated:

— sufficient strength and adequate stability by calculation or by a load test on board,

— compliance with the rules of technology,

— that the upward movement of the hoist and the exceeding of the working load are limited by suitable devices,

— the protective devices against crushing and shearing hazards,

— the safety distances of at least 50 cm from moving external parts to fixed components of the vehicle within the working area and traffic routes or according to ISO 13857.

— the downward movement of the hoist, if under any envisaged operating conditions at the moment of attaching the hook there can be less than two cable windings on the drum, is limited by suitable devices.

For the load test, the proof shall be provided by a test with 1,25 times the payload, which is driven over the full travel distance (360° or, if the use is restricted, from stop to stop). The resulting heeling and trim angles shall be documented for the payload and the 1,25 payload.

17.9 Electrical propulsion

The electrical propulsion shall be tested by an expert in accordance with the manufacturer's instructions.

17.10 Stairs

Sufficient strength is deemed to be given if the following conditions are met:

Stair treads shall be designed for an individual load of at least 1,5 kN. If the load assumption of 5 kN/m^2 results in greater values, these shall be used for the calculation.

When installed, the staircase shall withstand a load corresponding to 50 % of the sum of the underlying step loads; no permanent deformations shall occur.

Handrails and railings shall be able to withstand an applied force of 0,5 kN at any point without permanent deformation and shall not be deflected more than 20 mm.

17.11 Climbing devices

Sufficient strength is deemed to be given if the following conditions are met:

The dimensioning and the welds of the rungs and the handle shall be such that they withstand a load of 1,0 kN with fivefold safety against breakage.

The dimensioning and the welds of the stiles and the brackets shall be such that they withstand a load of 1,5 kN per started 2 m length of the fixed ladder at a statically unfavourable point against permanent deformation.

Annex A
(normative)

Proof of stablility

A.1 Requirement

It shall be confirmed that, when considering the loads applied during operation of the working gear and whilst under way, the residual freeboard and the residual safety clearance are sufficient. For that purpose, the sum of the trim and heeling angles shall not exceed 10° and the bottom of the float shall not emerge.

A.2 Heeling test

The proof of stability shall be based on a properly conducted and documented heeling test.

A.3 Data and documents

The proof of stability shall include the following data and documents:

a) scale drawings of floating objects and working gear and the detailed data relating to these that are needed to provide proof of stability, such as the content of the tanks, openings providing access to the inside of the vessel;

b) hydrostatic data or curves;

c) description of the operating conditions together with the corresponding data concerning weight and centre of gravity, including its unladen state and the equipment situation as regards transport;

d) calculation of the heeling, trimming and righting moments, with a specification of the trim and heeling angles and the corresponding residual freeboard and residual safety clearances;

e) a compilation of the results of the calculation with a specification of the limits for operation and the maximum loads.

A.4 Load assumptions

The proof of stability shall be based on at least the following load assumptions:

a) specific mass of the dredging products for dredgers:

   — sands and gravels: 1,5 t/m^3,

   — very wet sands: 2,0 t/m^3,

   — soil, on average: 1,8 t/m^3,

   — mixture of sand and water in the ducts: 1,3 t/m^3;

b) specific mass of the aquatic plants (wet) 0,25 t/m^3

A.5 Moments

The proof of stability shall take account of the moments resulting from:

a) from load or from mobile and temporarily arranged machines/work equipment on the floating body;

b) from structural asymmetries;

c) from wind pressure in accordance with the following formula:

$$M_w = c \cdot P_w \cdot A_w \cdot (l_w + T/2)\,[kNm]$$

where

c = shape-dependent coefficient of resistance

For frameworks c = 1,2 and for solid-section beams c = 1,6. Both values take account of gusts of wind. The whole area encompassed by the contour line of the framework shall be taken to be the surface area exposed to the wind.

P_w = specific wind pressure; this shall uniformly be taken to be 0,25 kN/m^2;

A_w = lateral plane of the vessel above the plane of draught according to the considered loading condition in [m^2];

l_w = distance of the centre of gravity of the lateral plane A_w from the plane of draught according to the considered loading condition in [m];

T = vertical distance in m between the lowest point of the hull without taking into account the keel or other fixed attachments and the maximum draught line.

d) from the centrifugal force, caused by the turning of the small floating working machinery, according to the formula:

$$M\mathrm{dr} = c\mathrm{dr} \cdot C\mathrm{b} \cdot v^2 \cdot D / L\mathrm{WL} \cdot (KG - T/2)\,[kNm]$$

where:

Cdr = a coefficient of 0,45;

Cb = the block coefficient (if not known, this shall be set 1,0);

v = the maximum speed of the small floating working machine in [m/s];

KG = the distance of the centre of gravity from the top of the keel in [m]...;

e) crossflow, if the manufacturer allows this application;

f) ballast and provisions; the most unfavourable degree of filling of the tanks for stability shall be determined and the corresponding moment used in the calculation;

g) deck loads and, where appropriate cargo;

h) free surfaces of liquids;

i) dynamic inertia forces; this shall be adequately taken into account if movements of the load and working equipment are expected to affect stability;

j) other mechanical devices.

The moments which may act simultaneously shall be added up.

A.6 Righting moments

The righting moments for floating objects with vertical side walls shall be calculated using the following formula

$$MR = 10 \cdot D \cdot \overline{MG} \cdot \sin\varphi\,[kNm]$$

where

$\overline{MG}$ = metacentric height, in m;

φ = heeling angle, in degrees.

That formula shall apply up to heeling angles of 5° or up to a heeling angle corresponding to the immersion of the edge of the deck or emergence of the edge of the bottom; the smallest angle shall be decisive.

Annex B
(normative)

Manoeuvrability

B.1 General

Small floating working machines shall fulfill the following requirements regarding navigability and maneuverability as well as minimum speed.

The tests according to B.2 shall be carried out on a fully equipped small floating working machine which is loaded to its load-bearing capacity (simulated e.g. by sandbags).

B.2 Trial

B.2.1 Engine rating

The tests shall be carried out at the maximum permissible engine rating.

B.2.2 Turning circle

The turning circle test shall be carried out at full speed turning, using full steering lock, to starboard and to port and:

a) the turning circle diameter shall not exceed 3 x *L*;

b) no stability-critical situation shall result;

c) the upper edge of the gunwale shall not immerse into the water.

B.2.3 Z-manoeuvre

In a Z-manoeuvre carried out at full speed over 200 m using full steering lock to each side, no stability-critical situations or rocking motions shall result.

B.2.4 Stopping test

For the stopping test, the ignition is interrupted from full speed. No water may come into the small floating working machine.

B.2.5 Reversing test

During reversing at approximately 2 km/h in relation to the water, the arch board shall not dip under the surface and the boat shall remain steady on course.

B.2.6 Towing test

With a “full astern” static bollard pull, the towing ring and its fastenings shall not show any signs of damage. The proof of strength may also be provided by static calculation.

Annex C
(normative)

Safety requirements on stairs and ladders

C.1 Stairs

C.1.1 Inclination angle

Stairs shall have an inclination angle between 30° and 40°.

C.1.2 Steps

C.1.2.1 Space between steps

The space between steps shall be 200 mm +/- 30 mm. Deviating from this, the step spacing of stairs for a height difference of less than 1,0 m may be up to 270 mm.

The dimensional deviation of all steps in a staircase may not exceed ±2 mm.

The uppermost step of a stair shall be at the same horizontal level as the adjacent landing or shall end one normal step underneath. The lowest step of a stair shall be at the same horizontal level as the adjacent landing or shall end one normal step above.

C.1.2.2 Depth of treads

The depth of treads – depending on the inclination angle - shall comply with Table 1.

Table 1 — Depth of treads

Dimensions in millimetres

Inclination angle	30° – < 45°	45° – < 50°	50° – < 55°	55° – < 60°	60°
Depth of treads	≥ 260	≥ 230	≥ 200	≥ 175	≥ 150

C.1.2.3 Safety of the treads

Stair treads of stairs shall

— be level;

— have an anti-slip surface;

— be easy to clean; and

— be designed in such a way that water cannot accumulate on them.

The leading edge of the steps shall be designed in such a way that there is no risk of slipping or tripping.

C.1.3 Handrails and Railings

Stairs with up to three steps shall have a handhold on one side for holding. Stairs with more than three steps shall have handrails or handholds on both sides.

Railings for stairs with inclination angle up to 55° shall have an intermediate rail at half the railing height.

Handrails or railings shall be continuous over the full length of the stairway. At their upper ends they shall be suitably connected to structures or other continuous railings. At their lower ends handrails and railings shall extend to the vertical line above the outermost point of the string.

Handrails shall be designed in such a way that their connectors do not hinder the continuous movement of the hands. Their distance g from adjacent structures shall be at least 60 mm; their ends shall be arranged to prevent injuries and to avoid damage to clothes.

C.1.4 Headroom above stairs

The headroom above stairs shall be at least 2 100 mm.

C.1.5 Strength

Stairs including handrails and railings shall have sufficient strength and be firmly installed.

Test according to 17.10.

C.1.6 Safety against fire

Stairs shall be made of non-combustible material, e.g. steel.

C.2 Ladders

C.2.1 General

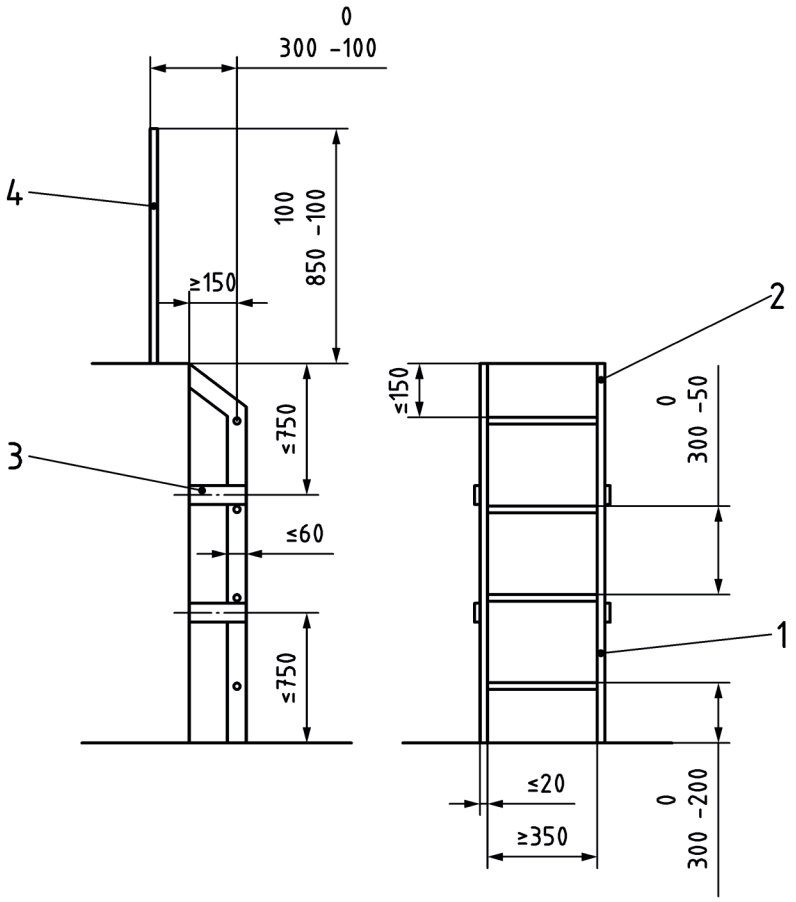
Fixed ladders shall be firmly installed and manufactured in such a way that they do not cause injury or snagging or unsafe treading when climbed.

The treads within a fixed ladder and the distances between the treads shall be uniform.

The dimensions shall comply with Figure C.1. The distance of the top tread of the fixed ladder from the top access may not exceed 150 mm, the distance of the bottom tread from the bottom access should be the same as the distance between the rungs, but shall be between 100 mm and 300 mm, see Figure C.1.

Fixed ladders may be inclined up to 15° from the vertical so that they are easy to walk on. They may not be inclined backwards. The upper and lower ends of the stringers shall be connected to the wall and floor to avoid snagging.

Dimensions in millimetres



Key

1 rung
2 stringer
3 mounting bracket
4 holding bar

Figure C.1 — Ladder with holding bar

C.2.2 Parts

C.2.2.1 Stringers

Stringers shall be suitable for safe gripping.

C.2.2.2 Rungs

The rungs shall be suitable for safe ripping.

They shall be designed as a square profile standing on its tip, which shall have a side length between 20 mm and 30 mm.

C.2.2.3 Holding bar

The upper access to the ladder shall be provided with a holding bar to allow safe transfer from the ladder to the access and vice versa.

A circular profile with a diameter of 20 mm to 34 mm shall be used for the holding bar.

Vertical tubular constructions of at least 1,00 m length above the top rung may be used instead of a holding bar.

C.3 Strength

Ladders shall have sufficient strength and be firmly installed.

Test according to 17.11.

C.4 Material

For steel fixed ladders,

— the rungs shall be made of square steel in accordance with ISO 1035-2,

— the stringers and their supports of flat steel shall be made of flat steel in accordance with ISO 1035-3,

— the holding bar shall be made of round steel in accordance with ISO 1035-1.

If materials other than steel are used, the fixed ladders shall have the same strength characteristics and shall be non-combustible.

Annex D
(normative)

Safety requirements for winches

D.1 General provisions

Winches shall be constructed so that their function is not adversely affected by vibration, the tilt of the vessel or the weather.

D.2 Strength requirements

The drum load shall not exceed 0,25 x minimum breaking force of the design rope or chain.

The holding load shall be between 0,8 and < 1,0 of the minimum breaking force of the design rope or chain.

All parts of the winches shall be designed and secured so that they withstand the minimum breaking force of the rope or breaking force of the chain with a safety factor of 1,3, relative to the yield point of the components.

D.3 Maintenance

Winches shall be constructed so that they are accessible for maintenance work.

It shall be possible to check the brake linings visually without removing the cover.

Lubrication points shall be identifiable and readily accessible. They shall be arranged so that if lubrication is carried out correctly, the effectiveness of the safety devices is not impaired by dripping lubricant.

D.4 Locking devices

Winches shall have locking devices preventing the rope or chain from running back unintentionally under load during lifting or making fast. They shall operate automatically and be constructed so that they can only be rendered ineffective by the use of tools.

Ratchet wheels and pawls shall not be made of cast iron

The locking devices may be designed, e.g. as

— ratchet wheel and pawl;

— self-acting brake or

— check valve.

D.5 Brakes

Winches shall be equipped with a brake designed for a holding load as specified in D.2.

If a power-driven brake is released, a hand-operated emergency release device shall be provided.

Brakes shall operate without producing any harmful impact or inadmissible temperature rise.

D.6 Operating elements

Operating elements shall be

— locked against unintentional operation;

— arranged so that no hazards can occur during operation from the running rope or running chain.

Power drives and couplings shall be marked in accordance with their function.

For winches with a power drive

— a red emergency stop device shall be provided;

— the drive operating elements shall return automatically to the zero position when released.

D.7 Rope reels

Wire ropes shall be attached to the rope reel with a securing device so that the holding load is securely taken up with three windings of the rope.

The direction or rotation of the rope reel shall be identifiable with the wire rope wound on.

The rope reel shall have flanges or other suitable devices to prevent lateral run-off of the rope. Flanges shall be high enough that they project a distance of at least 1½ times the rope diameter above the outermost layer with the useful length of the rope fully wound on.

For wire ropes, the reel diameter shall be at least 16 times the nominal diameter of the rope.

D.8 Safety devices

If reciprocating internal combustion engines for winches are started by means of a handle, it shall meet the requirements of ISO 11102-1 or equivalent.

Drawing-in points at the gearwheels and shaft flanges shall be fitted with guards. These shall not be capable of being detached without the use of a tool.

D.9 Handle kick back limiter

The handles shall have devices to prevent kick back.

Kick back limiters shall be permanently installed. They shall be designed and arranged so that they can only be rendered ineffective with the use of tools. Safe turning of the handle shall be ensured in each direction of rotation under load, whatever the gearing between the handle shaft and the load shaft. When releasing the handle, the kick back shall not exceed 150 mm and the handle shall not come off.

If there are two handles on a winch, they shall be designed so that operation of one of them does not impair the kick back protection on the other.

D.10 Manual drive

The manual drive of the winches shall have gearing that limits the maximum force to be applied to the handle to 150 N.

The direction of rotation of the handle shall remain the same whatever the gearing.

Handles shall have rotatable grips that cannot be removed.

There shall be no crushing points between the grip and the other handle parts or between the handles and the fixed and moving parts of the winch.

D.11 Handles on winches with manual drive and power drive

Winches with manual drive and power drive shall be equipped so that the power drive cannot set the manual drive shaft in motion.

The requirements of D.9 and D.10 shall apply to handles of winches with manual drive and power drive.

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