DNV

CLASS GUIDELINE

DNV-CG-0308 Edition July 2025

IMO Polar Code operational requirements

DNV AS

FOREWORD

DNV class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

Any comments may be sent by e-mail to *rules@dnv.com*

CHANGES – CURRENT

This document supersedes the December 2023 edition of DNV-CG-0308.
The numbering and/or title of items containing changes is highlighted in red.

Changes July 2025

Topic	*Reference*	*Description*
Structure	Sec.1, Sec.2, Sec.3, Sec.4, Sec.5, Sec.6	Updated and restructured to align with standard DNV format. New sections have been therefore created to address the main topics of this document, originally gathered in one single section.
Ambient (low) temperature	Sec.2 [2]	Included mean daily low temperature (MDLT) and the relation to polar service temperature (PST).

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

Contents

SECTION 1 GENERAL

1 Introduction

The International Code for Ships Operating in Polar Waters (IMO Polar Code), entered into force on 1. January 2017, provides for safe operation and protection of the environment in polar waters by addressing risks and hazards identified for the area and period of operation, and not adequately mitigated by other instruments of the organization.

2 Objectives

The objective of this class guideline is to provide interpretations, alternative solutions, and best practices to cover the operational aspects of IMO Polar Code.

3 Scope

This class guideline provides clarifications and alternative solutions for operational risks that may occur during operations in polar waters. Any risk mitigation measures should be based on the results of the operational assessment, as required by the Polar Code.

4 Application

This guidance is applicable to designers, owners, and managers of vessels intended for operation in polar waters, but it is also relevant for vessels operating in other waters where exposed to sea ice and/or sub-zero temperatures.

5 References

Table 1 lists DNV references used in this document.

Table 1 DNV references

Document code	*Title*
DNV-RU-SHIP Pt.6 Ch.6	Cold climate
DNV-SI-0552	IMO Polar Code
DNV-ST-0017	Competence of officers for navigation in ice

Table 2 lists other references used in this document.

Table 2 Other references

Document code	*Title*
IMO Res. A1024(26)	Guidelines for ships operating in polar waters
MARPOL Annex I	Prevention of pollution by oil
MARPOL Annex II	Control of pollution by noxious liquid substances
MARPOL Annex IV	Prevention of pollution by sewage from ships
MARPOL Annex V	Prevention of pollution by garbage from ships

Document code	Title
MSC.1/Circular.1519	Guidance on Methodologies for Assessing Operational Capabilities and Limitations in Ice - (6 June 2016) - Appendix - Methodology for Assessing Operational Capabilities and Limitations in Ice: Polar Operational Limit Assessment Risk Indexing System (POLARIS)
MSC.1/Circ.1614/Rev.1	Interim guidelines on life-saving appliances and arrangements for ships operating in polar waters
Overland J.E. et al, 1986	Prediction of vessel icing. Journal of Climate and Applied Meteorology, 25, 1793-1806.
Overland, J.E., 1990	Prediction of vessel icing for near-freezing sea temperatures. Weather and Climate, 5, 62-77.
Polar Code	International code for ships operating in polar waters
SOLAS Ch. XIV	Safety measures for ships operating in polar waters
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended
WMO No. 259	Sea-Ice Nomenclature

6 Definitions and abbreviations

6.1 Definitions of verbal terms

The verbal forms defined in Table 3 are used in this document.

Table 3 Definition of verbal forms (normative)

Term	Definition
shall	verbal form used to indicate a requirement strictly to be followed
should	verbal form used to indicate that among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others
may	verbal form used to indicate a course of action permissible within the limits of a requirement

6.2 Definition of terms

The terms defined in Table 4 are used in this document.

Table 4 Definition of terms

Term	Definition
antarctic area	as defined in SOLAS Ch. XIV Reg. 1.2
arctic waters	as defined in SOLAS Ch. XIV Reg. 1.3
escort	any ship with superior ice capability in transit with another ship
grey ice	young ice, 10 cm to 15 cm thick, that is less elastic than Nilas, it often breaks from swells
grey white	young ice, 15 cm to 30 cm thick
habitable environment	ventilated environment that will protect against hypothermia

Term	*Definition*
high latitude	latitudes over 80 degrees
ice free waters	no ice present, if ice of any kind is present, this term shall not be used, see WMO
maximum expected time of rescue	time adopted for the design of equipment and system that provide survival support (minimum five days)
mean daily low temperature	mean value of the daily low temperature for each day of the year over a minimum 10 years period (A data set acceptable to the flag administration may be used if 10 years of data is not available.)
medium first-year ice	first-year ice, 70 cm to 120 cm thick, see WMO
old ice	sea ice which has survived at least one summer's melt, typical thickness up to 3 m or more It is subdivided into residual first-year ice, second-year ice and multi-year ice, see WMO.
open waters	large area of freely navigable water in which sea ice is present in concentrations less than 1/10 No ice of land origin is present, see WMO.
polar service temperature	temperature specified for a ship intended to operate in low air temperature, which shall be set at least 10°C colder than the lowest MDLT for the intended area and season of operation in polar waters
polar waters	arctic waters and/or the antarctic area
ship intended to operate in low air temperature	ship which is intended to undertake voyages to or through areas where the lowest MDLT is below -10°C
thin first-year ice	first-year ice, 30 cm to 70 cm thick, see WMO

6.3 Abbreviations

The abbreviations described in Table 5 are used in this document.

Table 5 Abbreviations

Abbreviation	*Description*
GSE	group survival equipment
GSK	group survival kit
MDLT	mean daily low temperature
POLARIS	polar operational limit assessment risk indexing system
PSE	personal survival equipment
PSK	personal survival kit
PST	polar service temperature
PWOM	polar water operational manual
RIO	risk index outcome
RIV	risk index value

Abbreviation	*Description*
SAR	search and rescue
WMO	World Meteorological Organization

SECTION 2 ENVIRONMENTAL CONDITIONS

1 Ice conditions

Typical environmental conditions and appropriate ice class notations for qualifiers **C**, **B**, and **A** are listed in Table 1, and defined in DNV-RU-SHIP Pt.6 Ch.6 Sec.1 Table 1.

Table 1 Typical design environmental conditions for POLAR

Category	*Ice conditions*	*Design ice condition*	*Ice class*	*Ice concentration*	*Decision support system*
A	Other ice conditions [1]	Up to heavy multi year ice.	**PC(2)** and **PC(1)** [2]	$\geq 1/10$	Polaris or equivalent required.
		Up to light multi year ice, less than 2.5 m thick.	**PC(3)** [2]		
		Up to second year ice.	**PC(4)** [2]		
		Up to thick first year ice.	**PC(5)** [2]		
B	Other ice conditions [1]	Up to medium first year ice which may include old ice conditions.	**PC(6)** [2]		
		Up to medium first year ice less than 1 m thick which may include old ice conditions.	**PC(7)** [2] and **Ice(1A*)** [2] [3]		
C	Other ice conditions less severe than those included in categories **A** and **B** [1]	Up to medium first year ice less than 1 m thick.	**Ice(1A*)** [2]		
		Up to thin first year ice 2nd stage.	**Ice(1A)** [2]		
		Up to thin first year ice 1st stage.	**Ice(1B)** [2]		
		Up to grey white ice.	**Ice(1C)** [2]		
		Grey ice.			
		New ice.			

Category	*Ice conditions*	*Design ice condition*	*Ice class*	*Ice concentration*	*Decision support system*
	Open waters	Large area of freely navigable water in which sea ice is present.	**Ice(C)**, **Ice(E)** and none [2)]	$< 1/10$	No decision supp. required.
	Ice free	No ice.		0	

1) For ice classed vessels planning to operate in other ice conditions, proper crew training according to regulations, shall be in place together with the use of an appropriate decision support system, such as Polaris, the Canada's Arctic Ice Regime Shipping System, and/or the Russian ice certificate as described in the rules of navigation on the water area of the Northern Sea Route.

2) Ice classed vessels may be permitted to operate in other ice conditions higher than its full ice capacity provided the risk index outcome from the decision support system used onboard is found to be positive.

3) An **Ice(1A*)** classed vessel may be considered category B, provided that, by experience, it has been proven that ship structure, equipment and crew are able to operate safely in the ice conditions required by category.

2 Mean daily low temperature (MDLT)

The following applies to a ship that will operate in an area and season where the lowest MDLT is below -10^{o}C:

— it is categorized as intended to operate in low air temperatures
— it is required to have a PST (polar service temperature) assigned.

The PST shall be set at least 10°C below the lowest MDLT for the intended area and season of operation.

SECTION 3 MEASURES TO HANDLE ICING AND FREEZING

1 Icing

1.1 General

Icing may be caused either by atmospheric factors, and/or operational factors, causing freezing sea spray.

The atmospheric factors, that normally create accumulation of ice and snow on decks and vertical bulkheads at all levels of the exposed structure of the ship are:

- Snow: large amounts of snow can fall in a short period of time, and if left unattended, snow will transform into ice as it goes through thaw and re-freeze cycles and becomes very difficult to remove.
- Freezing rain: icing due to freezing rain demands a cold surface (preferably 0ºC or colder). It is unlikely to occur over a sea surface warmer than 5ºC.
- Freezing fog: the accumulated weights are generally small but within a persistent fog, considerable amounts of ice may be accumulated. Accumulation on vertical structures can be more than twice as heavy as that on flat surfaces.

The operational factors that may cause bow pounding in heavy seas and create freezing sea spray are mainly heading and/or speed. Freezing sea spray is the most common and the most hazardous form of icing. Freezing spray usually occurs when the air temperature is less than -2ºC and the water is less than +5ºC. Substantial icing can occur when the air temperature is between -3ºC and -8ºC with winds between 16 knots to 30 knots. The danger increases with stronger winds or colder temperatures.

1.2 How to avoid icing

The easiest method to avoid icing is to monitor the weather advice from national and commercial weather services and plan a route to avoid areas likely to experience high winds with low or falling temperatures.

Typically, areas with the potential for developing freezing spray have the following environmental factors:

- High wind speed: usually above 15 meters/second (30 knots) for a ship over 100 meters in length, but sometimes lower.
- Air temperature: colder than the freezing point of seawater (-1.8^{o}C).
- Low water temperature: usually colder than +7^{o}C.

National meteorological services issue special freezing spray advice to ships operating in the North Atlantic and North Pacific oceans. The advice is included in the normal marine weather forecasts for ships operating in or near the issuing country's waters. See also App.B [1].

1.3 Anti-icing measures

To minimize the impact of excessive icing on exposed structure and equipment, the following measures and procedures can be taken:

- Equipment important for safe operation of the vessel, should, as far as possible, be situated in protected locations, so that sea spray cannot reach them. This may be accomplished by using fully enclosed spaces, semi-enclosures, recesses with removable curtains in front, or similar. A shielded location will be the simplest and most reliable way against icing.
- Electrical heat tracing: the heating capacity shall be sufficient to prevent icing and freezing under the design environmental condition. Anti-icing and anti-freezing arrangement shall be able to maintain a surface temperature of at least +3°C when exposed to an average wind speed of 5 m/s. For special wind protected areas, a lower wind speed may be applied.
- Heating by circulating hot fluid.
- Hard removable covers may also be used for some types of equipment.
- Cover by canvas may be used for some types of equipment, like fire monitors.

— Supply of heated air may be an alternative if the equipment in question is enclosed under a cover, hard cover, or canvas.
— When severe icing is highly anticipated in the area and during the period of operation, preference is given to passive measures for anti-icing/anti-freezing protection (such as enclosures) versus de-icing or active measures for anti-icing/anti-freezing protection (such as heat tracing). Passive measures are inherently more effective, more efficient, and contribute to reducing emissions to the environment.

For more detailed examples for anti-icing measures, see App.B.

1.4 De-icing measures and procedures

De-icing measures should be located in areas to be readily available and protected from icing and any other adverse conditions. It is preferable to store de-icing measures inside the ship. For measures stored outside, the storage facilities should be afforded anti-icing protection to ensure accessibility.

Steam- or water-based de-icing equipment should be stored in heated spaces or containers that are kept above freezing temperature to prevent hoses from freezing.

For further details for examples of de-icing measures and recommended de-icing procedures, see App.B [2].

2 Freezing

2.1 General

Freezing temperatures can cause adverse effects to the ship's equipment and systems, and affect liquids, gases, powders, dry bulk commodities and other substances in the following ways:

— Obstruction of circulation, either by creating blockages or changing the flow rate (due to viscosity change).
— Freezing expansion can damage tanks, containers, pipes, sensors, vents and other components.
— Freezing can interfere with the movement of components through the viscosity change of control fluids, which can also interfere with critical timing of signals to some equipment.
— Change of essential chemical or physical properties, such as fire-fighting foam, drilling fluids and chemicals, and electrolytes.
— Freezing can affect combustion air, exhaust air, and emission control.
— Freezing can affect the efficiency of the air conditioning system.

For further details for examples of anti-freezing measures, see App.B Table 2.

2.2 Anti-freezing measures and procedures

Possible anti-freezing measures and procedures to protect equipment and systems before the vessel enters into an area with low air temperatures can be as follow:

— drain exposed systems
— change the freezing point of liquids by adding glycol, salt or other additives, or pressurize the liquid
— for compressed air systems, Kilfrost is an alternative
— movable equipment should be moved to a heated space
— use heating blankets to protect systems located in unheated or exposed spaces
— circulating fluids with fluid change (e.g. seawater), or maintaining constant re-circulation of fluids
— reduce heat loss with insulation
— dry compressed air to remove condensation
— liquids, such as lube oil, hydraulic oil, fuel oil, greases, foam, and drilling chemicals, should be rated for use at the vessel’s PST.

For more detailed examples for anti-freezing measures, see App.B.

2.3 Anti-freezing in ballast and freshwater tanks

2.3.1 General

Ballast and freshwater tanks, located entirely or partly above water line, are susceptible to freezing in cold temperatures. Most common accident scenarios that may occur due to freezing of ballast and freshwater tanks are expansion of fluid in ballast/freshwater tanks and falling of heavy ice blocks in the tank after discharging, which may damage piping arrangements and tank structure. The most common anti-freezing actions for mitigating this hazard are air-bubbling, water circulation, and heating coils, see Figure 1.

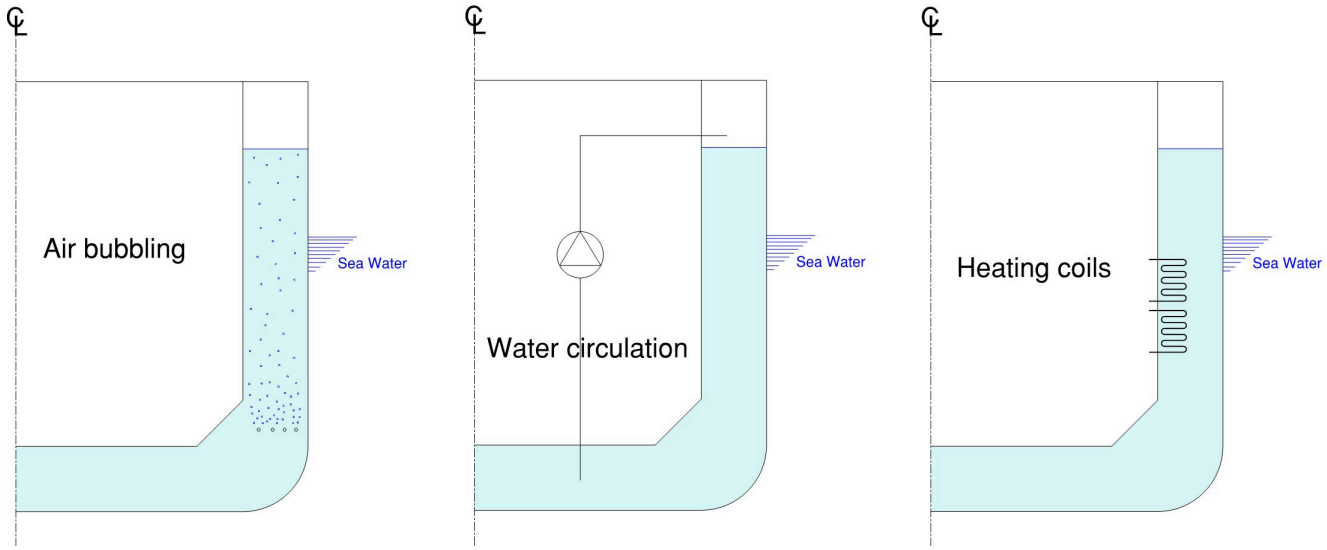

Figure 1 Anti-freezing measures in ballast and fresh water tanks

2.3.2 Air-bubbling

Air-bubbling, for continuos water circulation in the tank, can be used in large and small tanks, but it is not recommended for vessels intended to operate in low air temperature.

2.3.3 Water circulation

Water circulation from the bottom to the top of the tank requires installation of extra equipment and structural adjustment to fit this equipment. The method can also be used in large and small tanks, but it is not recommended for vessels intended to operate in low air temperatures.

2.3.4 Heating coils

Heating coils is the most effective method to prevent freezing in ballast and freshwater tanks, and therefore is the most suitable anti-freezing measures for vessels intended to operate in low air temperatures.

2.4 Heat balance calculation for exposed tanks

For ships intended to operate in low air temperature, a heat balance calculation is deemed necessary to estimate the total heat loss in the affected ballast/freshwater tanks, thereby the number and the capacity of the heat coils to be installed.

An example for a simplified heat balance calculation for a typical wing tank, surrounded by void, fuel oil, sea water and ambient air, see Table 1 and Sec.4 Figure 2, can be carried out as follow:

Table 1 Simplified heat balance calculation

Adjacent compartment/area	*Overall heat transfer coefficient [W/(m^2.K)]* [1)]	*Heat loss [W]*
Ambient air	U_1	$Q_1 = U_1.A_1.(t_b - t_a)$
Sea water	U_2	$Q_2 = U_2.A_2.(t_b - t_w)$
Fuel oil	U_3	$Q_3 = U_3.A_3.(t_b - t_f)$
Void in tank	U_4	$Q_4 = U_4.A_4.(t_b - t_{vt})$
Void	U_5	$Q_5 = U_5.A_5.(t_b - t_v)$
1) the overall heat transfer coefficient, U, shall be estimated on case-by-case basis, considering, among others, the thermal conductivity of tank boundaries, the tank boundary plate thickness, and the individual convection heat transfer coefficient for each fluid.		

The total heat loss [W] that shall be compensated for in the water ballast tank is:

$$Q_{total} = \sum_i Q_i$$

where:

t = coldest anticipated medium temperature within each compartment [^{o}C]

A = tank boundary area of contact for each temperature [m^2].

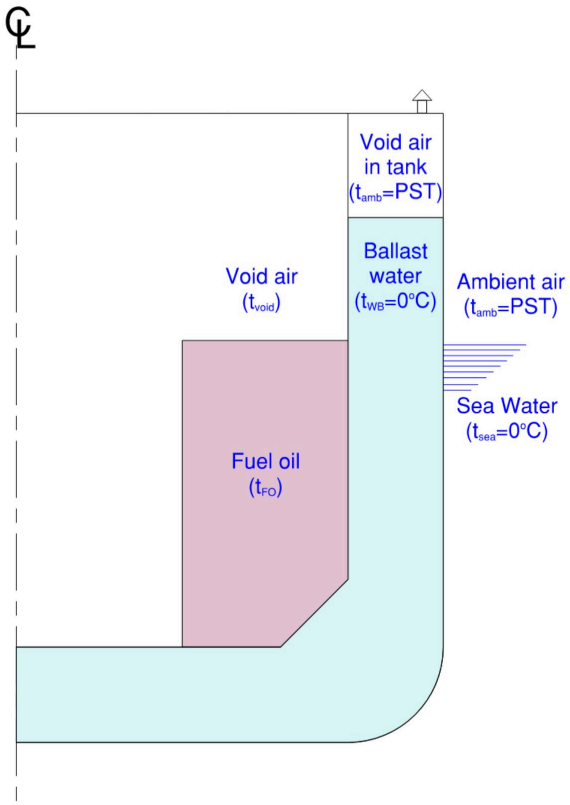

Figure 2 Heat balance calculation for a wing tank

SECTION 4 OPERATIONAL ASSESSMENT

1 General

An operational assessment shall be carried out to identify the hazards, analyse the risks, and define mitigating actions when needed.

The assessment shall take [2] to [4] into consideration.

2 Range of operation and environmental conditions

The anticipated range of operating and environmental conditions shall be defined when applicable, including:

- operation in low air temperature
- operation in ice
- operation in high latitude
- potential for abandonment onto ice or land.

3 Hazards

Hazards which may lead to elevated levels of risk due to increased probability of occurrence, more severe consequences, or both, shall be considered, including:

- Ice, as it may affect hull structure, stability characteristics, machinery systems, navigation, the outdoor working environment, maintenance and emergency preparedness tasks and malfunction of safety equipment and systems.
- Topside icing, with potential reduction of stability and equipment functionality.
- Low temperature, as it affects the working environment and human performance, maintenance and emergency preparedness tasks, material properties and equipment efficiency, survival time and performance of safety equipment and systems.
- Extended periods of darkness or daylight as it may affect navigation and human performance.
- High latitude, as it affects navigation systems, communication systems and the quality of ice imagery information.
- Remoteness and possible lack of accurate and complete hydrographic data and information, reduced availability of navigational aids and seamarks with increased potential for groundings compounded by remoteness, limited readily deployable SAR facilities, delays in emergency response and limited communications capability, with the potential to affect incident response.
- Potential lack of ship crew experience in polar operations, with potential for human error.
- Potential lack of suitable emergency response equipment, with the potential for limiting the effectiveness of mitigation measures.
- Rapidly changing and severe weather conditions, with the potential for escalation of incidents.
- The environment with respect to sensitivity to harmful substances and other environmental impacts and its need for longer restoration.
- Additional hazards, if identified.

The risk level within polar waters may differ depending on the geographical location, time of the year with respect to daylight, ice-coverage, etc. Thus, the mitigating measures required to address the above specific hazards may vary within polar waters and may be different in Arctic and Antarctic waters.

4 Risk matrix

The risk matrix, as described by Figure 1 and Figure 2, can be used to identify areas where measures and risk mitigating actions shall be taken.

Mitigating measures shall be taken to reduce the risks if categorized as high or extremely high. Both existing and newly introduced measures for risk mitigating shall be included in the PWOM.

For risk categorized as moderate or lower, no additional actions are required to be taken.

As an example, Figure 1 and Figure 2 show an acceptable method by which risk related to each hazard may be estimated.

Rating	Risk category
0 - 2	Very low risk
3 - 4	Low risk
5 - 9	Moderate risk
10 - 16	High Risk
20 - 25	Extremely high unacceptable risk

Frequency, F	Frequent	5	5	10	15	20	25
	Likely	4	4	8	12	16	20
	Possible	3	3	6	9	12	15
	Occasional	2	2	4	6	8	10
	Improbable	1	1	2	3	4	5
Risk, R = FxC			1	2	3	4	5
			Negligible	Minor	Significant	Critical	Catastrophic
			Consequence, C				

Figure 1 Definition of frequencies, consequences and risk categories

Identified Hazards	Before measures			Mitigating measures	After measures		
	F	C	R		F	C	R
Loss of stability due to ice accretion	2	5	10	De-icing actions Anti-icing measures Anti-freezing measures Procedures	1	5	5
High latitude	5	4	20	GNSS will be provided onboard	2	2	4
icing and freezing of fire monitor	5	5	25	Cover fire monitor with tarpaulin and steam blowing will be available for de-icing	2	3	6
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Etc.							

Figure 2 Example of risk assessment table

SECTION 5 POLAR WATER OPERATIONAL MANUAL

1 General

The main purpose of the polar water operational manual (PWOM) is to provide detailed instructions and guidelines for ships operating in polar waters.

See App.A for typical layout and information to be included in a PWOM.

The PWOM shall reflect the regulations in [2] to [10] as applicable.

2 Planning and environmental conditions

Table 1 Regulations related to planning and environmental conditions for PWOM

General regulations	*Guidelines*
.1 The PWOM shall include information on the ship-specific capabilities and limitations in relation to the assessment required under Sec.4. (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.1)	.1 The manual should be a ship-specific, decision-making, support document, for onboard use for ships operating in polar waters.
	.2 The PWOM shall contain all the principal particulars and class notations reflecting the capability of the ship.
	.3 The ship shall not be operated beyond the operational and design limitations specified in the PWOM.
	.4 A properly structured PWOM can be achieved following the PWOM template proposed in Annex I.

General regulations		*Guidelines*
.2 The PWOM shall include or refer to specific procedures to be followed in normal operations and in order to avoid encountering conditions that exceed the ship's capabilities.	.1 Voyage planning	.1 The PWOM shall include plans for the intended voyage, taking in account ships capabilities and limitations, and considering the safety of the crew/passengers on board, and as appropriate, environmental protection.
		.2 The voyage shall be planned considering the following: — Limitations of the hydrographic information and aids to navigation available. — Current information on the extent and type of ice and icebergs along the intended route. — Statistical information on ice and temperatures from former years. — Places of refuge: shall be identified along the route. The following factors shall be considered when evaluating their suitability: — availability of reliable water depth information — likelihood of ice cover during the planned voyage season — adequate anchor holding ground — whether the area is susceptible to katabatic (fall) winds. — Current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas. — Current information on relevant ships' routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas. — National and international designated protected areas along the route. — Operation in areas remote from search and rescue (SAR) capabilities.
	.2 Strategic planning (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.3)	.1 Avoidance of hazardous ice and ice conditions that exceed the vessel capability: The voyage shall be planed considering the typical ice conditions expected within the planned route and during the period of operation, and the master shall be provided with the following information: — historic sea ice conditions, including chokepoints and worst recorded ice conditions — current ice charts, and ice forecast where relevant — iceberg observations. The voyage should be planed to avoid areas where the following is likely to be encountered: — concentrations of icebergs — multi-year ice — fast ice — pack ice consisting of ice types and concentrations likely to exceed an acceptable risk index outcome for the vessel ice class when using POLARIS risk assessment system.

General regulations		*Guidelines*
		.2 Avoidance of hazardous cold temperatures that exceed the vessel capability: The voyage shall be planed considering the typical temperatures expected within the planned route and during the period of operation. The master shall be provided with the following information: — historic air temperatures statistics, including the lowest mean daily low temperature (LMDLT) in the planned operating area — current weather forecast, where relevant.
		.3 Protected areas: The voyage shall be planed considering the possible restrictions that may be imposed by different costal sates in polar waters. in case the voyage route will go through or near any of these areas, the master / ships operator should consult the relevant national or provincial authorities for regulations governing the area, and adjust the route accordingly.
		.4 Marine mammals: The voyage shall be planned to avoid known areas with densities of marine mammals, including seasonal migration areas.
	.3 Arrangements for receiving forecasts of the environmental conditions (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.3.2)	.1 Sources for receiving up to date meteorological forecasts, including sea ice and iceberg information, shall be listed in the PWOM.
		.2 The frequency of updates should provide sufficient notice that the ship can adjust its route or seek refuge to avoid adverse or hazardous conditions.
		.3 Prior to a voyage to polar waters, the vessel shall contact its primary meteorological service provider. Discuss with the service provider the types of products available and relevant for the vessel's intended voyage in polar waters and make arrangements to receive them.
		.4 Ice information: The PWOM shall include sources for ice information within the area and during the period of operation. Regional ice forecasts are available from national weather services, as described in WMO No. 574 - *Sea-Ice Information Services*, available from the WMO at https://library.wmo.int/.
	.4 Hydrographic, and navigational information	.1 Limited access to hydrographic and navigational information due to lack of coverage, high latitude and/or temperature should be addressed in the PWOM and alternative means to cover the needs should be detailed in the PWOM.
	.5 Operation in ice free or open waters, see Sec.2 Table 1 (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.2 and 2.3.3.3)	.1 The PWOM shall include detailed information on the capability and limitation of the vessel for operation in ice infested waters.
		.2 Means and procedures for detection and tracking of ice conditions ahead shall be provided and documented in the PWOM, such as: — ice radar — satellite image — clear watch keeping procedures.

General regulations		*Guidelines*
		.3 The PWOM shall include the ice conditions the vessel is allowed to operate within: — ice free waters — open waters.
	.6 Operation in air temperature below 0°C (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.3.5)	.1 The PWOM shall include procedures and measures for counteracting the adverse effect of freezing to the equipment and systems on board, see Sec.3 [2].
		.2 The PWOM shall include procedures for safe operation of personnel in cold temperatures, as cold can impair personal judgment, which in turn poses a significant hazard to shipboard safety.
		.3 The PWOM shall include the following procedures, to be followed in case the ambient air temperature is forecast to fall colder than PST: — The master shall evaluate the weather forecast and assess how the expected temperatures could affect planned activities, considering both how cold the temperature is expected to fall and how long the temperature is expected to be colder than PST. — The master shall assess determine which activities are essential and those that are non-essential under the forecast conditions. — The master shall evaluate the temperature distribution over the general geographic area of navigation to determine if moving the vessel or seeking refuge can help to avoid or reduce its exposure to cold air temperature.
	.7 Operation in icing conditions (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.3.5)	.1 The PWOM shall include procedures and measures to prevent or mitigate icing, to monitor and assess ice accretion, to conduct de-icing using equipment available on the ship, and to maintain the safety of the ship and its crew, see Sec.3 [1].
	.8 Operation in limited visibility and darkness	.1 The PWOM should include the following procedures in case of poor visibility due to fog or snow: — Dedicated watch on ice-radar should be established, with due caution, especially if sailing in moderate to rough seas. — Speed should be reduced to a minimum, compatible with quick manoeuvring. — If visual and radar visibility are so poor that the position and movement of known icebergs or sea ice cannot be monitored, move to clear water. — Before any backing manoeuvre, ensure a clear view aft and verify the absence of ice behind the ship. Use either the aft-facing camera and flood lights, or post a visual lookout at the stern, ensuring radio communications between lookout and the bridge.
		.2 The PWOM should include the following procedures in case of poor visibility due to darkness: — Set an additional, dedicated visual lookout. — Energize the searchlights, focusing them forward along the vessel's intended track.

General regulations		*Guidelines*
.3 The PWOM shall include risk-based procedures to be followed for measures to be taken in the event of encountering conditions which exceeds the ship's design capability or limitation. (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.5)	1. Adverse air temperature conditions	.1 The PWOM shall include the following procedures, to be followed in case the ambient air temperature falls colder than PST: — Focus on maintaining essential ship services: propulsion, power generation, heating, navigation, communications, fire protection, and life-saving systems. Direct supervisors to monitor these systems closely, assess any vulnerabilities, and take relevant mitigating or corrective actions. — Remove liquids from exposed systems that have not already been drained: blow-down lines and hoses with air. — Monitor systems closely for blockage by measuring flow rates, temperatures, and pressures: investigate where any parameters are out of the normal and take appropriate corrective actions. — Monitor the air conditioning system closely. Ensure heating to spaces with essential equipment maintains a temperature above freezing, and accommodation spaces are warm enough to protect the crew. If the heating load on the air conditioning system becomes too great, reduce heating to non-essential spaces. — Close non-essential areas and spaces and move essential equipment to interior locations. Cover and protect non-movable equipment with canvas, heating blankets, or other insulation as deemed necessary. — Ensure personnel carrying out preventive actions or inspections outside are properly protected, work together, and have an appropriate work/rest rotation for the wind chill measured. — Conduct cold climate toolbox talks to address potential hazards and increase the awareness of hypothermia and other cold-related injuries among the crew.
	.2 Severe icing conditions	.1 The PWOM shall include the following procedures, to be followed in case of severe icing conditions: — The master shall evaluate the need to seek refuge or heave-to. — If the vessel is near land, the best alternative is normally to seek refuge in a harbour or bay, or seek the lee of an island or headland. — If the vessel is near sea ice, another alternative is to sail into the ice pack to minimize the sea spray and icing on superstructure and equipment. This action shall only be taken where the ice conditions are within the capability of the ship's ice class. — Where neither land nor ice are nearby, a third alternative is for the vessel to heave-to, holding the ship's heading such that it minimizes spray over the vessel. — De-icing actions shall be taken as soon as it is safe to carry out.
.4 The PWOM shall include risk-based procedures to be followed for contacting emergency response providers for salvage, search and rescue (SAR), spill response, etc. as applicable. (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.4.1)		.1 For search and rescue (SAR), the PWOM shall include the following: — Contact details of the rescue coordination centers with responsibilities for Arctic waters. Contact details should be verified and updated prior t each voyage via polar waters. — Always verify if other sources of rescue and assistance may be available in the vessel's vicinity, such as coastal communities in the Arctic.

General regulations	*Guidelines*
	.2 For salvage, the PWOM shall include the following procedures prior entering polar waters: — Contact the contracted salvage provider and discuss the vessel's intended operation in polar waters. Confirm their ability to provide services in the vessel's intended operating area. — Seek their advice on pre-voyage planning, supplies, spare parts, and other preparations that the vessel should take to give it an additional capacity to address contingencies while waiting for outside assistance. — Decide and agree on any special procedures to be taken in the event salvage assistance is required in polar waters for the particular voyage planned.
	.3 The PWOM shall include the following procedures, in the event of a spill: — Initiate normal spill response procedures as per shipboard contingency plan. — For a spill in ice-infested waters, take immediate mitigating measures to minimize the spill. — Alert nearby vessels and settlements, requesting any assistance they may be able to offer. — Anticipate that cold air temperatures, icing, snow will hamper the response effort, and compensate as best possible. — Properly protect and closely monitor the people conducting the spill response. Provide them proper protection from the elements and rotate them frequently to maintain an effective response and prevent injury and fatigue. — Consult external response experts via the contracted salvor.

3 Operation in ice and in high latitudes

Table 2 Regulations related to ice and latitudes for PWOM

Specific regulations		*Guidelines*
.5 Operation in other ice conditions. See Sec.2 Table 1.	.1 The PWOM shall include the methodology use to determine capabilities and limitations in ice (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.2)	.1 The PWOM shall include the ice conditions the vessel is allowed to operate within: — other ice conditions less severe than those included in categories A and B — other ice conditions.
		.4 The PWOM shall include procedures and instructions for proper use of the decision support system, polar operational limit assessment risk indexing system (POLARIS), where navigation in ice shall be limited to types and concentrations of ice that do not give a negative risk index outcome, see App.B [3]. — When calculating the RIO for voyage planning purposes, and the RIO < 0, the ice regime shall be avoided. — Where the ship encounters an ice regime where the RIO < 0, the ship shall slow its speed and re-route its course to move out of the regime and to an area where the RIO ≥ 0.
	.2 The PWOM shall include risk-based procedures to be followed for measures to be taken in the event of encountering ice which may exceeds the ship's design capability or limitation (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.5)	.2 Manoeuvring in ice: The following procedures for safe manoeuvring in ice, should be included in the PWOM: — Always set the rudder amidships before backing in ice. Verify the rudder is indeed amidships before beginning the backing manoeuvre. Backing in ice may cause serious damage to the rudder, loss of steerage control, and possible entrapment in ice. — The Canadian Coast Guard (CCG) provides general guidance on manoeuvring in different ice conditions, please see Chapter 4 for Navigation in ice covered waters (ccg-gcc.gc.ca), for detailed practices for the following operations: — towing in ice — anchoring in ice — manoeuvres before entering ice — manoeuvres after entering ice — turning in ice — backing in ice — precaution to avoid becoming beset — freeing a beset vessel — and berthing.

Specific regulations		*Guidelines*
	.3 The PWOM shall include risk-based procedures to be followed for maintaining life support and ship integrity in the event of prolonged entrapment in ice (IMO Polar Code Pt. I-A Ch.2 Reg. 2.3.4.2)	1. The PWOM shall include the following procedures, in the case of entrapment in ice: — Call for icebreaker service, if available in the area. Otherwise, determine if any other vessels are close enough and have the ice-going capability to break the vessel out. If so, contact them. — Inform the relevant rescue coordination center of the ship's predicament and seek advice. — Monitor environmental conditions and their development closely and constantly. — Monitor the vessel's set and drift with the ice field and assess the danger for grounding. — Prepare for damage control and possible evacuation. — Take appropriate measures to keep the main engines warm during entrapment such that they can be started immediately. The vessel must be ready to quickly take advantage of any shift in the ice field that may release the vessel from entrapment and allow it to sail to benign waters.
.6 Operation in high latitude		.1 Communication. The PWOM shall contain the following procedures for navigation in high latitudes: — INMARSAT system instability or loss should be expected. — Master and navigation officers should be prepared to shift safety and mission critical communications to the Iridium system. — The master shall define the relative priority for various communication needs. — Master and navigation officers should identify alternative sources of safety and mission critical information (e.g. ice forecasting information) that do not rely on internet access. Shift to these sources when loss of internet access occurs.
		.2 Navigation Due to errors that can result from satellite geometry and from interference during periods of increased solar and aurora activity, the PWOM should include the following procedures, to be followed while in polar waters: — Verify chart datum and date of survey for each chart in use. — Enter the correct chart datum in electronic positioning system. — Use range and bearing to transfer position between different charts, especially charts based upon a different datum. — Make the proper latitude corrections to the gyrocompasses, as per manufacturer's instructions. — Determine/verify gyro error frequently, as per the company's SMS, verification should be carried out every watch.

4 Subdivision and stability

Table 3 Regulations related to subdivision and stability for PWOM

General regulations		*Guidelines*
.1 Stability in intact conditions (IMO Polar Code Part I-A Ch. 4.2.1)	.1 Ships operating in areas and during periods where ice accretion is likely to occur shall be equipped with such means for removing ice as the Administration may require for example, electrical and pneumatic devices, and/or special tools such as axes or wooden clubs for removing ice from bulwarks, rails and erections.	.1 See Sec.3.
	.2 Information on the icing allowance included in the stability calculations shall be given in the PWOM.	.1 The applied amount of icing allowance should be described in the PWOM, together with information regarding the ship's operational capabilities and limitations with respect to stability.
		.2 Icing allowance, on each exposed deck and bulkhead, shall be included in the PWOM.
	.3 Ice accretion shall be monitored, and appropriate measures taken to ensure that the ice accretion does not exceed the values given in the PWOM.	.1 Watch keeping procedures for monitoring of icing rate on exposed structure, shall be clearly stated in the PWOM. See also Sec.3 [1].
		.2 The frequency of icing rate monitoring shall be adjusted onboard based on the actual environmental conditions.
		.3 The master shall take appropriate early actions to avoid icing accumulations greater than those listed in icing conditions.
.2 Stability in damage conditions (IMO Polar Code Pt. I-A Ch.4 Reg. 4.3.2.2)		.1 The ice damage extents to be assumed when demonstrating compliance with damage stability calculations should be as illustrated in Figure 1.

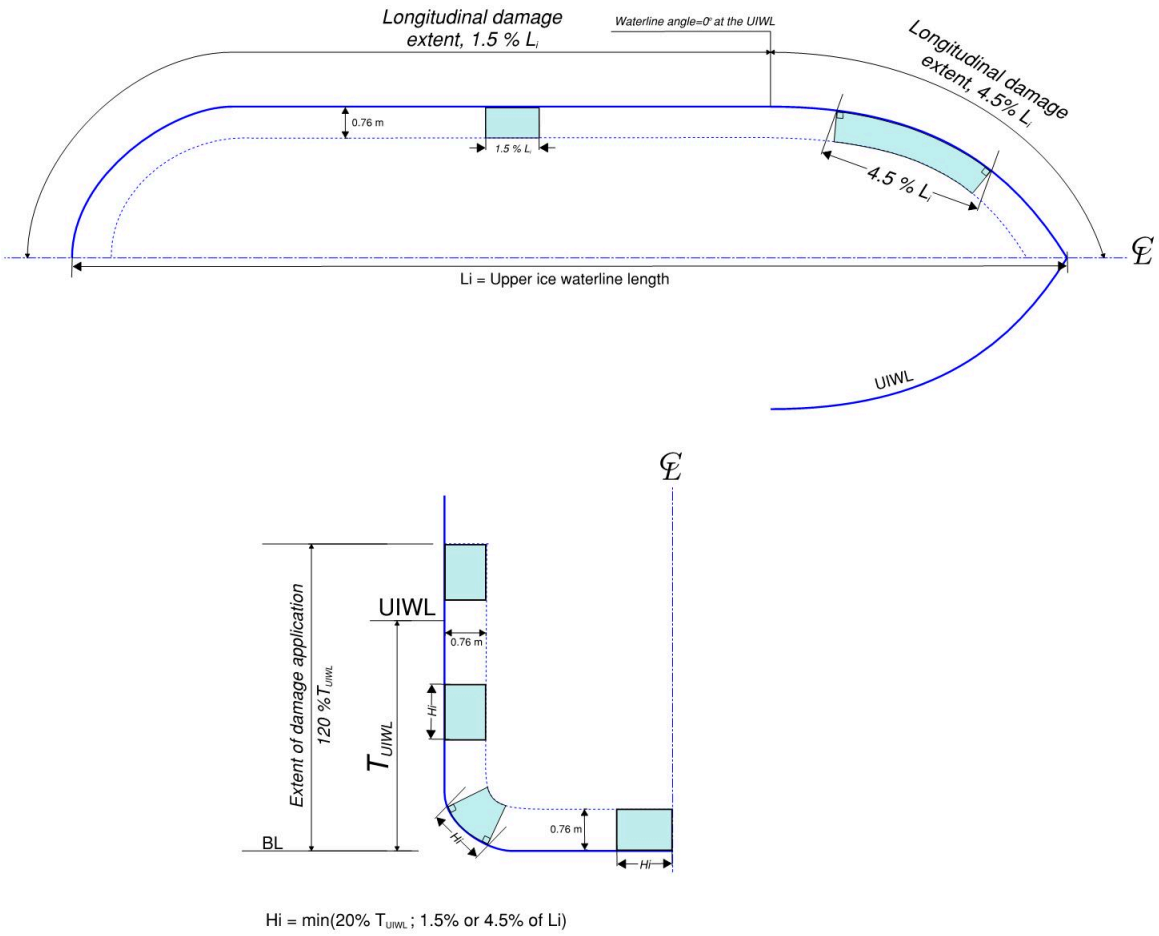

Figure 1 Ice damage extent

5 Watertight and weathertight integrity

Table 4 Regulations related to watertight and weathertight integrity for PWOM

General regulations	*Guidelines*
.1 All exposed closing appliances and doors relevant for the watertight and weathertight integrity of the ship shall be kept clear of snow and ice	.1 See Sec.3 [1].
	.2 In case of an incident, access to damaged tanks and spaces is important when ship's watertight integrity is breached. De-icing and anti-icing measures shall be provided if access hatches are located outside, see Sec.3.

General regulations	*Guidelines*
.2 Watertight and weathertight doors, hatches and closing devices which are not within an habitable environment and require access while at sea shall be designed to be operated by personnel wearing heavy winter clothing including thick mittens. (IMO Polar Code Pt I-A Ch. 5 Reg.5.3.2.2)	.1 Door and hatch handles should be large enough to be operated by personnel wearing heavy winter clothing and thick mittens.

Specific regulations	*Guidelines*
.3 Intended for operation in low air temperature: All closing appliances and doors relevant to watertight and weathertight integrity of the ship shall be operable. (IMO Polar Code Pt. I-A Ch.5 Reg. 5.3.2)	.2 For exposed hydraulically operated hatches and doors, the system shall either be provided with hydraulic fluids rated for operation at service temperature or heating/ circulation arrangements to keep the fluids at an appropriate viscosity.

6 Machinery installation

Table 5 Regulations related to machinery installations for PWOM

General regulations	*Guidelines*	
.1 Machinery installations and associated equipment shall be fully functional under and shall be protected against ice accretion and/or snow accumulation. (IMO Polar Code Pt. I-A Ch.6 Reg. 6.3.1.1)	.1 Anchoring, mooring and towing equipment	.1 Forward anchor winch, mooring capstan and bosun stores hatch should be covered with canvas prior to entering cold climate. Fitting canvas covers will minimize the need for de-icing and make de-icing easier when required.
		.2 The anchor windlass controls should be covered with a poly/canvas cover prior to entering cold climate.
		.3 Mooring lines, towing hawsers, bridles and other related equipment should be stored in protected area.
		.4 Anchor may freeze into the pockets, even under light icing conditions. Anchors must be walked out and proven ready for immediate use before entering a port, anchorage, coastal waters or piloting waters.
		.5 Hawse pipe should be checked to be ice free before entering a port, anchorage, coastal waters or piloting waters. If necessary, use steam service hose, or hot water to clear the Hawse pipe.
	Air conditioning for engine and engine room air intake	.1 The ventilation intakes shall be routinely checked for snow blockage or ice build-up.
		.2 If used, a de-icing mallet must be used carefully to prevent damage to the ventilation intake screens.

General regulations	*Guidelines*	
.2 Machinery installations and associated equipment shall be protected against freezing and increased viscosity of liquids. (IMO Polar Code Pt. I-A Ch.6 Reg. 6.3.1.2)	.1 Compressed air systems	.1 Freezing can block control lines and render air-controlled machinery difficult or impossible to operate. To avoid freezing in compressed air lines, as water vapour condenses out of the air supply, compressed air shall be dried to a pressure dew point colder than the vessel's PST.
		.2 The following procedures shall be established while in cold temperature: — Proper operability of compressed air dryers shall be routinely checked. — Compressed air pipeline shall be drained prior entering cold climate.
	.2 Hydraulic control systems	.1 The following procedures shall be established prior entering cold climate: — Verify that a sufficient supply of hydraulic oil, suitable for PST or colder, is available on board. — Activate hydraulic oil tank heaters and space heating to rooms with hydraulic equipment. — If heating is not provided, recirculation of the hydraulic oil through the machinery and hydraulic systems is an alternative.
		.2 The following procedures shall be established while in cold temperature: — Hydraulic oil tank heaters and space heating shall be checked routinely to be working properly, and that spaces with hydraulic equipment are above freezing. — Hydraulically powered units shall be energized prior to their use and operated in no-load mode until the hydraulic oil is at proper operating temperature and viscosity, per manufacturer's operating recommendations for cold temperature.
	.3 Drainage lines and systems	.1 To avoid blocking of exposed pipe systems with ice, the following items shall be drained prior entering cold climate: — cooling freshwater line — bilge and drain line — scupper line.
		.2 For piping and drainage systems equipped with heating, prior to entering cold climate, the heat providing system shall be energized and checked to be properly functional.
		.3 All drainage lines shall be checked to be clear from ice. Steam service hose can be used to clear ice from the drainage lines as necessary.

General regulations	*Guidelines*	
	.4 Emergency diesel generator (EMDG)	.1 Prior entering cold climate, the following shall be verified: — If provided with heating, the heating system shall be verified to be energized and properly functional. — Cooling water protection shall be checked and glycol water mix shall be adjusted to be suitable for PST. — Fuel and lubricant grades shall be suitable for PST.

7 Fire safety and protection

Table 6 Regulations related to fire safety and protection for PWOM

General regulations	*Guidelines*	
.1 All components of fire safety systems and appliances if installed in exposed positions shall be protected from ice accretion and snow accumulation. (IMO Polar Code Pt. I-A Ch.7 Reg. 7.2.1.1)	.1 Different anti-icing, anti-freezing and de-icing measures for protection of fire safety systems and appliances can be found in Sec.3.	
	.2 Measures and procedures listed in this table for protection of fire safety systems and appliances, shall be documented in the PWOM.	
	.3 Prior to entering polar waters, routinely check to ensure fire monitors, hose boxes, and extinguisher boxes are kept clear from snow and ice. Exercise the catches, locks, dogs and hinges to ensure they operate freely and can be opened at any time in an emergency. De-ice as required, using steam service hose, brush, or mallet. If used, a de-icing mallet must be used carefully to prevent damage to equipment.	
	.4 Ventilation	.1 Closing apparatus for ventilation inlets and outlets, if not designed or equipped with anti-icing measures, shall be located to protect them from ice or snow accumulation that could interfere with the effective closure of such systems.
	.5 Fire detection and extinguishing systems	.1 Fire detection and extinguishing systems, if not designed or equipped with anti-icing measures, shall be located inside.
		.2 Water or foam extinguishers shall not be located in any position that is exposed to freezing temperatures.
		.3 To avoid blocking of exposed pipe systems with ice, the following items shall be drained prior entering cold climate: — fire and wash deck line — water spray line.

General regulations	*Guidelines*	
	.6 Fire pump and associated equipment	.1 Fire pump(s), including emergency fire pump,(s), if not installed in heated compartment(s),shall be adequately protected from icing and/or freezing, see Table 1.
		.2 The fire main should be arranged so that external sections can be isolated and draining devices should be provided.
		.3 Isolating valves if not designed with anti-icing/anti-freezing measures, shall be located to be protected from icing and /or freezing.
		.4 Hydrants, if not designed with anti-icing/ anti-freezing measures, shall be positioned, to be protected from ice accumulation and freezing.
.2 Local equipment and machinery controls shall be arranged so as to avoid freezing, snow accumulation and ice accretion and their location to remain accessible at all time. (IMO Polar Code Pt. I-A Ch.7 Reg. 7.2.1.2)	.1 The following procedures shall be established while in cold temperature: — Use of fire-fighting system for non-emergency tasks shall be avoided. Periodic testing shall be postponed until ambient temperatures are above freezing. — Spare hoses and nozzles from storage can be used for non-emergency tasks, but not those in the hose boxes, which should only be used in an emergency. — Drain the system immediately upon completion.	

8 Life-saving appliances and arrangements

8.1 Escape

Table 7 Regulations related to life-saving appliances and arrangements for PWOM

General regulations	*Guidelines*
.1 For ships exposed to ice accretion, means shall be provided to remove or prevent ice and snow accretion from escape routes, muster stations, embarkation areas, survival craft, its launching appliances and access to survival craft. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.1)	.1 Different anti-icing, anti-freezing and de-icing measures for protection and action against icing and cold temperature can be found under Sec.3.
	.2 All escape routes, muster stations, embarkation areas, survival crafts, its launching appliances and access to survival craft, shall be kept clear of snow and ice to ensure a safe, unobstructed route to the survival craft. Procedures shall be included in the PWOM and or the winterization plan, as applicable.
	.3 Escape routes, muster station, and embarkation areas, shall be checked routinely to be clear from snow or ice accumulation.

General regulations	*Guidelines*
	.3 Preparations: Before entering an area where cold temperature and icing are highly anticipated, the following actions should be taken, and procedures should be established and documented in the PWOM: — de-icing means should be checked and made ready — heating systems should be switched on — procedures for frequent check of the heating system proper functionality — heating systems should be switched on — drains for meltwaters should be checked and made clear and ready.

8.2 Evacuation

Table 8 Regulations related to evacuation for PWOM

General regulations	*Guidelines*
.1 Ships shall have means to ensure safe evacuation of persons (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.2)	.1 Control units for handling crane and davits, dedicated for lifesaving appliances deployment, shall be protected from snow/ice accumulation, see Table 1.
	.2 Any ice accretion should be regularly removed from the lifeboats and launching equipment to ensure ease of launching when required. An icing removal mallet should be available in the vicinity of the lifeboats.
.2 Where the regulations of this chapter are achieved by means of adding devices requiring a source of power, this source shall be able to operate independently of the ship's main source of power. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.2.2)	.1 Electrical control units used for handling davits, cranes and other equipment used for deployment of life saving appliances, shall be connected to an independent source of power to the ship's main source of power.

Specific regulations	*Guidelines*
.2 Intended to operate in low temperature: (GUIDELINES FOR SHIPS OPERATING IN POLAR WATERS Res. A1024(26) Pt. B Ch.11)	.1 All lifeboat engines should be equipped with a means to ensure they will start readily at the minimum anticipated service temperature.
	.2 The lifeboat engine fuel oil should be suitable for operation in the minimum anticipated service temperature.
.3 Potential for abandonment onto ice or land: Ships shall have means to ensure safe evacuation of persons, including safe deployment of survival equipment, when operating in ice-covered waters, or directly onto the ice, as applicable.	.1 — Quick release drop -lifeboat system should not be used when abandoning the ship in ice covered waters. — Davits or similar means should be used for lowering lifeboats to the ice surface.

8.3 Survival

Table 9 Regulations related to survival for PWOM

<table>
<tr><th>General regulations</th><th>Guidelines</th></tr>
<tr><td rowspan="3">.1 Personal survival equipment in combination with life-saving appliances or group survival equipment that provide sufficient thermal insulation to maintain the core temperature of persons.
(IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.3.3.2)
.2 Personal survival equipment that provides sufficient protection to prevent frostbite of all extremities.
(IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.3.3.3)</td><td>.1 Personal survival kits, PSKs, should contains the following:
—<table><tr><th>Equipment name</th><th>Amount</th></tr><tr><td>Hat</td><td>1</td></tr><tr><td>Warm mittens</td><td>1 pair</td></tr><tr><td>Woolen socks</td><td>1 pair</td></tr><tr><td>Face mask</td><td>1 pcs.</td></tr><tr><td>Neck protection</td><td>1 pcs.</td></tr><tr><td>Sun protection lotion, SPF 50</td><td>1 tube</td></tr><tr><td>Thermal protective aid</td><td>1 pcs.</td></tr><tr><td>Sunglasses</td><td>1 pcs</td></tr><tr><td>Whistle</td><td>1 pcs</td></tr><tr><td>Plastic drinking mug</td><td>1 pcs</td></tr><tr><td>Penknife</td><td>1 pcs</td></tr><tr><td>Polar survival guidance</td><td>1 pcs</td></tr><tr><td>Emergency food</td><td>rations for five days</td></tr><tr><td>Waterproof carrying bag</td><td>1 pcs</td></tr></table>Guidance note:
PSK bags are recommended to be located in the same location as lifejackets, at the assembly or embarkation stations.
---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---</td></tr>
<tr><td>.2 Emergency food ratio shall provide a minimum of 5,000 kJ (1,195 kcal) per person per day, and which should be increased as necessary, taking into account the operational assessment and the maximum expected time of rescue.</td></tr>
<tr><td>.3 At least two (2) litres of fresh water per person per day shall be provided. De-salting apparatus or means to melt ice or snow may be considered taking into account the operational assessment and the maximum expected time of rescue. There should be a tank or a container of adequate size to collect water from the de-salting apparatus and rainwater collectors.</td></tr>
<tr><td>.3 Taking into account the presence of any hazards identified, survival craft shall provide a habitable environment for all persons on board, for the maximum expected time of rescue.
(IMO Polar Code Pt. I-A Ch.8 Reg. 8.2.3.3)</td><td>.1 Ventilation that prevent exposure to a long-term CO_2 concentration of more than 5,000 ppm for the maximum expected time of rescue should be provided. The ventilation should be considered in context with heating requirements to achieve a habitable temperature in the survival craft.</td></tr>
</table>

Specific regulations		*Guidelines*
.4 Intended to operate in low air temperatures.	.1 Taking into account the presence of any hazards identified, resources should be provided to support survival following abandoning ship, whether to the water, to ice or to land, for the maximum expected time of rescue. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.2.3.3)	.1 In the survival craft, the combination of personal survival equipment, ventilation, insulation and heating means, if provided, should be capable of maintaining a habitable inside air temperature when the outside air temperature is equal to the PST. All cold surfaces should be insulated, in particular the surfaces in direct contact with the persons, e.g. seats. (MSC.1/Circ.1614 Rev.1 of 2022-12-05)
		.2 Installed heating systems, if provided, and their power sources should be capable of operation during the maximum expected time of rescue. (MSC.1/Circ.1614 Rev.1 of 2022-12-05)
		.3 all persons, when in liferafts, should be wearing insulated immersion suits instead of thermal protective aids. (MSC.1/Circ.1614 Rev.1 of 2022-12-05)
		.4 Survival craft and containers for group survival equipment in their stowed position should have means to mitigate the freezing of drinking water supplies. (MSC.1/Circ.1614 Rev.1 of 2022-12-05)
		.5 In order to avoid exposure to cold air, toilet equipment should be provided inside the survival craft. (MSC.1/Circ.1614 Rev.1 of 2022-12-05)
.5 Potential for abandonment onto ice or land.	.1 Group survival equipment shall be carried, unless an equivalent level of functionality for survival is provided by the ship's normal life-saving appliances. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.3.3.3.1 , 2 and 3)	.1 Group survival kits, GSKs, should be stored in watertight, floatable containers/boxes, to be thrown directly to see, in case of evacuation. the containers/boxes can also be connected to the survival craft by a long line for collection from the sea, when the survival craft is launched. The containers/boxes for the GSKs can then be collected and towed by the survival craft when heading toward land.
		.2 The following procedures shall be included in the PWOM to evacuate safely to land, once waterborne: — Use the lifeboats to collect and tow the GSKs to shore. — Find a safe place to land personal ashore, either mooring, anchoring or beaching the survival craft as conditions dictate. Ensure survival craft are secured for continued use and shelter. — Establish a survival camp in a safe and sheltered location. — Gather all survival equipment, including life rafts, to the camp. — Inflate the life rafts (if not already inflated) and anchor them to the ground, for use as shelters. — Put up tents and anchor them to the ground. Place sleeping mats and bags into tents and life rafts. — Establish communication with the rescue coordination centre and rescue assets.

Specific regulations		*Guidelines*
		.3 Group survival kit should contains the following: —

Equipment	*Amount*
Group equipment	
Tents	1 per 6 persons
Air mattresses	1 per 2 persons
Sleeping bags (VP) [1)]	1 per 2 persons
Stove	1 per tent
Stove fuel	0.5 litres per person
Fuel paste	2 tubes per stove
Matches	2 boxes per tent
Pan (with sealing lid)	1 per stove
Fortified health drinks	5 packets per person
Flashlights	1 per tent
Candles and holders	5 per tent
Snow shovel	1 per tent
Snow saw and snow knife	1 per tent
Tarpaulin	1 per tent
Foot protection - Booties	1 per person
GSK containers	1
Spare personal equipment	
Head protection (VP) [1)]	1
Neck and face protection (VP) [1)]	1
Hand protection - Mitts (VP) [1)]	1 pair
Hand protection - Gloves (VP) [1)]	1 pair
Foot protection - Socks (VP) [1)]	1 pair
Foot protection - Boots (VP) [1)]	1 pair
Insulated suit (VP) [1)]	1
Thermal underwear	1 pair
Handwarmers	1 set
Sunglasses	1
Whistle	1
Drinking mug	1
[1)] VP means vacuum packed.	

Specific regulations		*Guidelines*
	.2 Whenever the assessment identifies the need to carry personal and group survival equipment, means shall be identified of ensuring that this equipment is accessible following abandonment. .3 Passengers shall be instructed in the use of the personal survival equipment and the action to take in an emergency. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.3.3.3.4 and .6)	.1 Procedures and instructions should be established and made clear to persons onboard for safe use of group survival equipment, GSE. Instructions should include, among others: — location of GSE — responsible persons for handling and carrying the GSE — list of components making the GSE — instruction on how to use the GSE during the expected time of rescue.
	.4 The crew shall be trained in the use of the personal survival equipment and group survival equipment. (IMO Polar Code Pt. I-A Ch.8 Reg. 8.3.3.3.3.7)	.1 The crew should be made familiar with the use of personal and group survival equipment, PSE and GSE, by running regular demonstrations and training sessions onboard.

9 Safety of navigation

Table 10 Regulations related to safety of navigation for PWOM

General regulations	*Guidelines*
.1 Nautical information Ships shall have means of receiving and displaying current information on ice conditions in the area of operation.	.1 The PWOM should set out means and resources for ice detection and ice forecast relevant within the area of operation for identification of ice patterns/regimes that may exceed the ships capabilities. If means with ice detection capability are provided onboard, the PWOM should include or see guidance on how this technology should be used to identify ice floes, how to be tuned the to be most effective, instructions on how to interpret ice imagery information, etc.

General regulations		*Guidelines*
.2 For ships operating in areas, and during periods, where ice accretion is likely to occur, means to prevent the accumulation of ice on antennas required for navigation and communication shall be provided. (IMO Polar Code Pt. I-A Ch.9 Req. 9.3.2.1.3)	.1 Navigation and communication antennas	.1 See Sec.3 for different anti-icing, anti-freezing and de-icing measures for protection and action against icing.
		.2 The following procedures shall be included in the PWOM and/or winterization plan: — Antennas shall be routinely checked to be free form ice. — De-ice as necessary and carefully, using steam service hose, if provided. — If provided with heating device, check if it is working properly. — De-icing mallets shall not be used on antennas. — A long pole can be used to carefully knock ice from whip antennas. — Radar scanners shall be tagged out before de-icing operation.

Specific regulations		*Guidelines*
.3 High latitude: Systems for providing reference headings and position fixing shall be suitable for the intended areas. (IMO Polar Code Pt. I-A Ch.9 Req. 9.3.2.2.2)		.1 As alternative to GNSS, fibre optic gyros have been proven to function up to latitudes of 88 degrees.
.4 Intended to operate in low air temperatures.	.1 Navigation and communication antennas	.1 For maintaining an acceptable operational temperature, antennae can be heated or placed in heated domes.

10 Survival craft and rescue boat communication capabilities

Table 11 Regulations related to survival craft and rescue boat communications capabilities for PWOM

General regulations	*Guidelines*
.1 All two-way portable radio communication equipment shall be operable at the polar service temperature.	.1 Basically, exposed radio communication shall be certified down to PST. If not, operational procedures that ensure proper functionality during the maximum expected rescue time, minimum 5 days, may be accepted as an alternative, such as: — thermal protection — heating source in the survival craft.
.1 Recognizing the limitations arising from battery life, procedures shall be developed and implemented such that mandatory communication equipment for use in survival craft, including liferafts, and rescue boats are available for operation during the maximum expected time of rescue.	.1 Procedures for maintaining enough battery capacity for all mandatory communication equipment for use in survival craft, including liferafts and rescue boats, during the maximum expected time of rescue, should be included in the PWOM.

SECTION 6 MANNING AND TRAINING

1 General

Ships operating in polar waters shall have adequately qualified, trained, and experienced personnel.

2 Training requirements

Table 1 Training certificate requirements in accordance with chapter V of the STCW Convention and the STCW Code

Ice conditions	*Ship types*	*Regulations*	*Guidelines*
Ice free	All ship types	Not applicable.	Not applicable.
Open waters	Other		
	Passenger ships	Certificate in basic training for master, chief mate and officers in charge of a navigational watch.	An approved basic training course should be completed. A certificate of proficiency is issued to seafarers who meets the standards in section A-V/4, paragraph 1, of the STCW Code. This shall be renewed at least every five years for continued service.
	Tankers		
Other ice conditions less severe than those included in categories A and B. [1)]	All ship types	Certificate in advanced training for master and chief mate. Basic training for officers in charge of a navigational watch.	Approved basic training course is a prerequisite to advanced course training. Approved seagoing services should be completed: — on board a ship operating in polar waters or equivalent seagoing service — in the deck department at the management level or while performing watchkeeping duties in an operational level — for period of at least 2 months in total during the preceding 5 years. Approved advanced training course should be completed.
Other ice conditions			

1) Basic training for master, chief mate and officers in charge of a navigational watch may be acceptable provided a person(s) other than the master, chief mate or officers of the navigational watch with advance training is available onboard:

- this person(s) shall be qualified and certified in accordance with regulation II/2 of the STCW Convention and section A-II/2 of the STCW Code and meets the advance training requirements noted in this table
- while operating in polar waters the ship has sufficient number of persons meeting the appropriate training requirements for polar waters to cover all watches
- this person(s) is subject to the administration's minimum hours of rest requirements at all times
- the use of a person other than the officer of the navigational watch to satisfy the requirements for training does not relieve the master or officer of the navigational watch from their duties and obligations for the safety of the ship.

3 Familiarization

Every crew member shall be made familiar with the procedures and equipment contained or referenced in the PWOM relevant to their assigned duties.

4 Certificate in basic and advanced training

A certificate of proficiency is issued to seafarers who meet the standards in section A-V/4, paragraph 1, of the STCW Code.

This shall be renewed at least every five years for continued service.

The requirements for these certificates are as shown in Sec.5 Table 11 and Table 1.

5 Responsibilities

The company is responsible for:

— ensuring that the crew is certified in accordance with the requirements in STCW
— that every crew member is made familiar with the procedures and equipment contained or referenced in the PWOM relevant to their assigned duties.

Flag administrations are responsible for:

— approving training courses
— defining approved or equivalent sea going service
— determining that a seafarer meets the required standard of competence.

Port state administrations may inspect ships to verify compliance (port state control).

Some coastal states have additional manning and training requirements for ships in their Arctic waters (such as Canada, Greenland and Russia). If planning a voyage to the Arctic, you should consult the relevant coastal states for national regulations that will apply.

Guidance note:

For more detailed crew performance elements and required competencies of the responsible deck officers, DNV-ST-0017 may be used as a best practice and reference for standard training, familiarization and assessment of crew in a related role onboard or onshore, regardless of the exact geographical location and applicability of the IMO Polar Code.

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APPENDIX A POLAR WATER OPERATIONAL MANUAL

1 Example of polar water operational manual

1.1 General

For vessels where the flag administration has not provided any instructions for the structure and/or content of the PWOM, the below layout is recommended to ensure that relevant information requested by the Polar Code is included.

Guidance note:

1) All contents included under guidelines are not included in the PWOM unless found relevant for the area and period of operation in polar waters.
2) Items included in this example are not required to be included in the PWOM unless found relevant for the area and period of operation in polar waters.
3) For the PWOM to be a valuable and useful document on board, it should include procedures to be followed in the following situations:
   - in normal operations to avoid encountering conditions that exceed ship's capabilities
   - in the event of incidents
   - in the event where conditions exceeding the ship's capabilities are encountered
   - and when using icebreaker assistance, as applicable.

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An example of the layout of a PWOM can be found in Figure 1.

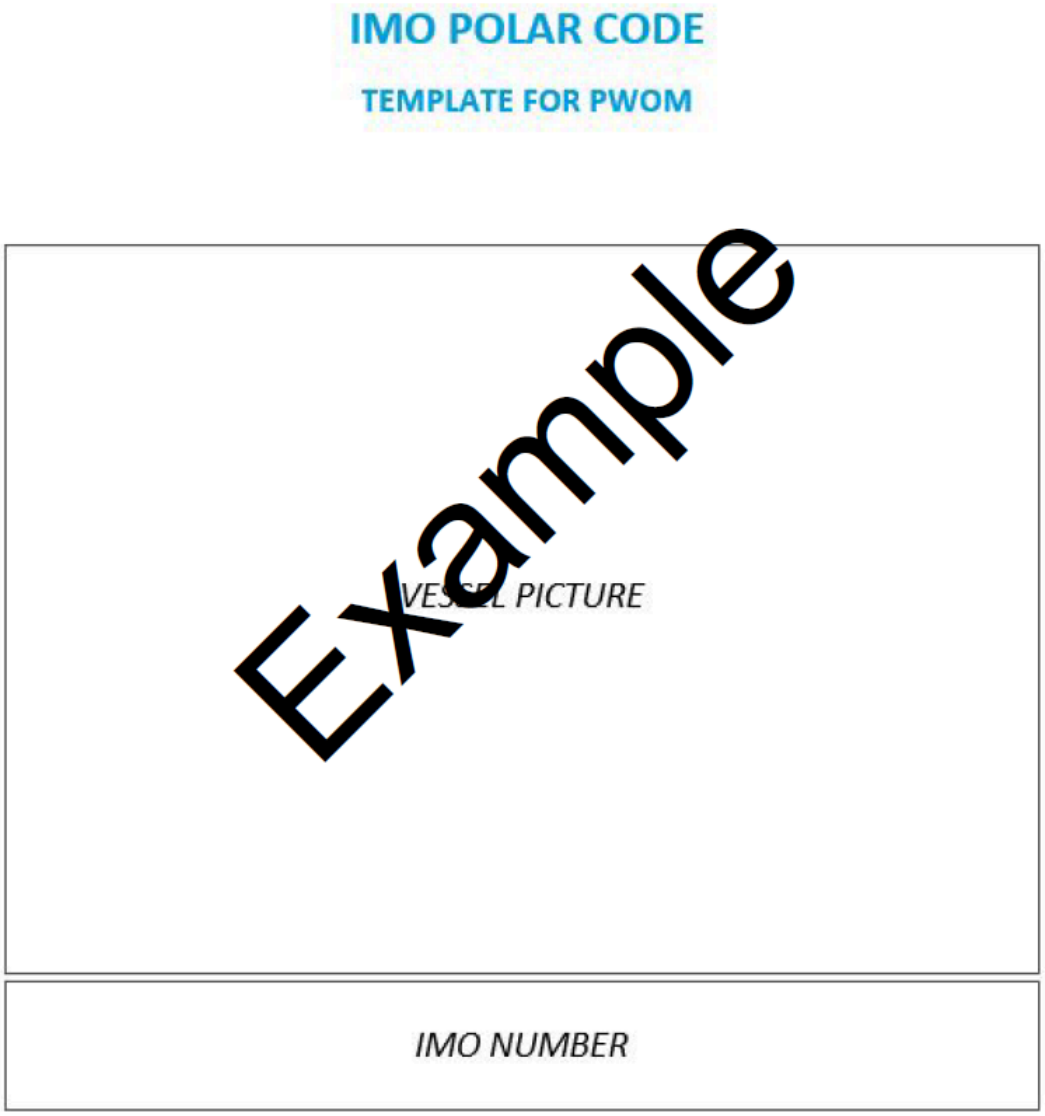

Figure 1 Example of a PWOM

Table of Contents

1 SHIPS PARTICULARS

2 INTRODUCTION TO POLAR OPERATIONS

Guidance note:

The introduction should contain general information and definitions of all terms relevant for polar waters navigation. I should also contain possible hazards relevant for the area and period of operations in polar waters.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

2.1 Polar water hazards

Guidance note:

This part should be a result of the outcome from the operational assessment and should contain all identified risk which require mitigating actions and procedures.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

Hazards	Comments
Ice	
Icing	
Low air temperature	
Extended period of darkness	
High latitude	
Lack of crew experience	
Potential for abandoning to ice or to land	
Additional hazards	

3 POLAR OPERATING CAPABILITIES AND LIMITATIONS

3.1 Polar operating profile

Guidance note:

If not mentioned otherwise the following needs to be addressed:

- MDLT
- PST as found applicable

- Area of operation within polar waters, i.e. maximum latitude etc.
- Period of operation in polar waters
- Ice conditions as applicable:
    - Ice free waters
    - Open waters
    - Other ice conditions less severe than those included in categories A and B.
    - Other ice conditions
- Maximum expected time of rescue

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2 Ships specific capabilities and limitations

Guidance note:

Capabilities and limitations part should include all ships-specifics that may be relevant for polar water navigation. This part should be considered as the basis for further voyage planning and incident preparedness.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.1 Navigation and communication

Guidance note:

Reference to be made to the communication and equipment lists in appendix A and B

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.2 Operation in ice

Guidance note:

The following should be discussed as found applicable:

- Ice class notation
- Crew experience and training if required
- Ice clearance of sea suction for sea water supplies for machinery
- Ice clearance of sea suction for Water-based firefighting system
- Protection of under hull projected sensors

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.3 Operation in low air temperature

Guidance note:

The following should be discussed as found applicable:

- Hull structure material

- Exposed machinery and foundation material
- Exposed fire safety system material
- Protection of portable and semi-portable extinguisher
- Protection of fire pumps including emergency fire pump, water mist and spray pump against freezing
- Equipment functionality

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.4 Operation in icing conditions

Guidance note:

The following should be discussed as found applicable:

- Intact stability
- Information on the icing allowance included in the stability calculation
- Damage stability for category A and B
- Susceptibility to ice accretion for:
  - Hatches and doors
  - Machinery installations in associated equipment
  - Fire safety system and associated equipment
  - Escape routes
  - Muster stations
  - Embarkation areas
  - Survival craft
  - Life-saving launching appliances
  - Antennas required for navigation and communication

Means for ice removal list:

Hazard	Means	Quantity	Location
Snow and ice accretion	Hammers		
	Axes		
	Crowbars		
	Shovels		
	Electrical devices		
	Pneumatic devices		
	Other...		

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

3.2.5 Operation in high latitudes

Guidance note:

The following should be discussed as found applicable:

- Operability of all navigation and communication equipment and alternative means for these affected by high latitude
- GNSS compass or equivalent

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3.2.6 Life-saving appliances

Guidance note:

The following should be included as found applicable:

- Life-saving appliances list

Hazards	Lifesaving appliances		Quantity		Location
Polar waters, general	Immersion suits				
	Additional food & water for at least 5 rescue days				
				Capacity	
	Rescue boats				
	Life raft				
	Lifeboat				
				Weight [kg]	
	Per PSK for at least 5 days	Ha			
		Glo			
		Sock			
		Mask			
		Mitten			
		Skin protection cream			
		Thermal underwear			
		Sunglasses			
		Whistle			
		Mug			
		Penknife			
		Polar survival guidance			
		Carrying bag			
		Etc....			

Abandonment to ice or land	GSK for at least 5 days	Shelter tents			
		Thermal protective aids or similar			
		Sleeping bags			
		Sleeping mats			
		Shovels			
		Sanitation			
		Stove and fuel			
		Emergency food			
		Flashlights			
		Weather/ and waterproof matches			
		Whistle			
		Signal mirror			
		Water containers			
		Spare set of PSK			
		Group survival equipment container			
		Etc....			

- Independent source of power for devices dedicated to safe launching of survival equipment

3.2.7 Operation in extended periods of darkness

Guidance note:

The following should be discussed as found applicable:

- Searchlights, including coverage, capacity and arrangement
- Lifeboat searchlight

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4 VOYAGE PLANNING

4.1 Strategic planning

4.2 Meteorological, hydrographic and navigation information

4.2.1 Meteorological and hydrographic information

4.3 Operation in ice

4.3.1 Means for ice imagery and forecast

4.3.2 Decision support system

Guidance note:

The PWOM shall include method by which decisions as to whether ice conditions exceed the ship's design limits should be made, this method may be one of the following:

- Polaris - IMO MSC.1/Circ.1519 6 June 2016
- Canadian AIRSS - https://www.tc.gc.ca/eng/marinesafety/tp-tp12259-menu-605.htm
- The Russian Ice Certificate as described in the Rules of Navigation of the water area of the Northern Sea Route

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4.3.3 Maneuvering in Ice

4.3.4 Adverse ice condition

Guidance note:

Measures to be taken in the event of encountering ice conditions that exceed ships design capability

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.4 Operation in low air temperatures

4.4.1 Equipment functionality

4.4.2 Personnel health and safety in cold climate

4.4.3 Adverse temperatures

Guidance note:

Measures to be taken in the event of encountering temperature conditions that exceed ships design capability

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.5 Operations in icing conditions

4.5.1 Icing prediction

4.5.2 Icing prevention

4.5.3 De-icing procedures

4.5.4 Adverse ice condition

Guidance note:

Measures to be taken in the event of encountering extreme icing that may impair the ships functionality and stability.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.6 Operation in limited visibility and darkness

4.7 Operation in high latitudes

Guidance note:

All navigational and communication equipment for normal operation and operation in polar waters whose functionality may be affected by high latitude, shall be listed with the corresponding alternatives and/or procedures for mitigating the needs.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

4.8 Pollution prevention measures

Guidance note:

The following should be included as found applicable:

4.8.1 Prevention of pollution by oil

4.8.2 Pollution by noxious liquid substances in bulk

4.8.3 Prevention of pollution by sewage

4.8.4 Prevention of pollution by garbage

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

5 INCIDENTS PREPAREDNESS

Guidance note:

The following should be discussed as found applicable:

5.1 **Shipboard damage control**

5.2 **Maintaining watertight integrity and stability**

5.3 **Firefighting**

5.4 **Escape and evacuation**

5.5 **Preparations for abandonment**

5.6 **Evacuation to sea**

5.7 **Evacuation to land**

5.8 **Evacuation to sea ice**

- Safe deployment of survival equipment in ice infested waters
- Survival craft and launching appliances capacity to accommodate the additional equipment

5.9 **Maintaining rescue communications**

- Battery capacity for all mandatory communication equipment for use in survival craft, including liferafts and rescue boats, during the maximum expected time of rescue

5.10 **Rescue and assistance**

5.11 **Search and rescue**

5.12 **Salvage**

5.13 **Environmental respo**

5.14 **Prolonged entrapment in ic**

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

6 SPECIAL OPERATIONS

Guidance note:

The following should be included as found applicable:

6.1 **Joint operations**

6.1.1 Icebreaker escort / convoy operations

6.1.2 Ice management operations

6.1.3 Helicopter operations

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7 REFFERENCES

8 APPENDIXS

Appendix A

Table 16 Ships communication equipment list

Hazards	Equipment	Quantity	Location	Risk of icing and/or low temperatures Y/N	Temperature range of operation
Polar waters / high latitudes	Ship-to-ship [1]				
	Ship-to-shore [1]				
	SAR communication [2]				
	Two-way on-scene communication [3]				
	TMAS transceiver [4]				
	Transceiver for ice & weather information [5]				
Other available equipment					

Guidance Notes:

1) SOLAS IV GMDSS radio equipment for applicable sea area is considered meeting this requirement
2) SOLAS III/6.2 & SOLAS IV radio equipment are considered meeting this requirement
3) Fixed or portable aeronautical VHF radio operating on 121.5 MHz and 123.1 MHz
4) Inmarsat F/FBB or VSAT or Iridium or other systems that provide both 2-way voice communication and data communication. Combination of different systems to ensure both coverage and desired functionality when sailing in high latitudes may be needed.
5) Inmarsat F/FBB or VSAT or Iridium or other systems. Combination of different systems to ensure both coverage and desired functionality when sailing in high latitudes may be needed.

Appendix B

Table 17 Survival craft and rescue boats communication equipment list

Hazards		Equipment	Quantity	Location	Risk of icing and/or low temperatures Y/N	temperature range of operation
Polar waters, general		Additional batteries for VHFs, SARTs, etc. for at least 5 rescue days				
Darkness		Searchlights for lifeboats [6]				
Low temperature	Rescue and lifeboats	Distress alerting [1]				
		Signal for location [2]				
		On-scene communication [3]				
	All survival crafts	Signal for location [4]				
		On-scene communication [5]				
Other available equipment						

Notes:

1) EPIRB may be used to comply with this requirement if it is documented that the EPIRB is functional at the defined PST and the operation procedure clearly describes how/when an EPIRB should be activated. In order to avoid confusion in search and rescue operations due to multiple EPIRB activation, the operation procedure shall also include instructions on optimal use of the available EPIRB units. Note that it is not required to transmit distress alerting signal continuously during the maximum expected time of rescue (at least 5 days).
2) Every lifeboat and rescue boat shall carry minimum 1 Radar Transponder (SART) or minimum 1 AIS-SART. It is must be documented that the SART or AIS-SART is available for operation during maximum expected rescue time (min. 5 days). An operation procedure for how/when to activate SART/AIS-SART optimally must be described as it will also justify the quantity of SART/AIS-SART provided on a lifeboat/rescue boat. It must be documented that the SART or AIS-SART is functional at the defined PST.
3) To comply with this requirement, every lifeboat and every rescue boat shall carry each 1 unit of portable VHF radio apparatus with additional sealed battery. The requirement of availability for operation during maximum expected rescue time (min. 5 days) is also considered met in this relation. It must be documented that the portable radio is functional at the defined PST.
4) Every (inflatable) raft shall be provided with SART(s)/AIS-SART(s) as described in 2)
5) Every (inflatable) raft shall be provided with portable VHF radio apparatus as described in 2)
6) Lifeboat searchlight with source of power with capacity enough for continuous use in ice infested waters.

APPENDIX B GENERAL OPERATIONAL ADVICE

1 Icing prediction

1.1 Operational icing prediction

To avoid icing on the vessel, a good practice is to use an icing prediction factor for estimating the anticipated icing rate, see Sec.2 Table 1. The easiest method is to monitor the weather advice from national and commercial weather services and plan a route to avoid areas likely to experience high winds with low or falling temperatures.

Typically, areas with the potential for developing freezing spray have the following environmental factors:

— High wind speed: usually above 15 meters/second (30 knots) for a ship over 100 meters in length, but sometimes lower.
— Air temperature: colder than the freezing point of seawater (-1.8°C).
— Low water temperature: usually colder than +7°C.

National meteorological services issue special freezing spray advice to ships operating in the North Atlantic and North Pacific oceans. The advice is included in the normal marine weather forecasts for ships operating in or near the issuing country's waters.

1.2 The Overland method for icing prediction

The rate of icing depends on wind speed, air temperature, sea surface temperature, vessel characteristics, ship course and ship speed. The relations are described in Figure 1, and in the prediction algorithm, below. In Figure 1, the left diagram is for a water temperature of +1°C, and the right for a water temperature of +5°C.

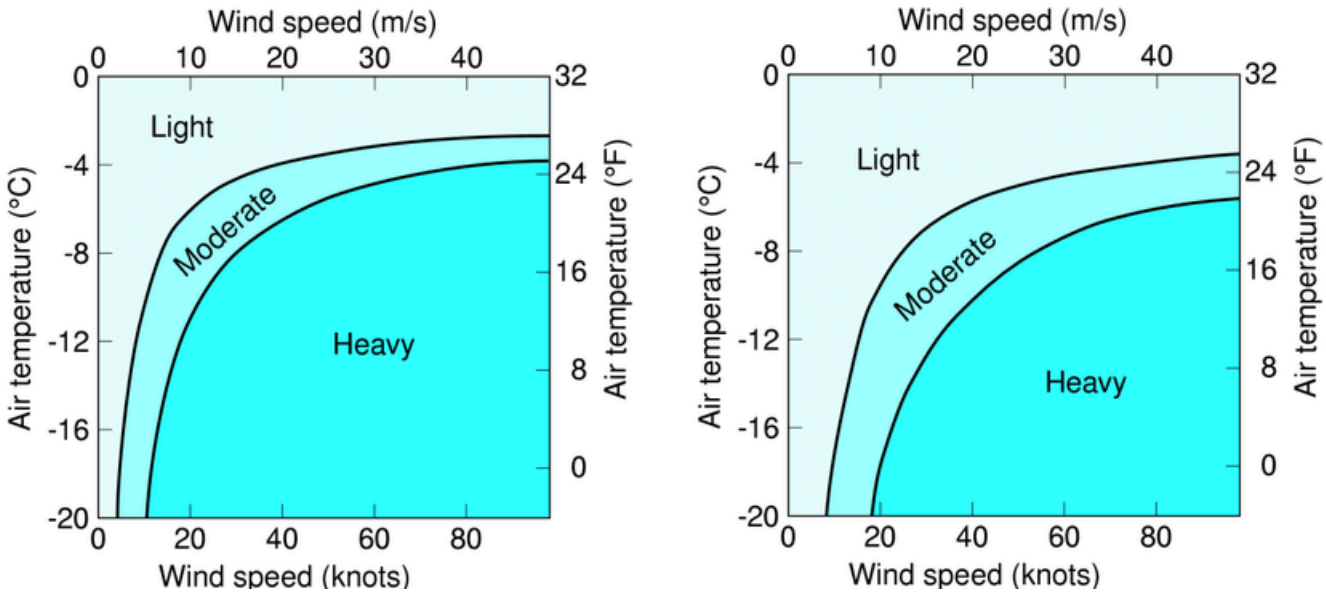

Figure 1 Icing conditions for vessels heading into or abeam of the wind for water temperatures of +1°C (34°F) [left] and +5°C (41°F) [right] (Overland, J.E. et al, 1986).

Alternatively, the following algorithm (Overland, J.E. 1990) can be used for predicting sea spray icing on a vessel. To use it, first calculate the icing prediction factor (PPR), and then find the associated icing category and predicted icing rate in Sec.2 Table 1.

$$PPR = \frac{V_a\left(T_f - T_a\right)}{1 + 0.3\left(T_w - T_f\right)}$$

where:

PPR = icing prediction factor
V_a = wind speed [m/s]
T_f = freezing point of seawater (usually -1.8 ºC)
T_a = air temperature [ºC]
T_w = sea temperature [ºC].

Icing rates according to icing category may be found in Table 1.

Table 1 Predicting icing rate

PPR	*Icing category*	*Predicted icing rate [cm/hour]*
< 0	None	0
0 - 22.4	Light	< 0.7
22.4 - 53.3	Moderate	0.7 to 2
53.3 - 83.0	Heavy	2 to 4
> 83.0	Extreme	> 4

The above are only guides for predicting the potential for icing for ships steaming into the wind and waves. The actual icing potential will depend on the type, load and handling characteristics of a ship. *Cold soaking* is an additional factor to consider. When a ship has been in cold temperatures for a long time (two to three weeks), the body of the ship will remain cold even if the air temperature is warmer. In this situation, icing may be more severe than predicted from the environmental conditions.

2 Anti-icing, anti-freezing, and de-icing measures and procedures

2.1 Examples for anti-icing, anti-freezing, and de-icing measures

Table 2 provides typical measures and applicable locations.

Table 2 Anti-icing, anti-freezing, and de-icing measures

Measures	*De-icing*	*Anti-icing*	*Anti-freezing*	*Location of applicability*	*Means in detail*
El. heating	**X**	**X**	**X**	El. heating of hatch coamings.	Electrical heating can be applied effectively on most locations onboard.
				El. heating of door frames.	
				Stair steps and hand rails.	
				Railings.	
				Walkways deck and hand rails.	

Measures	*De-icing*	*Anti-icing*	*Anti-freezing*	*Location of applicability*	*Means in detail*
				Escape ways.	
				Decks.	
				Bulkheads.	
				Bridge windows.	
				Life boats: — motor — cooling circulation — sealing of access door — cockpit windows.	
				Davit.	
				Life raft manual and hydrostatic release.	
				Heating of air intake inlets/grills.	
				Scuppers and deck drains.	
				Ladder.	
				Air venting.	
				Pressure/vacuum relief valves.	
				Heating of fire main valves.	
				Fire lines.	
				Fire outlets.	
				Exposed pipes.	
				Anchor hawse pipe.	
				Radar antenna.	
				Communication antenna.	
Manual means	**X**			Escape ways.	— shovels — snow blowers — wooden bats — rubber or plastic hammers — hoses for heated water flushing.
				Mooring winch.	
				Deck fitting and mooring.	
				Chocks.	
				Roller-fairleads.	
				Rollers.	
				Bollards.	
Steaming	**X**			Decks.	Low pressure steaming.
				Hatches.	
				Anchor pocket.	

Measures	*De-icing*	*Anti-icing*	*Anti-freezing*	*Location of applicability*	*Means in detail*
				Hawse pipe.	
				Chocks.	
				Roller-fairleads.	
				Rollers.	
				Bollards.	
				Mooring winch.	
Salting	**X**	**X**		Decks.	
Covering				Rescue boat.	Canvas cover.
				Bulwark openings.	
				Winch/windlass.	
				Winch/windlass controllers.	
				Crane.	
				Hydrants.	
		X		Foam monitors.	
				Hose reel station.	
				FIFI monitors.	
				Life raft.	
				Towing hooks and fittings.	
				MOB boat.	
				Fire pump.	Thermal insulation.
Insulation				Exposed bilge and drain lines.	
				Water spray lines.	
				Fresh water filling and service lines.	
			X	Scupper lines.	
				Steam supply lines.	
				Exposed bulkheads for non-heated space enclosing equipment important for safe operation of the vessel.	
Electrical heating blankets		**X**	**X**	Control units.	
				Fire pump.	
Thermal oil		**X**		Air intakes.	Thermal oil heated inlet grills.

Measures	*De-icing*	*Anti-icing*	*Anti-freezing*	*Location of applicability*	*Means in detail*
Semi enclosed area		**X**		Escape ways.	
				Walk ways.	
				Manifolds and valves.	
Hot water	**X**	**X**	**X**	Hawse pipe.	
Air Bubbling			**X**	Water ballast and fresh water tanks.	Not recommended in extreme temperatures.
Water circulation			**X**		Hotter water circulation systems.
Heating coils			**X**		Water glycol heating coils.

2.2 Recommended de-icing procedures

Before starting de-icing operation, all drain channels on deck and scuppers should be made clear and free from ice.

De-icing should start from the highest point and down to avoid ice falling of personnel below.

Exposed equipment and different parts of exposed ship structure, should be prioritised based on it's importance to the safe operation of the vessel, and should be carried out as follow:

- First priority: the first priority for de-icing should be given to the following equipment, systems, and areas:
  - Anchoring: anchors, anchor windlass, chain stoppers, and control equipment, when sailing within coastal or piloting waters.
  - Emergency towing: the emergency towing arrangement should be ready for deployment on a reasonably short notice.
  - Escape and access routes: includes doors, passageways, and stairways to survival craft, designated escape doors and hatches, and accommodation ladders and gangways.
  - Firefighting: fire monitors, hydrants, and valves, fire hose boxes.
  - Lifesaving: survival craft (lifeboats, rescue boat, and life rafts), survival craft launching areas and launching mechanisms, life rings, EPIRBs, exposed life jacket and, survival suit lockers.
  - Navigation: bridge windows, bridge wings, navigation lights, radars, navigation antennas, and communications antennas.
  - Propulsion: engine room air intake louvers, emergency generator ventilation inlet/outlet.
- Second priority: the second priority for de-icing should be given to the following equipment, systems, and areas:
  - Anchoring: anchors, anchor windlass, chain stoppers, and control equipment, while sailing outside coastal or piloting waters.
  - Cargo handling: manifolds and essential handling systems.
  - Decks: all deck areas outside those listed as Priority I. Special attention should be given to ensure scuppers are free from ice.
  - Helicopter area.
  - Railings.
  - Superstructure and derrick.
  - Ventilation – tank vents.

3 POLARIS - an example of methodology for determining capabilities and limitations in ice

Navigation in ice infested waters must be done with extreme due care and diligence. The challenge is to evaluate the severity of the ice condition ahead versus the limitation and the capability of the vessel.

Polar operational limit assessment risk indexing system (POLARIS), is an evaluation method of the hazards posed to the ship by the encountered or the expected ice conditions, considering the operation capability in ice and the strength of the vessel. Risk index values (RIVs), are assigned to the ship based on the assigned ice class notation, see Sec.5 Table 2 and Sec.5 Table 3. The RIV for each ice condition is then weighted by the concentration of each ice type, using input either from historic or current ice charts for voyage planning or from observation in real time from the bridge of the ship.

For each ice regime, the risk index values are used, see Table 3 and Table 4, as an input, to calculate a risk index outcome (RIO), which is the basis of the decision of whether to proceed in or to retreat from the ice infested waters. The risk index outcome (RIO) is then calculated as follows:

$$RIO = (C_1 \cdot RIV_1) + (C_2 \cdot RIV_2) + \ldots + (C_n \cdot RIV_n)$$

where:

C_i = concentrations (in tenths) of each ice type within the ice regime

RIV_i = corresponding risk index values in for each ice type.

Table 3 Risk index values

Ice class	*Ice - free*	*New ice*	*Grey ice*	*Grey white ice*	*Thin first year ice 1st stage*	*Thin first year ice 2nd stage*	*Medium first year ice, less than 1 m thick*	*Medium first year ice*	*Thick first year ice*	*Second year ice*	*Light multi year ice, less than 2.5 m thick*	*Heavy multi year ice*
PC1	3	3	3	3	2	2	2	2	2	2	1	1
PC2	3	3	3	3	2	2	2	2	2	1	1	0
PC3	3	3	3	3	2	2	2	2	2	1	0	-1
PC4	3	3	3	3	2	2	2	2	1	0	-1	-2
PC5	3	3	3	3	2	2	1	1	0	-1	-2	-2
PC6	3	2	2	2	2	1	1	0	-1	-2	-3	-3
PC7	3	2	2	2	1	1	0	-1	-2	-3	-3	-3
Ice(1A*)	3	2	2	2	2	1	0	-1	-2	-3	-4	-4
Ice(1A)	3	2	2	2	1	0	-1	-2	-3	-4	-5	-5
Ice(1B)	3	2	2	1	0	-1	-2	-3	-4	-5	-6	-6
Ice(1C)	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8
Not ice strengthened	3	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-8

Table 4 Risk index values- decayed ice conditions

Ice class	*Ice - free*	*New ice*	*Grey ice*	*Grey white ice*	*Thin first year ice 1st stage*	*Thin first year ice 2nd stage*	*Medium first year ice, less than 1 m thick*	*Medium first year ice*	*Thick first year ice*	*Second year ice*	*Light multi year ice, less than 2.5 m thick*	*Heavy multi year ice*
PC1	3	3	3	3	2	2	2	2	2	2	1	1
PC2	3	3	3	3	2	2	2	2	2	1	1	0
PC3	3	3	3	3	2	2	2	2	2	1	0	-1
PC4	3	3	3	3	2	2	2	2	1	0	-1	-2
PC5	3	3	3	3	2	2	2	2	1	-1	-2	-2
PC6	3	2	2	2	2	1	2	1	0	-2	-3	-3
PC7	3	2	2	2	1	1	1	0	-1	-3	-3	-3
Ice(1A*)	3	2	2	2	2	1	1	0	-1	-3	-4	-4
Ice(1A)	3	2	2	2	1	0	0	-1	-2	-4	-5	-5
Ice(1B)	3	2	2	1	0	-1	-1	-2	-3	-5	-6	-6
Ice(1C)	3	2	1	0	-1	-2	-2	-3	-4	-6	-7	-8
Not ice strengthened	3	1	0	-1	-2	-3	-3	-4	-5	-7	-8	-8

The risk index outcome (RIO) is interpreted as follows:

— if RIO ≥ 0, the ship may operate normally in ice infested waters
— if RIO < 0, the ship operation shall be subject to special considerations.

Operations subject to special consideration means operations whereby extreme caution shall be exercised by the master and officers in charge of a navigational watch when navigating in ice.

Guidance note:

More details and information about POLARIS can be found in MSC.1/Circ.1519 6 June 2016.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

CHANGES – HISTORIC

December 2023 edition

Changes December 2023

Topic	*Reference*	*Description*
Heat balance calculations	Sec.1 [3.2.3], Sec.1 [3.2.4]	Included information about anti-freezing measures and the required heat balance calculations.
Polar operational limit assessment risk indexing system (POLARIS) and prediction of icing	App.B [1], App.B [3]	Included recommendations for how to operate the vessel in cold climate.

July 2021 edition

Changes July 2021

Topic	*Reference*	*Description*
Watertight and weathertight opening and doors	Sec.1 Table 9	Included guidelines highlighting that hydraulic systems for watertight and weathertight doors and closing appliances shall operate under the design environmental conditions.
Rebranding to DNV	All	This document has been revised due to the rebranding of DNV GL to DNV. The following have been updated: the company name, material and certificate designations, and references to other documents in the DNV portfolio. Some of the documents referred to may not yet have been rebranded. If so, please see the relevant DNV GL document.

July 2020 edition

Changes July 2020

Topic	*Reference*	*Description*
Alignment with IMO interim guideline for life saving appliances in polar waters MSC.1/Circ.1614, 26 June 2019	Sec.1 Table 12 1.1 and 2.1	Detailed guidelines for equipment to be included in personal survival equipment (PSE).
	Sec.1 Table 12 3.1	Detailed guidelines for lifeboats and survival crafts ventilation.
	Sec.1 Table 12 4.1.1, 4.1.2, 4.1.3, 4.1.4 and 4.1.5	Detailed guidelines for resources provided in life crafts in the case of low temperatures.
	Sec.1 Table 12 5.1, 5.2 and 5.3	Detailed guidelines for group survival equipment in the case of abandonment onto ice or land.

July 2019 edition

This is a new document.

About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

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