INTERNATIONAL STANDARD

ISO 15748-2

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

Part 2: Method of calculation

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

Partie 2: Méthode de calcul

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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 15748-2 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, C and D of this part of ISO 15748 are for information only.

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

Part 2: Method of calculation

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 waterway crafts.

This part of ISO 15748 serves to determine the quantity of potable water to be carried on board, the capacity of the pressurized reservoirs and water heaters, the pumping capacity, etc.

NOTE In accordance with ISO 15748-1 plastic pipes are permitted but are rarely used at present due to the restrictive conditions laid down by the classification societies. Pressure losses in plastic pipes have not yet been included in ISO 15748 owing to their limited applicability.

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 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 274, *Copper tubes of circular section — Dimensions*

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

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 15748-1, *Ships and marine technology — Potable water supply on ships and marine structures — Part 1: Planning and design*

3 Potable water consumption

3.1 General

The consumption of potable water depends on the type of ship, underway time (time the crew and passengers are embarked), number of potable water dispensing and supply points and the cruising area.

Rough calculations of the daily potable water requirements should be based on the guide values in Table A.1.

Determination of potable water consumption with respect to the planned/existing dispensing points should be based on the guide values in Table A.2 for cargo ships and in Table A.3 for passenger ships.

3.2 Potable water requirements of technical equipment

The quantity of potable water required by other technical facilities including air conditioning equipment/plants for air humidification is to be taken from the information supplied by the manufacturer of the respective facility and added to the potable water consumption determined in accordance with 3.1.

3.3 Potable water consumption of commissary equipment

The following guide values for water consumption have been determined; detailed values shall be supplied by the manufacturer. The determined quantity shall be added to the values determined in accordance with 3.1.

— garbage grinders for food disposal = 20 l/min

— dishwashing machines = 3 l/rack up to 8 l/rack

— coffee and tea machines = 18 l/h to 120 l/h

— vegetable peeling and cleaning machines = 5 l/filling

— washing machines = 25 l/kg dry laundry

4 Potable water storage

Potable water storage and potable water distilling plants shall be provided in consultation with the contractor.

5 Determination and sizing of system components

The sizes of system components shall be determined taking into account:

— the pipe material to be used;

— the configuration of the potable water installations (pipelines, fittings, service devices);

— the calculation plans for cold water, hot water and circulation lines.

The sizing of components is calculated based on to the expected volume flow at the time of the maximum water comsumption = peak flow.

The values and information required for the calculations are listed in Tables A.4 to A.11 and in Figures A.1 to A.4.

The use of the forms supplied in annex B has proved helpful for the calculation process.

6 Flow rates

In order to prevent flow noises and pressure surges, flow rate limitations should be considered.

NOTE Two examples of flow rate limitation are given below.

Example 1

— 2,5 m/s in engine rooms and machinery trunks;

— 2,0 m/s in commissary spaces;

— 1,4 m/s in accommodation decks;

— 1,0 m/s in the hospital and close vicinity;

— 1,0 m/s in pump suction lines;

— 0,5 m/s in circulating lines.

Example 2

— 2,5 m/s for CuNi pipes with DN $\leqslant$ 65 (delivery);

— 2,0 m/s for CuNi pipes with DN 50 and steel pipes with DN $\leqslant$ 65 (delivery);

— 1,4 m/s for CuNi pipes with DN $\leqslant$ 25 and steel pipes with DN $\leqslant$ 32 (delivery); any material pipe with DN $\leqslant$ 65 (suction);

— 1,0 m/s for pipes with DN $\leqslant$ 15 (delivery); any material pipe with DN $\leqslant$ 32 (suction);

— 0,7 m/s for any material pipe with DN $\leqslant$ 15 (suction).

7 Supply pressure

The minimum system supply pressure (pump, water reservoir) is determined by adding the pressure losses due to:

— geodetic differences in altitude;

— pressure losses in the apparati;

— pressure losses from pipe friction and individual resistances;

— minimum flow pressure of 1,5 bar or, following greater demands at the highest dispensing point, plus 10 %. The pressure losses at the suction side shall be taken into consideration.

8 Generation and maintenance of pressure

8.1 General

Potable water may either be supplied directly, or indirectly, via pressurized water reservoirs. Direct supply is appropriate if large quantities of potable water per hour are consumed, e.g. on passenger ships. In all other cases mostly pressurized water reservoirs are used.

The decision as to which method of potable water supply is suitable depends on the peak demand for potable water and is also influenced by the arrangement, space requirements, weight etc. of the components or component groups within the entire supply system.

The limit for deciding between pressurized water reservoirs of direct pump supply lies between 30 m^3/h and 40 m^3/h.

Minimum supply pressure in accordance with clause 7 shall be ensured.

The design temperature for the system is 10 °C.

8.2 Pressurized water reservoirs

In order to keep the available quantity of water, i.e. the quantity between pump cut-ins and cut-offs, as great as possible, and to prevent frequent switchings of the pump, the water stored in the pressurized reservoirs is sufficiently pre-compressed with air.

This pre-compression shall be 0,3 bar less than the pump cut-in pressure. The pressure difference between cut-in and cut-off pressure shall be between 1 bar and 2 bar.

The switching frequency is usually between 6 and 8 switching events h^{-1}; however, 12 switching events h^{-1} shall not be exceeded.

The required reservoir capacity is to be determined in accordance with Figure A.4.

8.3 Supply pumps

8.3.1 General

The capacity of centrifugal pumps shall be such that when the cut-off pressure is reached the capacity corresponds to 110 % of the calculated maximum consumption (10 % margin). Reciprocating pumps shall be dimensioned for 120 % to 130 % of the maximum consumption rate determined.

Pumps with flat characteristic curves shall be selected. If several pumps are used, the cut-in and cut-off pressures of each pump shall be stepped with respect to each other, e.g. 4 bar, 3,5 bar, 3 bar.

Provisions shall be made for quantities of water supplied from continuous-action pumps but remaining unused to be fed back to the potable water reservoirs.

8.3.2 Pump suction lines

The guide values listed in Table A.4 are valid for steel pipes and do not include losses caused by pipe elbows, fittings, etc. These losses shall be taken into consideration.

8.3.3 Pump discharge lines

The pump discharge line connects the supply pump with the water reservoir via a shut-off fitting. The nominal width shall be determined in accordance with Table A.5.

9 Pipe diameters of distribution lines

The pipe diameters shall be determined as follows:

— ascertain the calculation flow at service points of pipe sections (for guide values see Table A.12);

— determine the sum flows for these pipe sections and allocate to the pipes;

— determine the peak flow for these pipe sections in accordance with Figure A.3;

— determine pipe diameters and pressure losses provisionally with the help of Figure A.1; if pressure losses are too high, larger diameters shall be selected;

or

by means of a more simple procedure by determining nominal widths from Table A.11 on the basis of the respective maximum flows.

10 Hot water requirements

The volume of hot water to be provided or to be kept in store shall be determined from the peak demand for mixed water using the following equations:

$$V_M = V_C + V_H \quad (1)$$

$$\frac{H}{C} = \frac{t_M - t_C}{t_H - t_M} \quad (2)$$

$$V_H = \frac{V_M}{H + C} \times H \quad (3)$$

where

V_M is the mixed water volume;

V_C is the cold water volume;

V_H is the hot water volume;

C is the cold water portion;

H is the hot water portion;

t_M is the mixed water temperature;

t_C is the cold water temperature;

t_H is the hot water temperature.

11 Water heaters

11.1 Determination of the necessary water heater volume

a) Continuous-flow water heaters

They shall be sized with respect to the peak demand for hot water.

b) Storage heaters

The size of storage heaters shall be selected so that the peak demand for hot water:

— on passenger ships can be heated in 4 h;

— on other ships can be heated in 2 h.

An additional heating facility which may be required for emergency use or during docking may be smaller in capacity. For passenger ships, it is recommended that the necessary hot water volume be divided between two or more water heaters.

The supply of hot water shall also be ensured in port.

11.2 Guide values for water heater volumes

Guide values for necessary water heater volume (depending on the load/number of persons), heating power and additional heating are listed in Table A.6.

12 Circulation lines and circulating pumps

12.1 Determination of nominal widths

The nominal widths of circulating lines depend on the nominal widths of the water supply lines. The respective guide values are listed in Table A.7.

For systems including several circulating lines, installation of restriction fittings in the direction of flow upstream of the shut-off fitting is recommended.

12.2 Determination of pump delivery flow

The pump delivery flow $\dot{V}_{UP}$ required is determined from the total volume V_{tot} of the water supply and circulating lines (not including the storage reservoir or water heater capacities) and the number of water circulations per hour according to the following equation:

$$\dot{V}_{UP} = n \times V_{tot} \quad (4)$$

where

$\dot{V}_{UP}$ is the pump delivery flow, in litres per hour;

n is the number of circulations per hour;

V_{tot} is the total volume of water supply and circulating lines, expressed in litres.

Circulating the hot water three times per hour is enough to prevent excessive cooling of the water. For the volume of water per meter of pipe see Tables A.8 to A.10.

12.3 Determining the head of the pump

The head of the pump required, H_{UP}, is determined from the sum of the pressure losses due to pipe friction and individual resistances in the longest circulation section plus 40 %.

The slight pressure losses due to the circulation flow through the water distributing lines and risers may be neglected in determining the head of a pump, H_{UP}.

12.4 Selection of pumps

Once the pump delivery and the required head, H_{UP}, have been determined, the adequate size of the pump shall be selected with the help of the pump diagram, which shall be supplied by the manufacturer.

If the operating point determined is between two pump-performance characteristics curves (P1 and P2 see Figure A.2), selection of the smaller pump is recommended for economic reasons.

13 Calculation example

A calculation example for the application of this part of ISO 15748 including tables and figures shown in annex A and the sheets shown in annex B, is given in annex C.

Annex A
(informative)

Tables and figures with useful information

Table A.1 — Guide values for potable water consumption in litre per person/bed and day

Type of ship		Group of persons embarked	Water consumption when fitted with	
			Flushing toilet system	Vacuum toilet system
Seagoing ship	Cargo ship	Crew/bed	220 l	175 l
	Passenger ship	Passenger/bed	270 l	225 l
	Luxury liner	Passenger/bed	—	275 l
	Ferryboat with cabins	Passenger/bed	205 l [a]	160 l [a]
		Passenger without bed	100 l	55 l
	Ferryboat without cabins	Passenger without bed	150 l	105 l
		Crew without bed	100 l	55 l
Inland waterway craft	Cargo ship	Crew/bed	Minimum 150 l	
	Passenger ship with cabins	Passenger/crew/bed	220 l	175 l
	Passenger ship without cabins	Crew/passenger	100 l	
Special-purpose ship	Research ship	per bed	220 l	175 l
	Federal armed forces tender and larger	Crew/bed	160 l	110 l
	Federal armed forces – smaller than tender	Crew/bed	100 l	55 l
Fishing vessel		Crew/bed	Minimum 150 l	
Offshore		Crew/bed	350 l	

[a] No shipboard laundry.

Table A.2 — Guide values for cargo ships water consumption at different service points per person and day

Service point	Consumption per use	Frequency of use	Consumption		
			Total quantity of water	Cold water	Hot water [a]
	l	per day	l/day	l/day	l/day
Wall-hung/pedestal wash basin	2	6 ×	12	5	7
Shower base	60	2 ×	120	50	70
Flushing W.C. [b]	10	6 ×	60	60	—
Vacuum W.C. [b]	1,2	6 ×	8	8	—
Urinal [b]	3	5 ×	15 [c]	15 [c]	—
Galley area	—	—	20	8	12
Laundry [b]	—	—	38	15 [d]	23
Cleaning	—	—	5	2	3

[a] At a hot water inlet temperature of 60 °C.

[b] If non-potable water is used the consumption of potable water decreases accordingly.

[c] The use of the urinals reduces the use of the WCs.

[d] Consumption of appliances with hot water connections.

Table A.3 — Guide values for passenger ships water consumption at different service points per person and day

Service point	Consumption per use	Frequency of use	Consumption		
			Total quantity of water	Cold water	Hot water [a]
	l	per day	l/day	l/day	l/day
Wall-hung/pedestal wash basin	2,5	8 ×	20	8	12
Shower base [d]	60	2 ×	120	50	70
Bath tub	150	1 ×	150	60	90
Flushing W.C. [b]	10	6 ×	60	60	—
Vacuum W.C. [b]	1,2	6 ×	8	8	—
Urinal [b]	3	5 ×	15 [c]	15 [c]	—
Galley dining rooms	—	—	25	10	15
Laundry [b]	—	—	75 to 100	30 to 40	45 to 60
Cleaning	—	—	20	8	12
Shower and swimming pool	—	—	10 [e]	—	—
Fresh water for swimming pool	—	—	10 [e]	—	—
Whirlpool	—	—	60 [e]	—	—
Sauna	60	1 ×	60	—	—

[a] At a hot water inlet temperature of 60 °C.

[b] If non-potable water is used the consumption of potable water decreases accordingly.

[c] The use of the urinals reduces the use of the WCs.

[d] If bath tubs and showers are provided, one use per day shall be anticipated.

[e] Additional quantity of water per user and day.

Table A.4 — Pump suction lines, nominal widths and maximum pipe lengths

Pump delivery flow	l/s	0,5	0,67	0,83	1,0	1,2	1,3	1,5	1,8	2,1	2,8	4,2	5,5	7,0	8,3
	m^3/h	1,8	2,4	3,0	3,6	4,2	4,8	5,4	6,6	7,5	10	15	20	25	30
Nominal width	DN	**25**		**32**		**40**		**50**		**65**		**80**		**100**	
Suction lift	m	Length of pipe line (m)													
0		120	80	105	80	210	140	280	210	140	120	130	100	120	105
1		100	70	90	70	180	120	240	180	120	100	110	85	95	90
2		85	55	75	55	150	100	200	150	100	85	90	70	75	70
3		70	45	60	45	120	80	160	120	80	75	70	60	55	45

Table A.5 — Pump pressure lines, nominal widths

Pump delivery flow	l/s	0,5	0,67	0,83	1,0	1,2	1,3	1,5	1,8	2,1	2,8	4,2	5,5	7,0	8,3
	m^3/h	1,8	2,4	3,0	3,6	4,2	4,8	5,4	6,6	7,5	10	15	20	25	30
Nominal DN width		**20**		**25**		**32**		**40**		**50**		**65**		**80**	

Table A.6 — Guide values for water heater volumes, heating power and additional heating

Number of persons	**Water heater volume**	**Heating power**	**Heating-up time from 10 °C to 65 °C**	**Quantity in l of mixed water of 40 °C to be produced in**		**Additional heating power**
	l	kW	min	1 h	2 h	kW
1 to 10	200	15	51	660	1 030	8
	300	10	115	680	930	5
11 to 20	400	30	51	1 320	2 060	15
	650	20	125	1 440	1 940	10
21 to 30	650	40	62	1 940	2 920	20
	1 000	20	192	1 960	2 450	10
31 to 50	1 000	40	96	2 450	3 440	20
	1 500	25	230	2 820	3 440	13
51 to 75	1 000	80	48	3 440	5 400	40
	1 500	60	96	3 680	5 160	30
	2 000	40	192	3 930	4 910	20
76 to 100	2 000	80	96	4 910	6 880	40
	3 000	40	288	5 400	6 380	20
101 to 150	3 000	100	115	6 880	9 330	50
	5 000	40	480	8 350	9 330	20
151 to 200	3 000	160	72	8 350	12 280	60
	5 000	100	192	9 820	12 280	50
201 to 300	5 000	200	96	12 280	17 200	60
	7 000	150	179	14 000	17 690	50
301 to 500	7 000	300	90	17 690	25 060	70
	10 000	200	192	19 650	24 570	60
501 to 700	7 000	400	67	20 140	29 970	80
	10 000	300	128	22 110	29 480	70
701 to 1 000	10 000	550	70	28 250	41 770	100

NOTE 1 As a rule, single water heaters with more than 3 000 l capacity are not used. For greater hot water demands, two or more water heaters of appropriate size, or continuous-flow heaters are provided.

NOTE 2 For every size of number of persons two possible decisions are shown.

NOTE 3 The column “Additional heating power” takes into consideration the hot water supply to be ensured in port (see 11.1).