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Ships and marine technology — Potable water supply on ships and marine structures —

Part 1: Planning and design

Navires et technologie maritime — Approvisionnement en eau potable sur navires et structures maritimes —

Partie 1: Planification et conception

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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

Attention is drawn to the possibility that some of the elements of this part of ISO 15748 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15748-1 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

ISO 15748 consists of the following parts, under the general title *Ships and marine technology — Potable water supply on ships and marine structures*:

— *Part 1: Planning and design*

— *Part 2: Method of calculation*

Annexes A, B and C of this part of ISO 15748 are for information only.

Ships and marine technology — Potable water supply on ships and marine structures —

Part 1: Planning and design

1 Scope

This part of ISO 15748 applies to the planning, design and configuration of potable water supply systems on ships, stationary or floating marine structures and inland navigation vessels.

This part of ISO 15748 specifies the minimum requirements for potable water supply systems to be met in order to protect the potable water and to maintain its quality.

It also provides hints on components to be used and on laying of the pipelines.

NOTE The transfer of potable water and the regulations to be observed are not covered by this part of ISO 15748. The transfer of potable water is subject to special regulations.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15748. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15748 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the thread — Part 1: Dimensions, tolerances and designation*

ISO 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1*

ISO 161-1, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 274, *Copper tubes of circular section — Dimensions*

ISO 426-2, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products — Part 2: Leaded copper-zinc alloys*

ISO 1127, *Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length*

ISO 1635, *Wrought copper and copper alloys — Round tubes for general purposes — Mechanical properties*

ISO 4200, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length*

ISO 5620-1, *Shipbuilding and marine structures — Filling connection for drinking water tanks — Part 1: General requirements*

ISO 14726-1, *Ships and marine technology — Identification colours for the contents of piping systems — Part 1: Main colours and media*

ISO 14726-2[1)], *Ships and marine technology — Identification colours for the contents of piping systems — Part 2: Additional colours for different media and/or functions*

ISO 15748-2, *Ships and marine technology — Potable water supply on ships and marine structures — Part 2: Method of calculation*

SOLAS 1974, *International Convention for the Safety of Life at Sea, 1974*

3 Terms and definitions

For the purposes of this part of ISO 15748, the following terms and definitions apply.

3.1
potable water supply system
system for the generation, treatment, transfer, conveyance, storage, transport and distribution of potable water

3.2
water treatment plant
equipment for treating potable water whilst maintaining potable water properties, e.g. using filters, dosage plants, ion exchangers, disinfecting plants

3.3
potable water heaters
appliances used to heat potable water without affecting its properties for consumption apart from a change in temperature, e.g. continuous-flow water heaters, storage heaters

3.4
apparatus
collective term for technical installations making use of and/or transforming potable water

EXAMPLE

— distillation and sterilization apparatus;

— large-scale cooking equipment, dosage plant;

— pressurized water reservoirs, water heaters;

— dishwashers, coffee machines, as well as devices of all kinds forming part of the potable water system or connected temporarily or permanently to it, except for supply and circulating pumps.

3.5
water
collective term for all types of water used for water supply

1) To be published

3.6
raw water
untreated water

NOTE Raw water and sea water are considered equivalent.

3.7
freshwater
water originally intended for human consumption and use on board as potable water but also used for certain technical purposes and for sanitary-hygienic needs

3.8
potable water
water suitable for human consumption and use in compliance with the quality requirements laid down in the applicable statutory provisions, defined in this part of ISO 15748 as:

a) water from a central public potable water supply;

b) water converted from sea water by evaporation at temperatures exceeding 80 °C;

c) water converted from sea water by evaporation at temperatures below 80 °C, and which has additionally been sterilized;

d) water generated by reverse osmosis;

e) hot potable water heated in suitable water heaters.

3.9
cold water
cold potable water at temperatures between 5 °C and 25 °C

NOTE The upper temperature limit may be higher e.g. in the tropics.

3.10
hot water
hot potable water at temperatures between 50 °C and 90 °C, usually up to 60 °C

3.11
mixed water
hot and cold potable water mixed by means of a mixer tap

3.12
potable water line
pipeline exclusively carrying potable water

3.13
supply line
entire potable water pipeline system downstream of the discharge (supply) pump

3.14
water main
section of piping between the discharge pump and the point where the cold water line branches off from the line leading to the central water heater

3.15
distribution line
section of the supply line downstream of the watermain

3.16
ring line
distribution line providing bidirectional water supply by way of loop-type installation

3.17
hot-water ring line
distribution line for unidirectional supply only with water circulation by means of a circulating pump to feed back unused hot water to the water heater

3.18
circulating line
section of the cold/hot-water ring line without dispensing point, via which unused cold water is fed back to the suction side of the supply pump or unused hot water is fed back to the water heater

3.19
trunk line
riser
vertical section of the supply line branching off from a distribution line

NOTE Deck lines and dispensing lines branch off from trunk lines.

3.20
deck line
section of the supply line branching off from the trunk line within one deck

3.21
service line
single feed line
section of the supply line leading from the deck line to the consumer

3.22
pump discharge line
discharge line downstream of the discharge outlet of a pump

3.23
pump return line
line through which water is fed to the pump

3.24
service fitting/outlet fitting
fitting for shutting off, releasing and controlling the volume flow at the end of a supply line, the outlet side thereof being in accordance with the service function, e.g. equipment valve, outlet valve, flush valve, mixer tap

3.25
safety fitting
fitting to protect system parts against inadmissible pressure and temperature transgressions, e.g. safety valves

3.26
protective fitting
fitting to protect the water characteristics in the piping system, e.g. vacuum breakers in connection with non-return valves, pipe disconnectors

3.27
filter
device for extraction of solid matter from potable water

3.28
calculation flow
assumed flow at the service fitting taken as calculation basis:

$$\dot{V}_R = \left(\dot{V}_{min} + \dot{V}_0\right)/2$$

where

$\dot{V}_R$ is the calculation flow, expressed in litres per second;

$\dot{V}_{min}$ is the minimum flow, expressed in litres per second;

$\dot{V}_0$ is the peak flow, expressed in litres per second.

3.29
sum flow
sum of the calculation flows for all water-consuming units served via one cross-section

3.30
peak flow
flow decisive for hydraulic calculation, taking into consideration probable simultaneous water withdrawals during operation

3.31
closed continuous flow heater
water heater resistant to pressure wherein the water is heated whilst passing the heater, with or without storage

3.32
open storage heater
pressureless water heater, heating and storing water in a container which is part of the storage heater

4 Capacity requirements

On ships, marine structures and inland waterway craft, pure potable water shall always be available in sufficient quantity. The potable water supply system shall be sized and designed accordingly.

Depending on needs, sufficiently sized potable water storage tanks and/or plants for the conversion of sea water to potable water shall be provided.

Any accommodation areas on ships and marine structures that are not provided with a dispensing facility from a central potable water supply shall be equipped with a sufficiently sized potable water container.

5 Sanitary requirements

5.1 Potable water

The quality of the potable water shall be such that its consumption and use will not affect human health, particularly as far as pathogenic microorganisms are concerned; i.e. potable water

— shall be free of pathogenic microorganisms;

— shall be as sterile as possible;

— should be palatable (it shall be colourless, clear, cool, odourless and acceptable with respect to taste);

— may only contain traces of dissolved minerals.

As far as health considerations are concerned, the potable water characteristics shall comply with the potable water regulations stated by the authorized national governmental bodies.

5.2 Protection of the potable water, maintenance of the potable water quality

5.2.1 Potable water supply systems shall be fitted with a means of sterilizing water transferred from land-based facilities or water stored on board for a prolonged period of time.

5.2.2 It is not permissible to connect potable water lines to lines or facilities carrying water which is not potable (e.g. cooling freshwater lines); there shall be a hygienically reliable separation between these lines, which may be achieved, e.g.

— by means of a free air line;

— by means of an indirect connection via the storage units (water supply via a free air line);

— by means of a pipe disconnector;

— by means of a back flow preventer.

5.2.3 Potable water dispensing points where a backflow of water is possible shall be secured by means of protective fittings in accordance with 3.26.

5.2.4 Any material, auxiliary material or protective coating used shall be safe from a hygienic and physiological point of view, and shall be sufficiently resistant to any physical, chemical or corrosive stress to be anticipated. It shall not release any substances which may influence the digestibility, taste, smell or colour of the potable water. If applicable, the coating shall comply with the requirements of national authorities.

Pressurized components shall not be negatively influenced by water temperatures of up to 90 °C. For service fittings the maximum temperature is 70 °C.

5.2.5 Internal corrosion shall be prevented as far as possible by selecting and using materials that are suitable for potable water (cold or hot) and that are compatible with each other.

5.2.6 Compressed-air cushions directly contacting the water surface inside the pressurized reservoir shall not impair the quality of the potable water.

5.2.7 Plastics and other non-metallic materials shall conform to the requirements and recommendations concerning the suitability of these materials to potable water, stated by the authorized national bodies.

6 Potable water supply systems

A potable water supply system includes all facilities, piping and apparatus serving to transfer, store, treat, transport or dispense potable water. Also included in this definition are facilities serving to produce potable water, e.g. distillation from sea water.

If the potable water is conveyed through apparatus and facilities that will impair its alimentary quality as defined by the regulations, the potable water system terminates at the assigned safety fitting. The following components may be included in potable water supply systems:

— potable water tanks;

— transfer, operating and service lines;

— pumps;

— pressurized water reservoirs;

— potable water heaters;

— potable water treatment plants;

— potable water distillation plants;

— fittings (shut-off, safety, protection and supply or outlet fittings);

— measuring and control devices. Figure 1 shows an example of realization of a potable water supply system.

7 Technical requirements

7.1 Associated regulations

In planning the installation of potable water supply systems, the following regulations and directives shall be observed:

— rules for classification and construction of seagoing ships stated by the relevant classification society;

— technical rules given by a marine employer's liability insurance (if applicable);

— nationally-stated requirements concerning potable water systems.

7.2 Identification marking

Fittings and appliances shall be marked legibly and permanently with the manufacturer's designation or name in order to readily provide identification of the product at any time. The marking shall comply with the applicable regulations.

7.3 Pressure and temperature

7.3.1 For safety reasons all components shall be designed to sustain the same working pressures; this pressure shall comply with the highest set pressure of a safety valve within the system.

7.3.2 Pressure surges and drops occurring during operation shall not exceed the applicable limits (see ISO 15748-2). This, and the admissible flow rates, shall be taken into consideration when selecting the fittings.

7.3.3 Temperature increases in cold water pipes shall be prevented by suitable means; see explanations in annex A.

7.3.4 The water temperature in hot water pipes shall be at least 50 °C; see explanations in annex A.

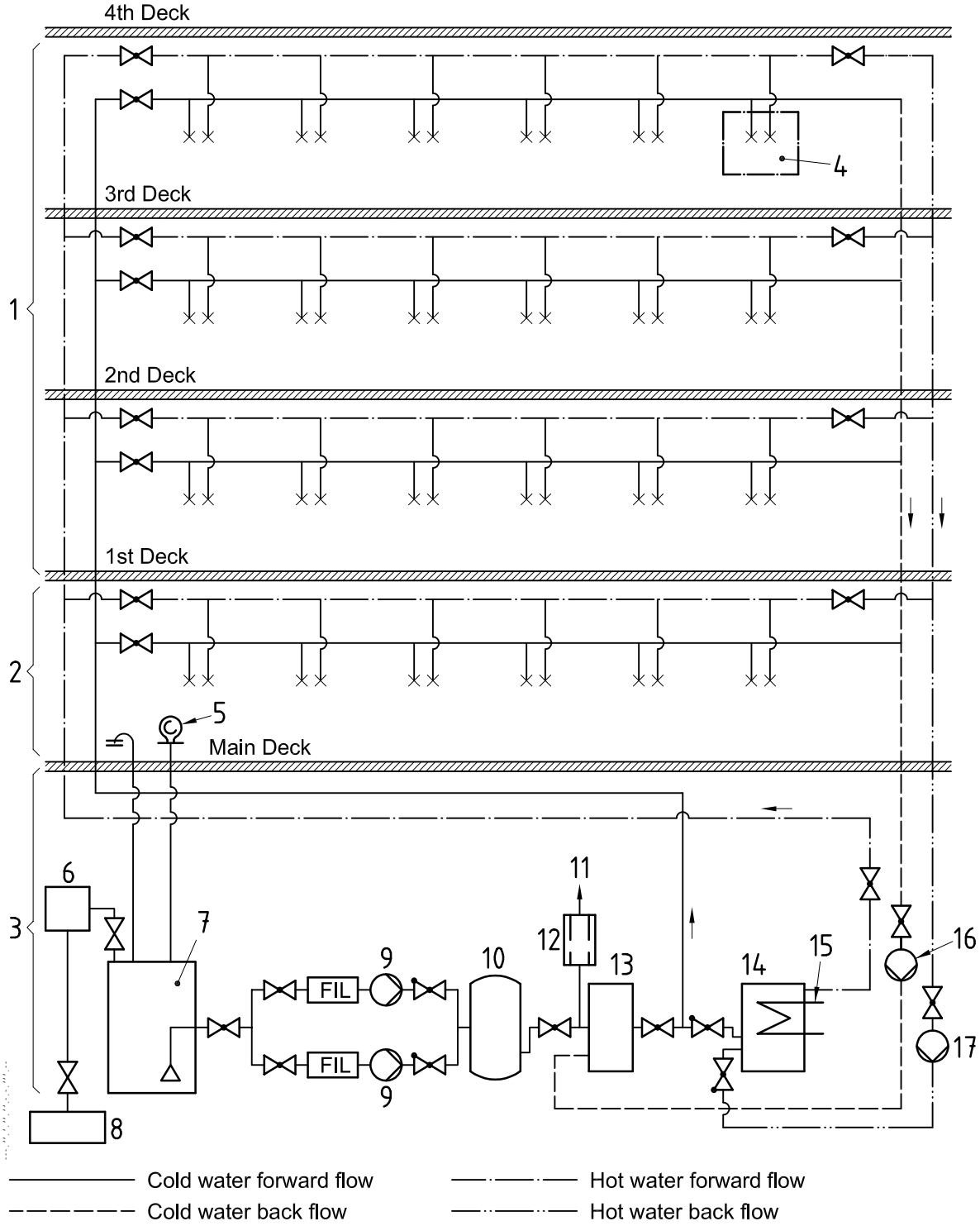
8 Pipelines

8.1 Air pipes, filling pipes and overflow pipes

For air pipes, filling pipes and overflow pipes see the requirements of the relevant classification society. The filling connection for drinking water tanks shall be in accordance with ISO 5620-1.

8.2 Sounding pipes

For sanitary reasons, sounding pipes for operational gauging in potable water tanks are not permitted. To check the level, fluid level gauges or devices for measuring tank contents shall be installed.



Key

1 Accommodation area with showers/W.C.
2 Commissary area
3 Engine room
4 Shower/W.C.
5 Filling connection for potable water tanks (see ISO 5620-1)
6 Potable water generator
7 Drinking water tank
8 Sea chest
9 Potable water supply pump
10 Pressure tank
11 Technical load
12 Pipe disconnector
13 Sterilization
14 Water heater
15 Heating medium
16 Cold water circulating pump
17 Hot water circulating pump

Figure 1 — Example of a potable water supply system on a ship with four superstructure decks

9 Pipes and pipe dimensions

For potable water piping systems the pipes and pipe dimensions given in Tables B.1 to B.3 may be used taking the installation and operating instructions, and the respective regulations devised by the cognizant authorities into consideration.

10 Fittings and pipe joints

10.1 Fittings and flanged joints

Taking installation and operating instructions into consideration, the fittings and flanged joints to be selected for the pipes listed in Tables B.1 to B.3 may be used without special proof of suitability.

10.2 Threaded joints

Whitworth threads shall conform to ISO 7-1.

Threads conforming to ISO 228-1 may only be used if the sealing effect is achieved by a gasket being pressed between the front face of the bell connection and a collar on the externally threaded section.

10.3 Welded, soldered or bonded joints

10.3.1 Steel pipes may only be welded on condition that the internal protective coating remain undamaged.

Brazed joints on steel pipes are only permissible if they are executed conformant with the instructions issued by the manufacturer of the solder [the development of hard zinc layers with reduced corrosion resistance in the soldering area (heat affected zone) shall be pointed out].

10.3.2 Copper tubes shall only be welded if their wall thickness is $\geqslant$ 1 mm.

10.3.3 Stainless steel pipes shall be worked in accordance with the manufacturer's recommendations.

10.3.4 For the fabrication of CuNiFe pipes see available national standards or the manufacturer's recommendations.

10.3.5 PVC pipes shall be bonded and shall not be welded.

10.3.6 For welded joints of high-density and low-density polyethylene pipes (PE-HD and PE-LD) see available national standards or the manufacturer's recommendations.

10.3.7 Brazing and soldering compounds shall not contain lead.

11 Fittings

11.1 General

Sanitary fittings for supply lines shall conform to the requirements of national authorities (if applicable).

11.2 Water-saving fittings

The fittings to be used shall be exclusively of the water-saving kind and, where appropriate, flow restrictors shall be installed.

11.3 Non-return valves

Fittings for cold and heated potable water shall have a common outlet only if this outlet cannot be closed or if crossing over of the warm potable water into the cold water line is prevented by means of adequate functional parts; these may be approved non-return valves.

11.4 Protection against scalding

To prevent scalding, hot water showers should be fitted with safety devices (e.g. thermostatic mixer taps) limiting the temperature of the heated water or the mixed water to 45 °C.

11.5 Materials

The following materials may be regarded as safe with respect to sanitary considerations and corrosion resistance. Other materials may only be used if they are of identical or better quality than the ones listed:

— wrought and cast stainless steels;

— materials such as CuSn10, CuPb5Sn5Zn5 and GKCuZn40Pb;

— materials specified in ISO 426-2, namely CuZn38Pb2.

11.6 Lubricants

Lubricants shall be suitable for potable water supply systems.

12 Protective fittings

Potable water supply systems shall be fitted with approved non-return valves downstream of the supply pump or water reservoir in order to prevent water from flowing back into the potable water tank.

Only protective fittings carrying the test lable of the national approving authority shall be used (if applicable).

13 Pumps

13.1 Self-priming pumps

Self-priming pumps shall be installed if the potable water tank is located below the installation level of the supply pump.

13.2 Pump capacity

Dimensioning of the pump capacity shall be such that there is still sufficient flow pressure despite maximum water consumption (for determination of the peak consumption see 8.3 of ISO 15748-2:—).

For projects with high peak consumption rates (e.g. passenger ships, marine structures) installation of two or more supply pumps is recommended.

13.3 Circulating pumps

Circulating pumps shall be installed if reasons given in 17.2.7 or in A.2 are to be considered.

13.4 Filters

Filters shall be installed in the suction line of the supply pump in order to clear the potable water of undissolved matter. They shall comply with requirements of the national authorities, if available, and shall undergo minimum maintenance in accordance with annex C.

13.5 Shut-off fittings and pressure gauges

Shut-off fittings and pressure gauges shall be fitted upstream of the intake as well as downstream of the discharge of the supply pumps.

13.6 Controllable non-return valves

With pumps switched in parallel, these valves shall be furnished on the discharge side.

14 Potable water tanks

14.1 General requirements

Potable water tanks may be a part of the ship's structure with minimum required framing (except double-bottom tanks, fore-peak and aft-peak tanks) or be installed as separate (inserted) tanks. Tanks, which are part of the ship's structure shall not have a common bulkhead (ceiling, deck) with tanks destined for other media.

Tanks shall be made of corrosion-resistant steel or shall have an anticorrosive coating. Steel water tanks shall be protected against corrosion by a galvanic or varnished coating.

Zinc coating shall not have flaws. Surfaces that come into contact with water shall not have even refurbished flaws. Surfaces shall be free of any residues such as zinc oxide or soldering flux and meet the requirements laid down in 5.2.4.

On sea-going vessels and marine structures, it is recommended that two potable water tanks be installed for good reliability of the water supply system.

Potable water tanks shall be disposed in the rooms that have no sources of heat emission and dirt. In exceptional cases if, for technical reasons, it is found impossible to satisfy this requirement, it is admissible to place them in rooms with heat emission, but then effective action for water protection against heating shall be taken.

Potable water storage tanks shall have tightly closable hand-holes for repair and cleaning.

Hand-holes shall be set and constructed in such a way that there is no soiling of water through them. Hand-holes shall be made preferably on side walls of tanks. For prevention of an occasional soiling, the hand-holes arranged on decks, may have coamings at least of 200 mm above deck.

For drainage of water residues and deposits, drainage cocks, plugs etc. should be provided preferably at the low part of inserted tanks and other tanks with arrangement of inclinations of tank bottoms.

Reinforcing ribs of inserted potable water tanks shall be provided on the outside.

Tanks shall be equipped with air pipes led out on the deck and ending with special facilities that prevent admission of sea water. The end of air pipe led out on the deck, shall be at least 400 mm above deck level and be sited in places which eliminate the possibility of soiling and flooding with sea water. Air pipes bores shall be at least 32 mm (for crafts and small boats at least 25 mm).

It is permitted to lead air pipes of inserted tanks into the rooms where the tank is situated or into the rooms of higher decks.

Air pipelines shall be laid in such a way that no stagnation of water can occur in the pipes.

For water mixing, filling and discharge pipes shall be located at the opposite ends of tanks. Construction of the filling pipes terminal shall not be such that supply water is emitted with a concentrated jet.

14.2 Pressurized water tanks

Additional to the requirements given in 14.1 the following requirements shall be met by pressurized tanks.

The following indications refer to separately installed vessels. The given regulations apply accordingly for tanks which are part of the ship's structure.

Pressurized water tanks shall comply with the requirements of national authorities (e.g. national standards) or shall be identical with such reservoirs.

Their capacity is to be determined in accordance with ISO 15748-2.

These reservoirs shall at least be fitted with:

— a safety valve;

— a water level indicator;

— a bleed-off valve;

— a pressure control switch;

— a pressure gauge;

— shutoff fittings for the water level indicator, pressure control switch and pressure gauge.

The reservoirs shall be fitted with tightly closable openings for cleaning and maintenance.

14.3 Safety valves

Only non-controllable safety valves may be used. They shall be fitted in the water area.

Safety valves and bleed lines shall ensure that the permissible operating pressure is not exceeded by more than 10 %.

14.4 Compressed air

The compressed air used in the potable water supply system shall be free of oil and water.

If the potable water comes into direct contact with the compressed air, air filters and deoilers shall be fitted upstream of the water reservoir.

14.5 Air pressure

The air pressure shall not be greater than the permissible operating pressure in the water reservoir. Otherwise the supply line shall be fitted with a pressure reducer and a safety valve.

14.6 Compressed air connection

The connection on the water reservoir shall serve exclusively to refill the compressed-air cushion.

14.7 Corrosion prevention

Steel water reservoirs shall be protected against corrosion by galvanizing or coating.

Zinc coatings shall have no flaws in the coating on surfaces which come into contact with water, not even refurbished flaws. In addition, these surfaces shall be free of any non-metallic residues such as zinc ash or soldering flux.

Coatings shall meet the requirements laid down in 5.2.4.

15 Potable water heating plants

15.1 General

For potable water heating plants and the distribution of the heated water, all provisions laid down in this part of ISO 15748 apply unless explicitly restricted to cold water.

Construction, equipment and testing shall be in compliance with national regulations.

Potable water heating plants are differentiated according to the type of supply as follows:

— individual supply;

— group supply;

— central supply.

The manner in which service points are supplied, construction, design and type of heating are to be decided keeping in mind economical considerations and the size of the object or structure to be equipped. Installation of central supply systems depends on the size of the object.

15.2 Water heaters

15.2.1 Design, function and application

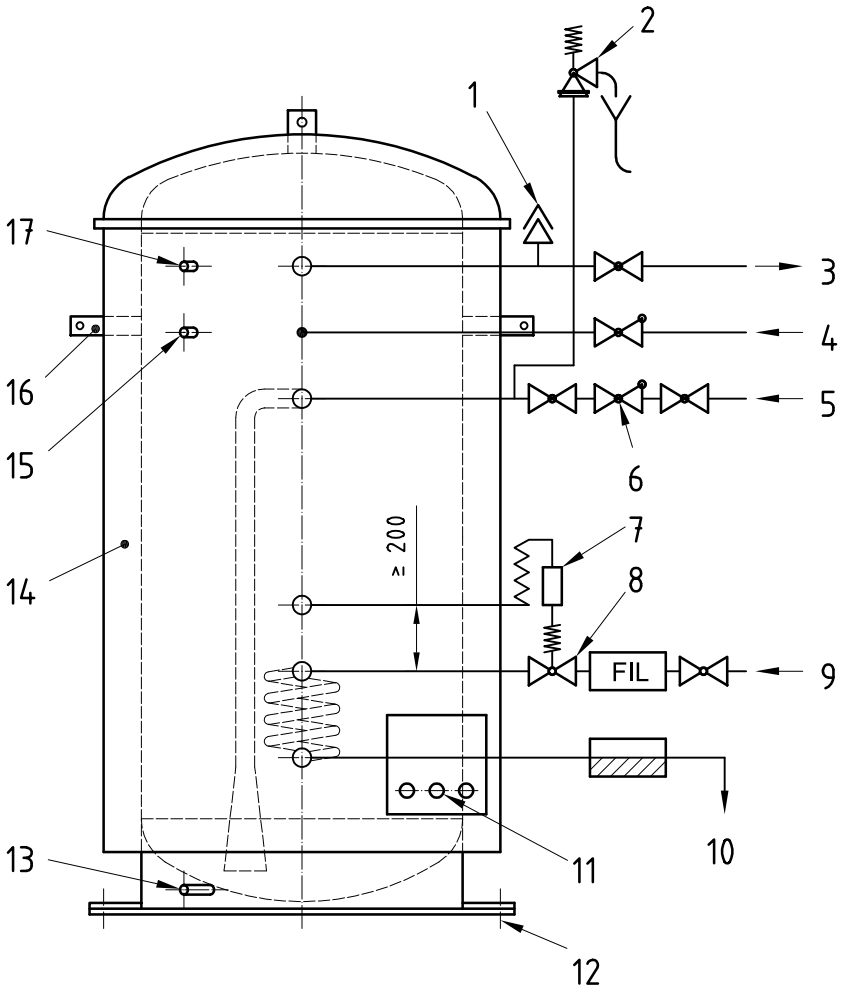
The following configurations shall be selected:

— closed continuous-flow heater (pressure-resistant), with water temperature limited to 39 °C for showers in NBC locks;

— closed continuous-flow heaters (pressure resistant, e.g. see Figure 2) for two or more supply points, (e.g. for washrooms and shower rooms, sinks with an additional service point, and central water supply systems);

— open storage heaters (nonpressurized), for one supply point, (e.g. for bath tubs, showers and washbasins or sinks).

Dimensions in millimetres



Key

1	Venting valve	9	Hot water steam heating
2	Pressure safety valve	10	Condensate discharge
3	Hot water outlet	11	Electrical heating
4	Circulating line	12	Deck mounting
5	Cold water inlet	13	Drain DN 25
6	Non-return valve	14	Insulation with covering
7	Thermostat	15	Thermometer
8	Valve	16	Bulkhead mounting
		17	Pressure and temperature safety valve (optional)

Figure 2 — Example of a closed continuous-flow water heater for central water heating

15.2.2 Heating

For an individual supply, electrical heating shall be provided; for a group supply electrical heating, as well as steam or cooling-water heating, may be selected.

For centralized water heating the water heater shall be directly heated by means of steam, heater water, electricity or indirectly by means of thermal oil.

15.2.3 Water heaters for centralized supply

15.2.3.1 Materials

Water tanks shall be manufactured from sheet metal with copper plating, from CrNi sheet steel or materials of at least equivalent quality.

15.2.3.2 Insulation

The hot water tanks shall be protected against heat loss by means of suitable insulation. The insulation materials shall be covered by preserved removable metal sheets mounted in a vibration-proof manner.

15.2.3.3 Connections

Water heaters shall be fitted with all the necessary connections for:

— cold water feed-in;

— hot water supply line;

— circulation line;

— drain line;

— thermometer;

— heating.

Heating connection (steam/electrical) shall be fitted with thermostatic controls.

15.2.4 Temperature limitation

The water temperature shall not drop below 60 °C in order to prevent furring or reproduction of legionellae. The upper temperature, which shall be controllable, shall be determined due to the necessities.

15.2.5 Water temperatures of over 95 °C

For closed water heaters for water temperatures exceeding 95 °C and for water heaters permitting the formation of an air or steam cushion claiming more than 2 % of the nominal volume or more than 10 l, the regulations for pressurized water reservoirs shall be observed.

15.2.6 Protection of potable water

Indirectly heated water heaters shall be designed in such a way that, in the event of damage, the potable water quality is in no way impaired by the heat transfer or intermediate medium.

15.3 Operation of water heaters for potable water

15.3.1 Protection against overpressure

Closed water heaters for potable water operating at a nominal pressure of PN 6 may only be used if a pressure reducer (setting pressure of 6 bar) is integrated into the cold water feed line upstream of the water heater. The pressure reducer may be dispensed with if operating pressures of more than 4,8 bar cannot occur at the connecting point of the water heater.

In addition, a pressure gauge connector shall be provided at the cold-water feed line.

15.3.2 Measures to prevent the backflow of heated potable water

If the nominal capacity of the water heater is greater than 10 l, a non-return valve shall be fitted in the cold-water feed line.

In closed water heaters, one shut-off valve shall be provided upstream and one downstream of the backflow gate.

15.4 Installation location for water heaters

Storage heaters for individual washbasins shall be mounted underneath the respective basin.

Open storage heaters shall only be installed in the vicinity of the hot water outlet: maximum distance 1 m vertically and 2 m horizontally. If these values cannot be maintained, venting shall be provided.

16 Sterilization of potable water

16.1 General

It cannot always be taken for granted that on-loaded or shipboard-converted potable water always meets or maintains the quality defined by the authorized national bodies.

Hence, a microbiological examination of the quality of the potable water shall be conducted anually.

Potable water supply systems shall be fitted with devices preventing the formation of germs. Appropriate maintenance of the systems shall be ensured.

The following methods of potable water sterilization have hitherto proven successful and economical:

— filtering of the water by means of filter candles;

— irradiation by means of ultraviolet light;

— addition of germicides to the water.

The success of these measures depends on clear water free of any undissolved matter and particle contamination. Therefore, installation of filters collecting undissolved matter in the water is recommended upstream of the sterilizing devices.

Which sterilizing process is selected depends on the concept of the potable water supply system and on the maximum consumption to be expected.

Potable water converted from seawater by evaporation at temperatures not exceeding 80 °C shall additionally be sterilized.

16.2 Sterilization by means of silver-coated filter candles

Silver-coated filter candles retain suspended matter which may be present in the water and they have a bactericidal effect.

Sterilization is instantaneous without any addition of chemicals.

16.3 Sterilization by means of ultraviolet light

16.3.1 The flowing water is irradiated with ultraviolet light which has a germicidal effect.

No chemicals are added. Sterilization is instantaneous but without a long-term effect.

This is a highly effective method if the water supplied is clear and without any suspended matter.

16.3.2 The device shall be installed downstream of the water reservoir or supply pump.

The ultraviolet radiation device shall not be bypassed. The manufacturer's instructions shall be observed.

The direction of flow (installation) shall be vertical in order to keep deposits in the tubes to a minimum.

Installation of a device to measure the intensity of UV-radiation and of a switch-off mechanism with an alarm activated via a solenoid valve is recommended in the event of UV-radiation being too weak.

16.3.3 The capacity of the UV-tube should be such that within its service life irradiation at a wave length of 253,7 nm will not fall below 16 mWs/cm^2. The performance of the tubes shall be controlled at regular intervals.

16.4 Sterilization by means of adding chemical germicides

16.4.1 Chlorination

16.4.1.1 Chlorine is added to the water in liquid form or as a powder. Contaminants are destroyed chemically.

Sterilization is not instantaneous and a reaction time of 15 min to 30 min shall be ensured.

This method requires permanent checking of the residual chlorine content and is therefore only recommended as additonal action to be taken in the event of anticipated or actual bacterial contamination.

16.4.1.2 The addition of chlorine is recommended

— at the transfer line;

— at the evaporator-distilled water line;

— at the permeation line;

— at the pressure line leading to the water reservoir.

(Addition of chlorine to the water reservoir line constitutes the minimum requirement if this method is used).

16.4.1.3 The quantity of chlorine to be added depends on the degree of contamination of the water.

A residual quantity of 0,1 mg/l of chlorine or 0,05 mg/l of chlorodioxide after a minimum reaction time of 20 min shall be ensured.

16.4.1.4 Dosing devices shall conform to the national health requirements and shall be marked with the inspection stamp of the national inspection authority (if applicable).

16.4.1.5 For protection against consumption of water containing excessive chlorine quantites, the installation of dechlorinating systems is recommended.

16.4.2 Silvering

16.4.2.1 The following substances have proven successful:

— Chlorine-free substances to be added to the water in liquid form or as a powder. The contaminants are destroyed by means of the silver ions formed in the course of dissolution of the substance in the water.

Sterilization is not instantaneous and a reaction time of at least 6 h shall be ensured.

This method has a marked long-term effect.

— Substances of low chlorine content added to the water in liquid form or as a powder:

The chlorine content has a rapidly sterilizing effect and the silver ions formed have a long-term effect.

The time required for chlorine to take effect is at least 15 min and for silver ions at least 6 h.

The application of these substances is subject to the manufacturer's instructions and the respective statutory requirements. The quantity added depends on the degree of contamination of the water.

16.4.2.2 The sterilizing substance shall be introduced into the line which leads from the evaporator to the potable water containers. Introduction of the substance into the filling line of the tank ensures sterility of the tank as well as of the pipes connected.

16.5 Sterilization through calefaction

Potable water supply lines contaminated with legionellae cannot be reliably desinfected by means of chemical agents. In this case the possibility of thermal disinfection shall be provided.

Heating the flowing water to a temperature of at least 60 °C and maintaining this temperature for 30 min kills the legionellae. At a water temperature of 70 °C the period for which the temperature shall be maintained is considerably shorter.

17 Layout of piping

17.1 General

17.1.1 It is recommended to install potable water lines preferably in passageways and public rooms. Potable water lines shall be arranged in such a way that convenient maintenance and possibility of dismounting of gears, pipelines and equipment are ensured. Free access for examination, maintenance and repair should be provided as far as possible.

17.1.2 No lines may run above or near electrical and electronic equipment essential for the operation of the ship. If this cannot be avoided, provisions shall be made to avoid damage to this equipment in the event of leakage.

In these areas no separable connections are permitted.

17.1.3 Lines which may be affected by temperatures below freezing point shall be fitted with drainage and shut-off devices.

17.1.4 It is recommended to structure the potable water supply system into several service areas in order to keep supply problems due to system casualties, to a minimum.

17.1.5 It is not permitted to route potable water lines through tanks which do not contain potable water. If this cannot be avoided, such lines shall be installed in pipe tunnels which shall have an effective discharge to a controllable point.

17.1.6 Potable water lines that may become damaged, e.g., those in storerooms, holds, issue rooms, shall have adequate protection (hard casings). Casings in cargo holds shall be impenetrable for bulk cargoes.

17.1.7 Potable water supply systems shall be designed in such a way that tests, maintenance and repairs are possible in an appropriate manner.

17.1.8 Within accommodation cabins the piping shall be screened.

17.1.9 Pipes and fittings shall be fastened to the ships structure or to welded foundations. If special acoustic requirements are to be met, special fasteners shall be used.

17.1.10 If hot water piping and cold water piping are laid side by side close together, appropriate thermal insulation shall be carried out.

17.2 Design principles

17.2.1 At the design stage, allowance shall be made for elastic deformation of the ship's hull as well as expansions caused by heat.

17.2.2 Venting and draining of the entire system as well as of individual pipe sections shall be possible.

17.2.3 In order to prevent the formation of contaminant concentrations, the routing of pipings shall be executed in such a way that no water or air traps may occur. Unused lines shall be shut off.

17.2.4 Changes in piping cross-sections shall only be executed by means of conical connecting pieces.

17.2.5 Suction pipe inlets shall be widened to a funnel 1,5 $\times$ the cross-section of the suction pipe. They shall end at least 50 mm above the tank bottom.

17.2.6 System components made of copper or copper alloys shall not be installed upstream of components made of galvanized iron with respect to the direction of flow.

17.2.7 When the length of the hot water ring line is large, circulation water pumps shall be provided with an automatic mechanism for keeping the water temperature in the main within the limits of 60 °C to 70 °C.

17.2.8 Where there is a need to arrange cold water lines near hot water lines, cold water lines shall be disposed lower than hot water lines or be insulated for preventing heating of potable water.

Laying of water supply and air pipes of potable water tanks through baths, shower-baths and laundries shall be avoided. Potable water suction hoses on to the ship shall have end plugs. Hose ends shall be cased.

17.2.9 Lines without circulating flow shall be kept as short as possible and shall not exceed 10 m in length.

17.3 Pipe passages

At the points where pipes are laid through walls, bulkheads and decks, bulkhead pieces shall be fitted.

The fire resistance of passages through type “A” vertical or horizontal separating surfaces in accordance with SOLAS shall meet the requirements of the “Standard Fire Test” laid down in SOLAS 1974.

Passages through type “B” surfaces shall conform to the requirements of the relevant national authorities.

Pipe passages through watertight bulkheads, walls or decks shall ensure total tightness of these parts.

17.4 Pipe supports

Pipes shall be fixed by means of brackets taking structural conditions (spacing of frames and stiffeners etc.) into consideration.

The use of galvanized steel brackets that completely enclose the pipe is recommended. If necessary, sound-proofing inserts or, in the case of different materials being used (pipe/bracket), anticorrosion inserts shall be provided to prevent contact corrosion.

The spacing of brackets depends on

— pipe diameter and wall thickness;

— weight of the medium conveyed.

The following distances between brackets have proved appropriate in practice and should therefore not be exceeded.

For pipes of the following nominal diameter

— DN 8 to DN 20 distance between brackets, one frame;

— DN 25 to DN 50 distance between brackets, two frames;

— DN 70 to DN 100 distance between brackets, three frames.

17.5 Insulation

Only those highly fire-resistant insulation materials approved by the responsible authorities/classification societies shall be used.

Hot water lines shall be sufficiently insulated against the loss of heat (see 7.3.3).

Cold water lines shall be insulated against condensation water in those places where it may cause damage.

17.6 Identification marking of pipelines

Potable water lines shall be marked adequately-recommended at distances of 5 m and in areas of branch-offs in such a way that they may be unmistakably identified as lines carrying potable water.

Potable water hoses shall be marked correspondingly.

Identification marking shall occur in compliance with ISO 14726-1 and 14726-2.

In addition, the words “Potable Water” may be painted on the pipe or on an extra label where reasonably needed.

If the direction of flow is important, this shall be shown by means of an arrow pointing in the respective direction.

If necessary, additional marking to differentiate between hot and cold water may be agreed upon.

17.7 Special installation instructions

17.7.1 PVC-U pipes

The regulations laid down by the supervisory activities and manufacturers shall be observed.

17.7.2 Stainless steel pipes

The regulations laid down by the supervisory activities and manufacturers shall be observed.

18 Calculation principles

These shall be in accordance with ISO 15748-2.

19 Testing and flushing of pipelines

19.1 Pressure test

19.1.1 The pressure test shall be performed before covers/encasings are attached to individual system parts. The system shall be filled with potable water, vented and subsequently subjected to a test pressure of 1,5 × the operating pressure. This test pressure shall be maintained by the system for at least 10 min.

The pressure gauge shall be installed at the lowest point of the system. The measuring range shall cover double of the operating pressure and shall permit readings of 0,1 bar differential pressure.

19.1.2 Plastic pipes shall be subjected to a specially agreed pressure test. Owing to the properties of the material the pressure test will cause extensions, furthermore, temperature differences will influence the results.

19.2 Flushing of the system

Subsequent to the pressure test the system shall be thoroughly flushed with potable water. When transferring potable water into the tanks it may become necessary to take sterilizing action in accordance with 16.3.

Flushing shall be performed by means of the supply pumps. The flow rate through the individual sections to be flushed shall not drop below the calculated flow.

To prevent contamination penetrating too far into the system, the service points closest to the pump shall be opened first to be followed by those located further away. Each service point shall be flushed for at least 2 min.

During the flushing, high pump- and flow-rates through the individual sections shall be aimed at.

Annex A
(informative)

Explanations

A.1 General

Potable water, even though meeting the microbiological requirements, will always contain minor concentrations of germs. These may include legionellae, which became known only recently. However, as yet, few details are known about these pathogenes so the establishment of binding regulations to avoid such a danger on board a ship is scarcely advisable for the time being. For this reason, a general statement concerning the protection against this danger is not possible in this part of ISO 15748. It is, however, expected that the actual findings are generally known in order to have them observed when designing endangered equipment at the time of planning. The risk factor is particularly high with water that remains in the reservoir for a longer period of time or with water of 20 °C up to 50 °C temperature. Germ reproduction starts at a temperature of about 20 °C. The thermal destruction of these bacteria starts at a temperature of 50 °C. The dying period for these germs is strongly reduced with increasing temperature (at 60 °C about 30 min, at 70 °C only a few seconds). Above 72 °C no such germs have been traceable up to now.

A.2 Preventative measures

Since the latest tests of the “Deutsches Zentralinstitut für Arbeitsmedizin” (German Central Institute for Industrial Medicine) in Hamburg have proven that high concentrations of legionellae types are especially found in cold water pipes of the upper decks, the following recommendations should be observed.

a) The cold potable water should be circulated in order to ensure the standard necessary for human health. This circulation circuit should include the UV sterilization unit (see 16.2).

b) It should be the goal of preventive measures not to provide favourable conditions in which the legionellae can multiply; e.g. drinking water supply plants should be so constructed and operated that any considerable legionellae increase is excluded. In order to achieve this objective, the following recommendations should be observed:

   1) warm water to be heated to a temperature of at least 60 °C, distribution of the water at not less than 50 °C;

   2) application of decentralized continuous-flow water heater without storage;

   3) regular cleaning of central drinking water heater (reservoir);

   4) use of self-draining shower hoses and nozzles;

   5) cut-off of unused parts of the pipes and of their connections.

c) According to the latest information the following procedures for the disinfection of potable water should apply:

   1) heating of the water to a temperature of $\geqslant$ 60 °C;

   2) UV irradiation (at least 16 mWs/cm^2).

d) In the case where an increase of disease-causing germs in the drinking water is suspected, suitable measures should be taken for further clearing and for the removal of any source of danger.

Annex B
(informative)

Appropriate pipe dimensions

Table B.1 — External diameters and wall thicknesses of steel pipes

Nominal width DN	$d_a \times s$ **(mm) for tubes made of**				
	Unalloyed steel in accordance with				**Stainless steel** in accordance with
	ISO 65		ISO 4200		ISO 1127
	Light series	Heavy series	Seamless tubes	Welded tubes	
6	10,2 × 2	10,2 × 2,65	—	—	—
8	13,5 × 2,35	13,5 × 2,9	—	—	—
10	17,2 × 2,35	17,2 × 2,9	17,2 × 1,8	17,2 × 1,8	17,2 × 1,6
12	—	—	—	—	—
15	21,3 × 2,65	21,3 × 3,25	21,3 × 2	21,3 × 2	21,3 × 1,6
20	26,9 × 2,65	26,9 × 3,25	26,9 × 2,3	26,9 × 2	26,9 × 1,6
25	33,7 × 3,25	33,7 × 4,05	33,7 × 2,6	33,7 × 2	33,7 × 1,6
32	42,4 × 3,25	42,4 × 4,05	42,4 × 2,6	42,4 × 2,3	42,4 × 1,6
40	48,3 × 3,25	48,3 × 4,05	48,3 × 2,6	48,3 × 2,3	48,3 × 1,6
50	60,3 × 3,65	60,3 × 4,5	60,3 × 2,9	60,3 × 2,3	60,3 × 1,6
65	76,1 × 3,65	76,1 × 4,5	76,1 × 2,9	76,1 × 2,6	76,1 × 2,3
80	88,9 × 4,05	88,9 × 4,85	88,9 × 3,2	88,9 × 2,9	88,9 × 2,3
100	114,3 × 4,5	114,3 × 5,4	114,3 × 3,6	114,3 × 3,2	114,3 × 2,6

Table B.2 — External diameters and wall thicknesses for copper and wrought copper alloy tubes

Nominal width DN	$d_a \times s$ **(mm) for tubes made of**	
	SF-Cu in accordance with ISO 274	**CuNiFe** in accordance with ISO 1635
6	8 × 1	10 × 1
8	10 × 1,5	12 × 1
10	12 × 1,5	—
12	16 × 1,5	16 × 1
15	20 × 1,5	20 × 1
20	25 × 1,5	25 × 1,5
25	30 × 2	30 × 1,5
32	38 × 2	38 × 1,5
40	42 × 1,5	44,5 × 1,5
50	57 × 2	57 × 1,5
65	76,1 × 2	76 × 2
80	88,9 × 2	89 × 2
100	108 × 2,5	108 × 2,5

Table B.3 — External diameters and wall thicknesses for plastic pipes

Nominal width DN	$d_a \times s$ **(mm) for tubes of outer diameters in accordance with ISO 161-1**						
	Polybutene	Polyethylene			Polypropylene	Polyvinylchloride	
	PB Pipe series PN 16	**PE-LD**	**PE-HD** Pipe series PN 10[a]	**PE-X** Pipe series PN 20	**PP** Pipe series PN 25	**PVC-C** Pipe series PN 25	**PVC-U** Pipe series PN 16[b]
6	10 × 1,8	10 × 2	10 × 1,8	10 × 1,8	10 × 2	10 × 1,2	—
8	12 × 1,8	12 × 2	12 × 1,8	12 × 1,8	16 × 3,2	12 × 1,4	12 × 1
10	16 × 1,8	16 × 2,7	16 × 1,8	16 × 2,2	20 × 4	16 × 1,8	16 × 1,2
12	—	20 × 3,4	—	20 × 2,8	25 × 5	20 × 2,3	—
15	20 × 1,9	25 × 4,2	20 × 1,9	25 × 3,5	—	25 × 2,8	20 × 1,5
20	25 × 2,3	32 × 5,4	25 × 2,3	32 × 4,4	32 × 6,4	32 × 3,6	25 × 1,9
25	32 × 3	40 × 6,7	32 × 3	40 × 5,5	40 × 8	40 × 4,5	32 × 2,4
32	40 × 3,7	50 × 8,4	40 × 3,7	50 × 6,9	63 × 12,6	50 × 5,6	40 × 3
40	50 × 4,6	63 × 10,5	50 × 4,6	63 × 8,7	75 × 15	63 × 7	50 × 3,7
50	63 × 5,8	75 × 12,5	63 × 5,8	75 × 10,3	90 × 18	75 × 8,4	63 × 4,7
63	90 × 8,2	110 × 18,4	75 × 6,9	90 × 12,4	110 × 22	90 × 10	75 × 3,6
80	100 × 10	125 × 20,9	90 × 8,2	110 × 15,1	140 × 28	110 × 12,3	90 × 4,3
100	125 × 11,4	—	125 × 11,4	140 × 19,2	180 × 36	140 × 15,6	110 × 5,3

[a] DN 6 and DN 8: Pipe series PN 16; ⩾ DN 10: Pipe series PN 10.

[b] Up to DN 50 PN 16; DN 65 up to DN 100: Pipe series PN 10.

Annex C
(informative)

Inspection and maintenance of filters

C.1 Back-scouring filters

Inspection and maintenance:	At water flow reduction by heightened pressure loss, back-scouring in accordance with the manufacturer's maintenance instructions.
Performance	Back-scouring by operator, remaining work by installation firm, manufacturer.
Interval:	Back-scouring in accordance with actual operational conditions, however, not exceeding two months.

C.2 Non-back-scouring filters

Inspection:	Checking of the residues of the filter fabric by visual inspection for filters with a transparent filtering casing, and by checking of the flow resistance for filters with non-transparent filtering cups.
Performance:	Operator, installation firm.
Interval:	In accordance with operational conditions, however, not exceeding two months.
Maintenance:	Changing of the filter filling in accordance with the manufacturer's maintenance instructions. When restarting the unit, the first draining water should be drained off by short-termed opening of a nearby service point.
Performance:	Operator, installation firm, manufacturer.
Interval:	In accordance with operational conditions. However, for hygienic reasons, in intervals shorter than six months.

Bibliography

[1] ISO 2604-2, *Steel products for pressure purposes — Quality requirements — Part 2: Wrought seamless tubes*

[2] ISO 2604-3, *Steel products for pressure purposes — Quality requirements — Part 3: Electric resistance and induction-welded tubes*

[3] ISO 2604-5, *Steel products for pressure purposes — Quality requirements — Part 5: Longitudinally welded austenitic stainless steel tubes*

[4] ISO 3114, *Unplasticized polyvinyl chloride (PVC) pipes for potable water supply — Extractability of lead and tin — Test method*

[5] ISO 5667, parts 1 to 18, *Water quality — Sampling*

[6] ISO 6107, parts 1 to 9, *Water quality — Vocabulary*

[7] ISO 7858, parts 1 to 3, *Measurement of water flow in closed conduits — Meters for cold potable water — Combination meters*

[8] ISO 10221, *Ductile iron pipelines — Rubber sealing rings for pipelines carrying potable water*

NOTE In the ISO Catalogue in field 13 and group 060 (13.060) a large number of ISO Standards is listed dealing with the examination of water.

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