GUIDE FOR

VESSELS OPERATING IN LOW TEMPERATURE ENVIRONMENTS

SEPTEMBER 2015

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Foreword

The operation of merchant vessels in low temperature environments presents many challenges for designers, builders, Owners, and Operators. These challenges include both hardware issues related directly to the construction, outfitting, and operation of vessels, as well as those issues pertaining to the ability of the crew to function in a difficult environment.

To assist the marine industry, ABS issued the *Guide for Vessels Operating in Low Temperature Environments* in September 2006. This 2015 version of the Guide has been updated in accordance with the latest industry standards, as well as ABS plan review and survey practice.

Overall, the update consists of a general relocating of some items to make the document easier to follow.

The particular changes to the Guide are as follows:

- Section 1, General:

  Added definitions and Plans and Particulars to be submitted.

- Section 2, Materials, Welding and Coatings:

  Added guidance for dis-similar materials and repair welding in low temperatures.

  Removal of possible confusion with material grade selection. With the ABS *Steel Vessel Rules* adopting IACS UR I6, the structural material requirements are now contained in Part 3 of the *Steel Vessel Rules*.

- Section 3, Hull Construction and Equipment:

  Requirements adjusted to align with industry practice, placing emphasis on a plan and application of technical solutions consistent with that plan.

- Section 4, Vessel Systems and Machinery:

  Revised to be more consistent with recent industry best practice and generally restructured Section for easier referencing.

  Added Subsection on electronic equipment to help address new high-tech vessels.

- Section 5, Safety Systems:

  Lifesaving appliance requirements updated to reflect recent developments in technology and knowledge.

- Appendix 1 to 9:

  Updated accordingly with corresponding Sections of the Guide, as well as additional information included to assist with low temperature operations.

- Appendix 10, Climatic Conditions:

  All new temperature data provided, including isothermal plots that may be used to help estimate the Polar Service Temperature in accordance with the IMO Polar Code.

This Guide becomes effective on the first day of the month of publication.

We welcome your feedback. Comments or suggestions can be sent electronically to rsd@eagle.org.

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SECTION 1 General

1 Application *(1 September 2015)*

The requirements in this Guide apply to vessels that are designed, equipped and intended to operate in low temperature environments. Application of the requirements in this Guide is optional. When a vessel is designed, equipped, built and surveyed in accordance with this Guide, and when found satisfactory, a classification notation as specified in Subsection 1/3, as appropriate, may be granted.

Those vessels that are designed to meet the requirements of an ice class are to meet Part 6, Chapter 1, "Strengthening for Navigation in Ice" of the ABS *Rules for Building and Classing Steel Vessels* (*Steel Vessel Rules*) or other recognized ice class Rules prior to seeking the optional notation discussed in this Guide.

Noting that the regional climatic conditions may vary, this Guide provides notations directly related to the vessel's operating area. For example, for vessels intended to operate in Polar regions (Arctic or Antarctic) on a year-round basis, the requirements contained within the Guide differ from the requirements for a vessel operating in the Polar region only during the local summer period. Similarly, other vessels may be non-ice class yet operate in low temperatures. The Guide also recognizes the fact that the vessels' intended operational profile may vary as some vessels are intended to operate with the assistance of an ice breaker and others are intended to operate independently. Accordingly, the Guide provides requirements addressing the duration of emergency electrical power. This extended emergency power duration is expressed in hours and may be appended to the base optional class notations.

Within this Guide, ABS refers to relevant international regulations and standards that are considered to be applicable. It is recommended that the users of this Guide refer to the most recent text of those regulations and standards when applying the requirements of this Guide, as it is the intent of the Guide to remain consistent with the pertinent international regulations and standards developed by the maritime industry.

2 Objective

The objective of this Guide is to provide supplemental requirements that generally are not addressed by ice class Rules. Low temperature environments present numerous challenges related to operation of equipment, systems, structure, vessel maintenance and safety equipment. Additionally, the vessel's crew performance may be adversely affected. Vessels designed and constructed without addressing the effects of low temperatures may experience increased structural and equipment failures and nonfunctioning systems. Personnel performance will typically be reduced by the effects of low temperatures.

Vessel systems and exposed structure designed and equipped in accordance with the requirements of this Guide may obtain a class notation indicating the vessel is designed to operate in a Low Temperature Environment which may include the presence of ice and/or at a design service temperature specified by the Owner. This Guide is intended for design service temperatures of –10°C (14°F) or less, excluding ice class requirements, if specified.

It is recognized that vessels operating in low temperatures may have unique operating characteristics for which the requirements in this Guide may not be applicable. For such cases, ABS is prepared to consider alternative arrangements, provided substantiating information and/or a risk analysis is submitted for review.

Users of this Guide may refer to Appendices 2 through 9 which provide non-mandatory notes in support of the requirements in Sections 2 through 9. Section and Paragraph numbers used throughout the Appendices refer to the relevant Sections and Paragraphs of the Guide.

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3 Classification Notations

Where requested by the Owner, vessels designed, equipped, built and surveyed in accordance with the requirements of this Guide may be assigned the following class notations, as appropriate:

- **CCO(T_{DST}, T_{MAT})** is a basic notation for vessels operating in a low temperature and is applicable to vessels designed, constructed, and surveyed in accordance with the requirements contained in Sections 2 through 7. The design service temperature and the minimum anticipated temperature in °C for which the vessel's structure and exposed machinery are designed respectively are annotated in place of "T_{DST}, T_{MAT}" in the parentheses.

  Included in this notation are vessels which typically operate in those low temperature environments (such as the Baltic region, Okhotsk Sea, Gulf of St. Lawrence, etc.). Vessels which operate in a Polar region during the local summer season exclusively are also eligible for this optional notation.

- **CCO-POLAR(T_{DST}, T_{MAT})** is a notation available for those vessels intended to operate in Polar Regions on a continuous basis. The requirements contained in Sections 2 through 7 are applicable to vessels seeking this optional notation. The design service temperature and the minimum anticipated temperature in °C for which the vessel's structure and exposed machinery are designed respectively are annotated in place of "T_{DST}, T_{MAT}" in the parentheses.

- **(HR *HOURS*)** notation can be appended to the **CCO-POLAR(T_{DST}, T_{MAT})** notation to indicate that a vessel is equipped and provided with arrangements for emergency power in excess of the minimum 18 hours specified within Regulation II-1/43 of the 1974 Safety of Life at Sea Convention (SOLAS) and 4-8-2/5.5.2 through 4-8-2/5.5.9 of the *Steel Vessel Rules*. This notation would be expressed with the designation **HR** in parentheses with the total number of hours (i.e., **CCO-POLAR(–30, –50)(HR24)**).

Vessels receiving either the **CCO** or the **CCO-POLAR** notation will also be required to obtain the Class notation **POT**. See 3/2.4 of this Guide.

- **DE-ICE** is a notation available for vessels occasionally operating in low temperatures subject to ice accretion. The requirements in Section 10 are applicable to vessels seeking this optional notation.

As an option, vessels designed, built, and surveyed in accordance with the requirements for any of the previous notations may have the **+** appended to the notation to indicate the placement of additional equipment onboard for the crew and specific low temperature environment training for the crew as per Sections 8 and 9 of this Guide.

4 Definitions *(1 September 2015)*

The following definitions are applied to the terms used in this Guide.

Ambient Temperature: The air temperature in the vicinity of the vessel.

Anti-icing: Use of a system and/or a procedure that when in operation will keep ice from forming on the protected surfaces.

Deck Machinery: Any machinery or equipment onboard the vessel that is directly exposed to the low temperature operating environment. Some examples include winches, windlasses, cranes or other lifting appliances, hatch covers, vehicle ramps, boat davits and mooring fittings.

De-icing: Use of a system and/or a procedure that will reduce ice levels on the surfaces being protected. De-icing is commenced after ice accretion has occurred, resulting in either complete or partial removal of the ice.

Design Internal Temperature: The design internal temperature, also denoted as T_{DIT}, is applicable for machinery located in closed, unheated spaces. It is determined from the Design Service Temperature plus 20°C (36°F) ($T_{DIT} = T_{DST} + 20$). In no case is the design internal temperature to be greater than 0°C (32°F).

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Design Service Temperature: The design service temperature, also denoted by T_{DST} is to be taken as the *lowest mean* daily *average* air temperature in the area of operation where:

- *Mean*: Statistical mean over observation period (at least 20 years).
- *Average:* Average during one day and night
- *Lowest:* Lowest during year.

For seasonally restricted service, the lowest value within the period of operation applies. Section 1, Figure 1 illustrates this definition graphically.

EPIRB: Emergency Position Indicating Radio Beacon

Emergency: A serious, unexpected, often dangerous event requiring immediate action.

Emergency Service Hours: The number of hours which the emergency source of electrical power can provide. SOLAS Regulation II-1/43 and 4-8-2/5.5.2 through 4-8-2/5.5.9 of the *Steel Vessel Rules* require the minimum time to be 18 hours.

Essential: Systems or equipment necessary to maintain vessel propulsion, maneuvering, specified electrical services, firefighting (along with bilge system), ballasting, or personnel safety.

Guide for Certification of Lifting Appliances: The latest edition of this ABS Guide.

In the notch: An operational mode in which a trailing vessel is moored in a specially constructed notch at the stern of an ice breaker.

Low temperature environment: Areas of vessel operations with ambient temperatures less than or equal to –10°C (14°F).

Machinery: Equipment and systems subject to the design requirements of Parts 4, 5C and 6 of the *Steel Vessel Rules*.

Maneuvering Mode: The lowest vessel speed necessary to maintain maneuverability.

MCR: The maximum continuous rating of the prime mover.

Minimum Anticipated Temperature: The minimum anticipated temperature, also denoted as T_{MAT}, can be specified by the Designer, Owner, or Builder. T_{MAT} may be a probabilistic temperature, taken as 2 standard deviations below the mean daily low temperature, or defined as a value below the T_{DST} such as $T_{MAT} = T_{DST}$ -20°C, or $T_{MAT} = LMDLT$ –10°C (where *LMDLT* is *Lowest Mean Daily Low Temperature*).

Steel Vessel Rules: The latest edition of the ABS *Rules for Building and Classing Steel Vessels*.

5 Certification Procedure

A diagram for the procedure for vessels to be certified in accordance with this Guide is shown in Section 1, Figure 2.

5.1 Engineering Review

Vessels operating in low temperature environments need to be provided with certain design characteristics. These design characteristics are addressed in Sections 2 through 5. Certain vessel types have unique features or operating characteristics unlike other vessels. Requirements for four specific vessel types are listed in Section 6. The design characteristics and/or equipment required in Sections 2 through 6 are assumed to be permanently installed (e.g., welded or bolted) in/on the vessel at the completion of construction.

This Guide also lists requirements for additional equipment that is not permanently installed (e.g., clothing for personnel protection, special safety equipment) and additional personnel training described in Sections 8 and 9. The Owner may indefinitely delay the implementation of the requirements of Sections 8 and 9 for those instances where vessel operations in the low temperature environment are not anticipated. Prior to the vessel operating in a low temperature environment, the Owner is to provide this additional equipment onboard and suitable personnel training together with a vessel operations and training manual. Arrangements are to be made for an ABS Surveyor to verify the equipment is onboard and the personnel have received proper training via onboard supporting documentation.

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5.1.1 Plans and Particulars to be Submitted – Winterization Plan *(1 September 2015)*

A winterization plan is to be submitted to ABS for review. The plan is to indicate measures to be taken in different conditions, and is to include at least the following items:

i) Proposed methodology for anti-icing or de-icing on:

- External superstructure horizontal surfaces (decks)
- External superstructure vertical surfaces (bulkheads)
- Radar antenna
- Navigational lights
- Search lights
- Communication antenna
- Lifesaving appliances
- Vents for tanks
- Escape Routes deck surfaces, rails, doors, and stairs (must be ice accretion prevention)
- Fueling stations
- Mooring equipment and controls
- Calculations to support the above arrangements.

ii) Means to prevent the following systems from freezing or becoming uncontrollably viscous:

- Firefighting systems in tanks, cargo spaces, or on deck
- Fresh water lines in tanks, cargo spaces, or on deck
- Sanitary drains, black and grey water lines
- Ballast lines, in tanks, cargo spaces, or on deck
- Fuel and oil lines
- Ballast tanks
- Fresh water tanks
- Fuel and oil tanks
- Any tank and associated piping containing a fluid that is susceptible to low temperatures.
- Combustion air intake
- Ventilation air intake
- Calculations to support the above arrangements

iii) Means of heating and ventilation, including calculations:

- Crew and passenger cabins
- Public areas in accommodation
- Enclosed working spaces
- Combustion air (pre heating)
- Engine room(s)
- Steering gear compartment
- Pump room

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iv) Test plan(s) to demonstrate the functionality of the above systems.

v) Electrical single-line diagram of any electrical heat tracing systems (if-fitted)

vi) Piping diagrams for any thermal fluids used for heat tracing (if-fitted)

vii) Instructions for crew on how and when to exercise the various aspects of the plan.

5.2 Initial Survey

Vessels complying with the requirements of Sections 2 through 6 and confirmed by satisfactory survey may receive the **CCO** notation**,** which will be listed in the *Record*. The **CCO** notation may be maintained indefinitely provided the hull and machinery are to the satisfaction of the attending Surveyor at the subsequent Annual Surveys. See 1/5.3.

When ABS is notified that the implementation of the requirements in Sections 8 and 9 have also been complied with and confirmed by satisfactory survey, the **CCO** notation with **+** will be listed in the *Record*.

5.3 Annual Surveys

Simultaneously with each Annual Survey – Hull and Annual Survey – Machinery, the hull and machinery subject to Sections 2 through 6 are to be examined by the attending Surveyor. The additional equipment and personnel training requirements in Sections 8 and 9 are also to be verified by the attending Surveyor at this time, if applicable.

5.4 Notation Changes

The Owner may advise by written notice to ABS prior to or during the Annual Survey that the additional equipment and personnel training requirements described in Sections 8 through 9 will not be complied with. The notation will be changed to **CCO** without **+** in this instance. See 1/5.2.

6 National Administration Requirements

National administrations have additional requirements for vessels operating in their territorial waters. These requirements may address additional vessel features, equipment, personnel training and instruction manuals. These requirements are not included in this Guide. A list of administrations is provided in Appendix 12.

7 Design Service Temperature *(1 September 2015)*

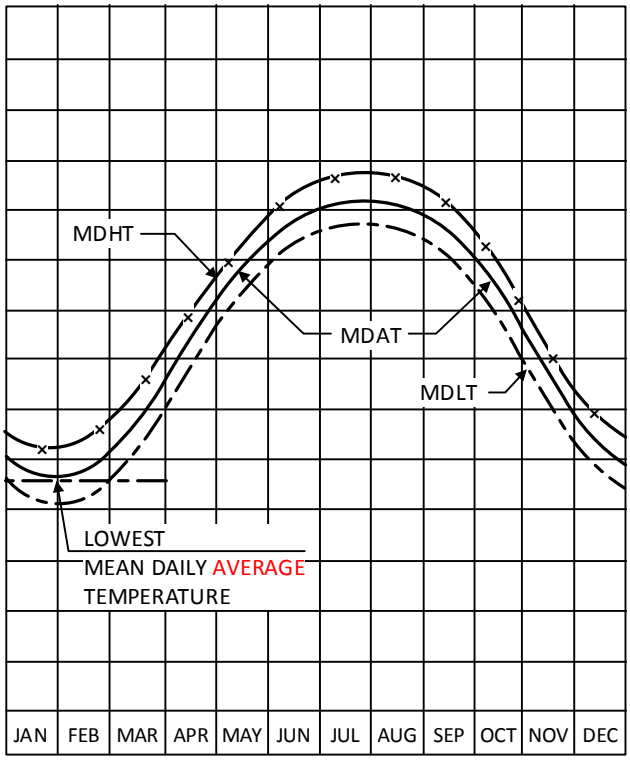
The design service temperature is to be selected based on the months and the regions the vessel is designed to operate in. Temperature data for northern and southern areas for the 1st and the 15th of each month are provided for guidance purposes only in Subsection A10/3, “Air Temperature”. A listing of various meteorological organizations is provided for guidance in Appendix 13.

8 Ergonomics

The maritime industry is aware of the important role of the human element for effective operation, safety standards and practices. For example, effective heating of accommodation spaces to an acceptable temperature, provision of proper clothing, or heated shelters on deck. Additional information is available in the ABS *Guidance Notes on the Application of Ergonomics to Marine Systems* to promote the application and understanding of ergonomic data and principles to vessel and offshore installation design. The ergonomic guidance presented in the Guidance Notes is not required although ABS urges designers, owners, and operators to adopt these principles to the greatest extent feasible.

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FIGURE 1
Graphical Definition of Design Service Temperature *(1 September 2015)*



MDHT: Mean Daily High Temperature

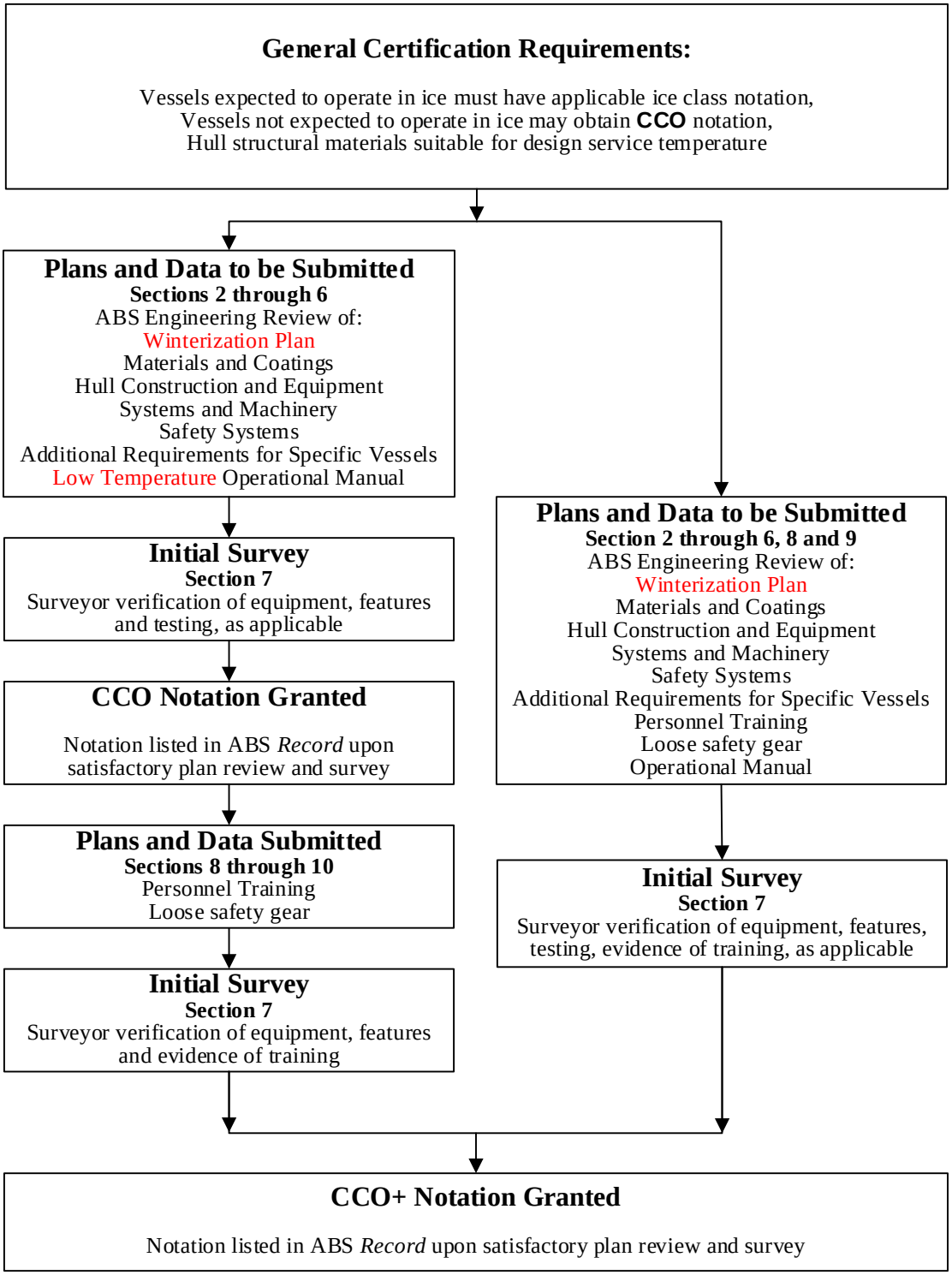
MDAT: Mean Daily Average Temperature

MDLT: Mean Daily Low Temperature

LMDAT: Lowest Mean Daily Average Temperature - (Design Service Temperature)

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FIGURE 2
Certification Procedure *(1 September 2015)*



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TABLE 1
Design Temperatures for Systems, Equipment and Components *(1 September 2015)*

	Item	*Guide Reference*	*Temperature*[1]
1	Towing fittings	3/3.6	DST[2]
2	Anchors and anchor chain	3/6.1	DST
3	Combustion air system	4/2.2	MAT[3]
4	Turbochargers	4/2.3	MAT
5	Deck machinery	4/4	MAT
5a	Anchor windlass	4/4.2	MAT
5b	Towing winch	4/4.3	MAT
5c	Cargo Handling Equipment – cranes, hatch covers, ramp doors, side doors, cargo pumps, deck cargo securing equipment	4/4.6	MAT
6	Piping systems	4/5	MAT
6a	Materials	4/5.1.1	MAT
6b	Flexible hoses	4/5.1.2	MAT
6c	Heating and ventilation for accommodations	4/5.1.8i)	MAT
7	Compressed air system	4/5.6	DST
8	Fire fighting system	4/6.1.1	MAT
8a	Water or foam extinguishers	4/6.1.2	MAT
8b	Fire pumps and associated equipment	4/6.1.3ii)	MAT
8c	Hydrants	4/6.1.3iv)	MAT
8d	Fire fighting system components	4/6.1.4	MAT
9	Navigation light system	4/7.1.3	DST
10a	Rotating machines – unheated spaces	4/7.2.1	DIT[4] See 4/7.2.1
10b	Rotating machines – exterior	4/7.2.1	MAT
10c	Cables	4/7.2.3	DST
10d	Electronics	4/7.3	MAT
11a	Heating and ventilation for accommodations	4/8	MAT
11b	Safety systems – heating for survival	5/2	DST
12	Navigational equipment in ice covered waters	5/3	DST
13	Lifesaving appliances and survival arrangements	5/4	30°C or DST[5]
13a	Lifeboat radio equipment and batteries	5/4.1v)	MAT
13b	Life rafts	5/4.2	DST
13c	Rescue boat radio equipment and batteries	5/4.3i)	MAT
13d	Launching stations and arrangements – sheave lubricants	5/4.4	DST

Notes:

1 Equipment fitted inside an enclosure may apply DIT.

2 Design Service Temperature, (see Subsection 1/4).

3 Minimum Anticipated Temperature, (see Subsection 1/4).

4 Design Internal Temperature, (see Subsection 1/4).

5 Apply the lower temperature.

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SECTION 2 Materials, Welding and Coatings *(1 September 2015)*

1 General *(1 September 2015)*

Materials for exposed hull structures and deck machinery are to be selected taking into consideration the intended functions in cold weather.

All hull and structural materials for ice class vessels are to be selected as follows:

- For vessels subject to the requirements in Sections 6-1-1 through 6-1-5 of the *Steel Vessel Rules*, or other recognized ice class Rules as applicable, the material requirements in these Rules are to be applied.
- For vessels subject to the requirements in Section 6-1-6 "Baltic Ice Classes" of the *Steel Vessel Rules*, the materials are to be selected in accordance with the requirements of 3-1-2/3.5 of the *Steel Vessel Rules*. When 3-1-2/3.5 of the *Steel Vessels Rules* is applied, the definition of temperature given in 3-1-2/3.5 of the *Steel Vessel Rules* is to be used.

For non-ice class vessels, the hull and structural materials are to be selected in accordance with the requirements of 3-1-2/3.5 of the *Steel Vessel Rules*. When 3-1-2/3.5 of the *Steel Vessel Rules* is applied, the definition of temperature given in 3-1-2/3.5 of the *Steel Vessel Rules* is to be used.

2 Dissimilar Materials *(1 September 2015)*

This paragraph is mandatory for systems and equipment in essential services, (4-8-1/Tables 1 and 2 of the *Steel Vessel Rules*, or systems included under the definition of "Essential" in Subsection 1/4 of this Guide). This paragraph is optional, but recommended, for all other systems and equipment.

The application of dissimilar materials is to be avoided where possible. Where impractical or impossible to avoid the use of dissimilar materials, tolerances are to be such that thermal expansions or contractions will not cause components to bind at the Design Service Temperature. This is applicable when components may need to be subjected to maintenance and consist of dissimilar materials. For additional information see Subsection A2/2.

The control of dissimilar materials used in construction is the responsibility of the final assembly yard and is to be covered by the yard's quality system. Components or assemblies may be enrolled in the ABS Type Approval program with specific approval on material applicability for low temperature service.

3 Material of Machinery

(1 September 2015) Machinery subject to these requirements includes any machinery associated with the function or purpose of the vessel.

Exposed machinery is to be suitable for operation at the minimum anticipated temperature if the vessel operator intends to operate the machinery in low temperatures. Safety critical systems are to be suitable for operation at the minimum anticipated temperature unless otherwise stated in this Guide. A particular machinery component/equipment can be excluded from applying requirements in this Subsection if the machinery component/equipment is not intended to be operated in low temperatures. In that case, a note will be entered in the *Record* to indicate that the specific machinery component/equipment is not reviewed to these requirements.

Section 1, Table 1 lists design temperature requirements for various systems, equipment and components.

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3.1 Machinery Structural Members/Components Exposed to Weather *(1 September 2015)*

The material class and temperature of steel products used for exposed machinery foundations and load bearing components are to be in accordance with Section 2, Table 1. Material grade selection is to be selected in accordance with 3-1-2/3.5 of the *Steel Vessel Rules*. The Design Temperature (t_D) in 3-1-2/3.5 of the *Steel Vessel Rules* is to be taken as the temperature referenced in Section 2, Table 1 of this Guide.

3.2 Deck Machinery, Piping, Valves, and Fittings *(1 September 2015)*

Deck machinery materials are to comply with material specifications in Chapter 3 of the ABS *Rules for Materials and Welding (Part 2)* or of a national or international material standard. The proposed materials are to be approved in connection with the design. All such materials are to be certified by the material manufacturers and are to be traceable to the manufacturer's certificates. Materials for piping, valves and fittings for minimum anticipated temperatures lower than –18°C (0°F) are to be selected in accordance with Section 2-3-13 of the ABS *Rules for Materials and Welding (Part 2)*.

Appendix 1 of the ABS *Rules for Materials and Welding (Part 2)* contains the "List of Destructive and Nondestructive Tests Required for Materials, and Responsibility for Verifying". The listings indicate which tests require Surveyor witness, manufacturer provided data without Surveyor witness, and those tests for which data is to be provided by the manufacturer and subject to auditing by the Surveyor.

3.3 Cranes, Lifting Appliances, Vehicle Ramps, and Boat Davits *(1 September 2015)*

3.3.1 Cranes and Lifting Appliances

Certification of lifting appliances is optional.

2-1/9.19 of the ABS *Guide for Certification of Lifting Appliances (Lifting Appliance Guide)* defines the "Design Service Temperature" as "the minimum anticipated temperature at which the crane will operate as specified by the Owner, crane manufacturer or builder." For vessels seeking lifting appliance certification, the minimum anticipated temperature as defined in Subsection 1/4 of this Guide is to be applied. Having established the minimum anticipated temperature for each component, the following should be applied:

i) The material class and minimum anticipated temperature of steel products used for crane and foundation/pedestal are to be in accordance with Chapter 2, Section 3 of the *Lifting Appliance Guide*.

ii) Crane structural components are to be tested in accordance with the requirements of Chapter 2, Section 3 of the *Lifting Appliance Guide*.

iii) The machinery components are to be assessed as per Chapter 2, Section 6 of the *Lifting Appliance Guide*. Therefore, it would have to be demonstrated by way of testing or analysis that such components will operate satisfactorily at the minimum anticipated temperature. In this regard, the testing requirements of Chapter 2, Section 3 of the *Lifting Appliance Guide* may also be applied to such components.

3.3.2 Vehicle Ramps

Vehicle ramps and boat davits are to be in accordance with 2/3.3.1 of this Guide as far as practicable. Where 2/3.3.1 is not applicable, items 2/3.3.2i) or 2/3.3.2ii) below are to be applied.

i) Large structural components of vehicle ramps exposed to the weather, materials are to be selected in accordance with the requirements 3-1-2/3.5 of the *Steel Vessel Rules* for material class II. T_{DIT} defined in Subsection 1/4 may be used instead of t_d if the structures are in an enclosed space.

ii) Large structural components of vehicle ramps exposed to the weather, materials are to be The material for machinery components of vehicle ramps, such as locks, guides, or rollers, are to be in accordance with 2/3.1 and 2/3.2 of this Guide.

3.3.3 Boat Davits

Boat davit materials are to be selected based on Chapter 2, Section 3 of the *Lifting Appliance Guide*. The temperature to use for material selection is to be the Minimum Anticipated Temperature as defined in Subsection 1/4 of this Guide. Davits are normally not certified in accordance with the *Lifting Appliance Guide*.

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3.4 Material of Exposed Outfitting *(1 September 2015)*

Steel products material class used for deck machinery are to be selected from Section 2, Table 1.

Material selection is to be in accordance with 3-1-2/3.5 of the *Steel Vessel Rules.*

3.5 Insulated Members

Design service temperature for insulated members will be considered upon submission of substantiating data.

3.6 Criteria for Other Steels

3.6.1 Steels with Specified Minimum Yield Strength Below 410 N/mm^2, (42 kgf/mm^2, 60 ksi)

Where steels other than those in 2-1-2/Table 5 or 2-1-3/Table 5 of the ABS *Rules for Materials and Welding (Part 2)* are intended, their specifications are to be submitted for approval. These steels are to comply with the following impact test requirements:

Yield Strength			*CVN (Longitudinal)*		
N/mm^2	*kgf/mm^2*	*ksi*	*J*	*kgf-m*	*ft-lbf*
235-305	24-31	34-44	27	2.8	20
315-400	32-41	45.5-58	34	3.5	25

At the following temperatures:

Class I: design service temperature

Class II: 10°C (18°F) below design service temperature

Class III: 20°C (36°F) below design service temperature

3.6.2 Steels with Specified Minimum Yield Strength in the Range of 410-690 N/mm^2 (42-70 kgf/mm^2, 60-100 ksi)

Where steels having this yield strength range are intended, their specifications are to be submitted for approval. These steels are to comply with the impact test requirements of 34 J (3.5 kgf-m, 25 ft-lbf) at the following temperatures:

Design Service Temperature	*Test Temperature*
0°C (32°F)	–30°C (–22°F)
–10°C (14°F)	–40°C (–40°F)
–20°C (–4°F)	–40°C (–40°F)
–30°C (–22°F)	–50°C (–58°F)
–40°C (–40°F)	–60°C (–76°F)

3.6.3 Alternative Requirements

As an alternative to these requirements, higher strength steels are to comply with the following:

i) For transverse specimens, $^2/_3$ of energy values shown in 6-1-5/33.9.1 of the *Steel Vessel Rules.*

ii) For longitudinal specimens, lateral expansion is not to be less than 0.5 mm (0.02 in.). For transverse specimens, lateral expansion is not to be less than 0.38 mm (0.015 in.).

iii) Nil-ductility temperature (NDT), as determined by drop weight tests, is to be 5°C (9°F) below the temperature specified in 6-1-5/33.9.1 of the *Steel Vessel Rules*.

3.7 Additional Requirements for Plates over 100 mm (4 in.) Thickness *(2014)*

In the application of this Guide, rolled steel plates of thickness over 100 mm (4 in.) for primary structural members are considered as thick plates and are subject to additional requirements in 2-1-1/16 of the ABS *Rules for Materials and Welding (Part 2)* in order to avoid possible brittle failure in cold environments.

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3.8 Cast Irons

Ordinary cast iron or gray cast iron is not to be used. Nodular (ductile) iron may be acceptable (See 4-6-2/3.1.4 of the *Steel Vessel Rules*).

3.9 Cast Steels

Cast steel components which are not intended to be welded in construction or fabrication, are to comply with the following impact test requirements:

Yield Strength			*CVN (Longitudinal)*		
N/mm²	*kgf/mm²*	*ksi*	*J*	*kgf-m*	*ft-lbf*
235-305	24-31	34-44	20	2.0	15
305-410	31-42	44-59	24	2.4	18
410-690	42-70	59-100	27	2.8	20
>690	70	100	27	2.8	20

At the following temperatures:

Class I: design service temperature

Class II and III: 10°C (18°F) below design service temperature

For cast steels with yield strengths exceeding 690 N/mm^2 (70 kgf/mm^2, 100 ksi), the test temperature for all classes is to be 10°C (18°F) below design service temperature. The impact test requirement is subject to agreement between the designer/manufacturer and ABS.

3.10 Steel Forgings

Forged steel components which are not intended to be welded in construction or fabrication, are to comply with the following impact test requirements:

Yield Strength			*CVN (Longitudinal)*		
N/mm²	*kgf/mm²*	*ksi*	*J*	*kgf-m*	*ft-lbf*
235-305	24-31	34-44	27	2.8	20
305-410	31-42	44-59	34	3.5	25
>410	42	59	42	4.3	31

At the following temperatures:

Class I: design service temperature

Class II and III: 10°C (18°F) below design service temperature

For steel forgings with yield strengths exceeding 690 N/mm^2 (70 kgf/mm^2, 100 ksi), the test temperature for all classes is to be 10°C (18°F) below design service temperature. The impact test requirement is subject to agreement of the designer/manufacturer and ABS.

4 Weld Metal *(1 September 2015)*

4.1 ABS Grade Hull Steels

When the ordinary and higher strength hull steels listed in 2-1-2/Table 5 or 2-1-3/Table 5 of the ABS *Rules for Materials and Welding (Part 2)* are applied in accordance with the vessel's ice class requirements or 3-1-2/3.5 of the *Steel Vessel Rules*, approved filler metals appropriate to the grades as shown in Part 2, Appendix 3 of the ABS *Rules for Materials and Welding (Part 2)* may be used.

4.2 Criteria for Other Steels

For the welding of hull steels other than the ABS grades listed in Section 2-1-2 or 2-1-3 of the ABS *Rules for Materials and Welding (Part 2)*, the weld metal is to exhibit a Charpy V-Notch toughness value at least equivalent to the transverse base metal requirements ($^2/_3$ of longitudinal base metal requirements).

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4.3 Repair Welding in Low Temperatures

The procedure used for welding in low temperatures is to be agreed upon with the attending ABS Surveyor prior to work. The procedure is to specify the minimum ambient temperature, as well as pre and post weld heating temperatures. Welding materials with an ambient temperature below –10°C is not recommended and should be avoided where possible. Where welding in low temperatures cannot be avoided, the work area is to be protected from the low temperatures and wind as far as is possible by a heated temporary shelter and the weld base materials are to be pre-heated in accordance with the procedure. Post weld heating and insulation are to be applied unless otherwise specified in the procedure. It is to be noted that a vessel's hull is a large heat sink and heating of the local area to be welded will likely be required on a continuous basis during the repair. The area is to be subject to NDT in accordance with the ABS *Guide for Nondestructive Inspection of Hull Welds* after the area has cooled to ambient temperatures.

5 Coatings

Coatings in low temperatures applied to those areas of the hull subject to contact with ice are to be durable and resistant to peeling, abrasion or other degradation. Coating product information and testing results are to be submitted for information. See Subsection A2/5 for additional information.

TABLE 1
Material Class of Machinery Structural Members/Components *(1 September 2015)*

Machinery Members	*Material Class*	*Temperature*
1. Exposed load bearing structural and machinery components directly exposed to the weather	II	*MAT* (1)
2. Load bearing structural and machinery components attached to and within a distance of 600 mm from the other parts which are directly exposed to the weather	II	*MAT* (1) + 10°C
3. Load bearing structural and machinery components attached to but at a distance of over 600 mm from the other parts which are directly exposed to the weather in enclosed spaces		
3a. Unheated space	II	*DIT* (2)
3b. Heated space	I	0°C

Notes:

1 Minimum Anticipated Temperature, (see Subsection 1/4).

2 Design Internal Temperature, (see Subsection 1/4).

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SECTION 3 Hull Construction and Equipment

1 General

For vessels intended to navigate in ice in Polar regions or in non-Polar regions, the applicable requirements for strengthening are provided in the Part 6, Chapter 1 of the *Steel Vessel Rules*. For equivalency ABS will consider other recognized ice standards.

If the intended routes in which the vessel is expected to operate are ice free, then ice strengthening classification is not required.

The materials used in the hull structural members are to be in accordance with the requirements in Section 2 of this Guide.

Information has been provided in Appendix 3 to indicate background and intent of the Guide requirements and, for some cases, recommendations or examples as to how the requirements may be complied with.

2 Tanks

2.1 Fresh Water Tanks

Fresh water tanks with boundaries including the side shell or the deck exposed to the weather are to be provided with arrangements to prevent freezing. See 4/5.2.1.

Fresh water tanks arranged such that the tank boundaries do not include the side shell or the deck exposed to the weather and are located in a heated area such as the machinery space will not require heating arrangements to be provided.

2.2 Fuel Oil Tanks

Fuel oil tanks are to be provided with heating arrangements (See 4-6-4/13 of the *Steel Vessel Rules*) if the fuel will cool below its pour point. Fuel oil tanks for residual fuels are to be maintained 10°C (18°F) above the fuel's pour point. Tank heating calculations are to be provided to show sufficient heat transfer capacity for the design service temperature.

2.3 Ballast Water Tanks *(1 September 2015)*

Ballast water tanks on vessels with design service temperatures equal to or above –30°C (–22°F) but lower than –10°C (14°F) and arranged such that the top of the tank is located above the lightest operating draft are to be provided with arrangements to prevent freezing of the ballast water. Acceptable arrangements include turbulence and convection-inducing systems, for example, bubble systems or heating coils. Other arrangements will be specially considered. See 4/5.2

Vessels with design service temperatures less than –30°C (–22°F) are to be provided with a means of heating. Tank heating calculations are to be provided to show sufficient heat transfer capacity for the design service temperature. See 4/5.2.

For ice class vessels, the capacity and arrangement of the water ballast tanks are to be sufficient to immerse the top of the propeller edges at least to the maximum thickness of level ice in the anticipated area of navigation.

Reference is made to IMO Resolution MEPC.163(56) – Guidelines for Ballast Water Exchange in the Antarctic Treaty Area.

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2.4 Additional Measures for Oil Pollution Prevention *(1 September 2015)*

If the vessel's aggregate fuel and lube oil is of 600 m^3 and above, the requirements of 4-6-4/17.5 of the *Steel Vessels Rules* for the protection of fuel oil and lubricating oil tanks are to be applied. The Class notation **POT** – Protection of Fuel and Lubricating Oil Tanks will also be listed in the *Record*.

Where the vessel's aggregate fuel and lube oil is less than 600 m^3, the fuel oil and lube oil tanks are to be protected, as far as is practical, from possible damage to the ships bottom and sides.

3 Superstructures and Deckhouses

3.1 Bow Area and Forecastles

The bow area is to be accessible for personnel in all weather conditions.

Forecastles are recommended so as to deflect waves and spray away from the deck areas immediately aft of the bow. If a forecastle is not provided, the shell plating is to be flared so as to deflect waves and spray away from the main deck area immediately aft of the bow. The bow area is to be designed to protect anchoring and mooring equipment and operating personnel by means of sheltered or enclosed spaces.

3.2 Deckhouses *(1 September 2015)*

The bridge wings are to be enclosed or designed to protect navigational equipment and operating personnel and to permit operating personnel observation of the ice/hull contact. [See 5/3.1v)]

We note that Bridge Visibility is a requirement of SOLAS Chapter V, Regulation 22.

External access to the navigation bridge windows is to be provided to facilitate their cleaning.

At least 50% of the total number of bridge windows are to be heated and provided with window wipers and cleaning system for de-icing purposes. The heated windows are to be located to maximize visibility assuming all non-heated windows are unusable. The window wiper blade material is to be suitable for operation at the minimum anticipated temperature.

Access to the accommodations spaces and work areas are to be provided with a means, such as two doors, to reduce heat loss from the heated space. Windows and side scuttles are to be of a type designed to minimize heat loss. An example would be double or triple glass panes.

All doors and the adjacent deck areas on emergency escape routes and navigation bridge doors and the adjacent deck areas are to be designed and arranged so that they can be maintained free of snow and ice so as to be readily functional in accordance with the winterization plan required in 1/5.1.1. See 5/4.7 for further details on escape routes.

When personnel are required to perform functions such as a lookout when underway, or security at the gangway when in port, a heated deckhouse is to be provided for sheltering purposes.

3.3 Exterior Stairs *(1 September 2015)*

All exterior stairs are to be installed at a lower angle of about 35 degrees.

Stair step and landing material is to be technically consistent with the solution selected to maintain stairways free of ice and snow. Cases where no heat is applied to the stair step, a grating type material are to be used. In all cases the walking surface of the stairs are to be of high traction.

3.4 Operating Platforms for Deck Equipment *(1 September 2015)*

Platforms for deck equipment (see Subsection 1/4) material is to be technically consistent with the solution selected to maintain the platforms free of ice and snow. Cases where no heat is applied to the platform, a grating type material are to be used. In all cases the walking surfaces are to be of high traction.

3.5 Railings

For **CCO** notation, there are no additional requirements.

For **CCO-POLAR** notation internal heating of railings exposed to low temperatures is to be provided where practicable on escape routes. See 5/4.7.

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3.6 Towing Fittings for Ice Class Vessels

All ice-class vessels are to be provided with arrangements for being towed. Substantial fittings such as bollards should be well incorporated into the hull structure and should be sized for the high dynamic loads that can be experienced in ice. The towing fittings are to be suitably marked with the maximum allowable load, manufacturer, and any restrictions associated with their operation. Reference is made to MSC Circ. 1175 "Guidance on Shipboard Towing and Mooring Equipment".

In some areas (e.g., Baltic Sea, subject to Finnish and Swedish Maritime Administrations requirements), the vessel is to be provided with arrangements to secure the anchors onboard the towed vessel. (This may be accomplished by swinging the anchor aft to prevent contact with the towing vessel, in particular for ice breakers with a notch stern. This may be accomplished with shackles and cables.)

Emergency towing arrangements are to be provided together with suitable arrangements or equipment to provide de-icing capability.

3.7 Cargo Handling

Refer to 4/4.6.2 for requirements for hatch covers, ramp doors and side doors.

Refer to 4/4.6.4 for requirements for deck cargo securing equipment.

3.8 Deck House Insulation

Additional insulation will be required in the superstructure. See Subsection A4/8 for information.

3.9 Access to Machinery on Deck

Access to the deck for personnel (e.g., doors, hatches, etc.) and to other equipment located on the main deck is to be available at all times. Access by the operating personnel is not to be obstructed by ice accumulation or endangered by overhead ice accumulation.

4 Stern

4.1 Towing Notch for Ice Breakers

When provided, towing notches are to be constructed as appendages to the main hull structure.

Fendering is to be used to reduce the possibility of damage at the towing notch, including the bow of the towed vessel. The notch is to be designed to accept various bow shapes.

See A3/4.1 for additional information.

5 Stability *(1 September 2015)*

Ice buildup is most probable in the forward parts of a vessel; however, smaller vessels can experience significant icing thicknesses in almost all areas. This can present a significant safety hazard, as the increase in topweight (aggravated by changes in trim) reduces the stability of the vessel. Stability information onboard should contain sufficient data on the vessel's stability taking into account icing to allow masters to recognize such risks as they arise and to take measures to address the situation.

The IMO Code on Intact Stability requires an allowance for ice accretion for certain vessel types. Other Administrations may have additional requirements for ice accretion.

Ice release coatings can be applied to exposed structure to minimize ice accretion and thereby reduce the effects of ice accretion on vessel stability. See 2A/5.2.

The vessel is to be provided with equipment for de-icing. See 4/1.1 and A4/1.1.

Any freeing ports in accordance with the International Load Line Convention 1966 are to be equipped with means to remain operational due to icing.

Decks are to be designed to avoid stagnant water, in forms of wells or in forms of small pools of water between structural stiffening.

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6 Equipment

6.1 Anchor Chain

Anchor chain is to be provided manufactured with impact resistant properties based on the design service temperature in compliance with the applicable requirements in Section 2.

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SECTION 4 Vessel Systems and Machinery

1 General

Section 4 contains the Guide requirements for machinery. These requirements are organized similarly to the sections in Part 4 of the *Steel Vessel Rules*. These requirements are in addition to those listed in Part 4 of the *Steel Vessel Rules.*

Information has been provided in Appendix 4 to indicate background and intent of the Guide requirements and, for some cases, recommendations or examples as to how the requirements may be complied with.

1.1 Heat Tracing, Anti-icing and De-icing *(1 September 2015)*

Heat tracing needed to meet the requirements in Subsection 4/6, "Fire Safety Systems Requirements", are mandatory. However, requirements related to heat tracing of various systems referenced elsewhere in this Guide are optional but are to be in accordance with the winterization plan.

The vessel's superstructure surfaces and systems are to be heat traced or de-iced in accordance with the winterization plan considering:

- Open deck areas
- Gangways
- Stairways
- Superstructure areas subject to icing
- Railings

A test program for de-icing and heat tracing is to be submitted for engineering review and subsequent use by the Surveyor. The capability of the de-icing and heat tracing systems to function at the minimum anticipated temperature is to be demonstrated by onboard testing or calculations. Calculations are to be in accordance with a recognized standard or manufacturer's code of practice taking into account:

- Snowfall in the area of operation
- Ambient temperature (apply minimum anticipated temperature)
- Wind velocity in the area of operation
- Water source

The factors, for which the heating power capacity is selected, are to be clearly identified.

As the vessel arrangements differ greatly depending on vessel size, service and operating area, information for de-icing and heat tracing various systems and equipment onboard are provided in A4/1.1.

1.2 Hydraulic Systems *(1 September 2015)*

Hydraulic oil sumps are to be provided with heaters or other suitable means for heating purposes, where necessary and capable of being circulated to avoid cold spots.

The use of steam heating coils is not permitted.

The hydraulic oil is to be suitable for the minimum anticipated temperature.

If the power unit and hydraulic lines are located in a heated space, a heater is not necessary.

Thermal expansion and contraction of fixed lines is to be considered and incorporated into the design.

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1.3 Overboard Discharges and Drainage *(1 September 2015)*

The use of gray cast iron material for piping, valves and fittings is prohibited.

Drains are to be protected from freezing

Direct steam or compressed air connections to the sea chests are to be provided for de-icing purposes.

For vessels with a design service temperature below –30°C (–22°F), steam or heat tracing is to be provided on all overboard discharges.

Deck drains are to be protected from freezing or provided with means to be quickly cleared of blockage by ice and snow.

1.4 Lubricating Oil Systems *(1 September 2015)*

Lubricating oil is to be maintained at the proper minimum temperature in accordance with manufacturer's recommendations to allow equipment start-up.

The use of steam heating coils within lubricating oil tanks is not permitted.

2 Prime Movers

2.1 Prime Mover Operating Characteristics for Ice Class Vessels

The propulsion plant is to be capable of continuous operation at low power outputs and/or low vessel speeds.

If icebreaking vessels are likely to operate at or near their continuous ice breaking limit, their operation will be adversely affected by ridges, rafted ice and pressured ice conditions, and they may have to back and ram. The propulsion system should be capable of rapid and repeated variation of power and direction; and should be able to develop a significant percentage of ahead thrust when moving astern.

Ice class vessels following icebreakers should be capable of rapid and repeated variation of power and direction to avoid colliding with the icebreaker or other vessels when in a convoy. Maneuvering mode is considered to be some fraction of the full ahead speed of the vessel.

2.2 Combustion Air Systems for All Vessels

The combustion air system is to be based on the minimum anticipated temperature of the outside air.

2.2.1 Combustion Air for Internal Combustion Engines

2.2.1(a) Means are to be provided to pre-heat combustion air for proper functioning of the main propulsion, auxiliary and emergency generator internal combustion engines in accordance with the engine manufacturer's recommendations.

2.2.1(b) For **CCO-POLAR** notation in addition to complying with 4/2.2.1(*a*) the combustion air is to be led directly from the weather to the engines having a rated power of 100 kW (135 HP) and over by way of ducting or other suitable means such that all of the combustion air is not drawn from the machinery space.

2.2.1(c) The combustion air intakes are to be located on both sides of the vessel and arranged so as to prevent: the recirculation of engine exhaust gases into the combustion air intakes; ice accumulation; and blockage of the duct. The installation of a heat tracing system at the combustion air intakes is acceptable provided that calculations confirming the adequacy of the heat tracing system are submitted.

2.2.2 Combustion Air for Other Prime Movers

Combustion air for other prime movers, such as steam plants and gas turbines, is to be provided in accordance with the manufacturer's recommendations. The details and arrangements will be subject to special consideration.

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2.3 Turbochargers for All Vessels

Turbochargers and the associated combustion air system for internal combustion engines are to be designed to obtain surge-free operation throughout the range of ambient air temperatures in which the vessel is expected to operate.

2.4 Emergency Generator Starting *(1 September 2015)*

In low temperatures the emergency generator is essential to survival. Starting of the generator is to be in accordance with 4-8-2/5 of the *Steel Vessel Rules* while the ship is in ambient temperature at the Minimum Anticipated Temperature.

The two sources of energy for starting the generator are to be selected based on minimizing the single failure mode attributed to cold temperatures.

3 Propulsion and Maneuvering Machinery

For ice class vessels, the additional requirements for propulsion and maneuvering machinery are in the applicable sections of Part 6, Chapter 1, "Strengthening for Navigation in Ice" of the *Steel Vessel Rules*.

3.1 Propulsion Shafting Bearing Lubrication for All Vessels

3.1.1 Oil-Lubricated Bearings *(1 September 2015)*

Vessels with mineral-based oil-lubricated stern tube bearings are to be provided with a pollution-free oil-seal gland.

Systems are to be in accordance with 4/1.4.

3.1.2 Biodegradable Oil-Lubricated Bearings

Vessels with stern tube bearings lubricated with biodegradable lubricant may be fitted with a pollution-free oil-seal gland.

The requirements of 4/1.4 for providing lubricating oil heating arrangements are also applicable.

3.1.3 Water-Lubricated Bearings

Vessels may be fitted with water-lubricated bearings. The bearings are to be suitable for continuous operation in low temperatures.

3.1.4 Shaft Seal Type

The final selection of shaft seal type, radial or axial, must take into account the maximum diameter of the shaft itself and the speed of rotation.

3.2 Fixed Pitch Propellers for Ice Class Vessels

See A4/3.2 for non-mandatory information related to propeller blade attachment methods.

3.3 Controllable-Pitch Propellers for Ice Class Vessels *(1 September 2015)*

The controllable-pitch system is to be designed to take into account the numerous pitch reversals to be expected when operating in ice conditions. Calculations confirming the adequacy of the controllable-pitch system to withstand the additional pitch changes or service experience from the manufacturer are to be submitted for information.

For any hydraulic components exposed to low air temperatures, the requirements of 4/1.2 are applicable.

4 Deck and Other Machinery

(1 September 2015) Deck and other machinery listed in this Subsection exposed to the low temperatures or located in unheated spaces are to be suitable for operation at the minimum anticipated temperature, (see Subsections 1/4 and 2/3). Note that piping and other machinery in cargo holds will be considered exposed to the design service temperature when hatch covers, ramp doors and side doors are opened to load or discharge cargo.

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4.1 Anchoring Arrangements for Ice Class Vessels

4.1.1 Ice Breaking Vessels

The locations of the anchors are to be considered with respect to the waterline and anticipated ice conditions. Consideration is to be given to the height of anticipated ice ridges and rubble; and whether close towing operations will be conducted.

4.1.2 Ice Class Vessels

The locations of the anchors are to be considered with respect to towing operations with the ice breaker.

4.2 Anchor Windlass for All Vessels *(1 September 2015)*

In addition to the requirements of Section 4-5-1 of the *Steel Vessel Rules*, the anchor windlass design is to include these additional requirements:

i) It is suitable for operation at the minimum anticipated temperature.

ii) Anchor releasing arrangements are to be provided in such a manner as to reduce the effects of icing.

iii) The requirements of Subsection 4/7 apply to all electrical components of the windlass.

iv) The requirements of 4/1.2 apply to all hydraulics associated with the windlass.

v) All windlass components subject to tensile stresses are to be constructed of materials subjected to impact testing.

4.3 Towing Winch

If a vessel is expected to undertake regular towing operations, a towing winch is to be provided.

The design, construction and testing of the towing winch is to conform to an acceptable standard or code of practice. To be considered acceptable, the standard or code of practice is to specify criteria for stresses, performance and testing.

The requirements of 4/4.2i), iii), iv), and v) are applicable.

Towing winches are to be of the electric or electro-hydraulic type, single drum, constant tensioning, and fitted with automatic spooling gear.

The winch is to be able to be controlled from the navigation bridge and an emergency override is to be located in close proximity to the winch itself.

The design load of the towing winch is to be based on the available total thrust of the vessel.

4.4 Towing Lines

The towing line breaking strength is to be determined in accordance with the requirements of the standard or code of practice discussed in 4/4.3.

4.5 Towing Fittings for Ice Class Vessels

See 3/3.6.

4.6 Cargo Handling for All Vessels

Cargo handling equipment that may be affected by low temperature environments include cranes, hatch covers, ramp and side doors, cargo pumps and deck cargo securing equipment.

4.6.1 Cranes

Cranes and any other lifting devices exposed to low temperatures are to be certified in accordance with the ABS *Guide for Certification of Lifting Appliances* at the minimum anticipated temperature. See 2/3.3.1iii) of this Guide. In addition, the operator's cab is to be able to be heated to 20°C (68°F) at the minimum anticipated temperature. If the crane is hydraulically actuated, the hydraulic oil should be suitable for the design service temperature, including an electric heater within the oil sump. If the crane is not controlled from an operator cabin, it is recommended to have, as a minimum, nylon or other synthetic material covers for all controls to keep ice/snow off the controls.

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4.6.2 Hatch Covers, Ramp Doors, and Side Doors *(1 September 2015)*

Arrangements or equipment is to be provided to efficiently remove ice buildup around hatches and doors.

If the hatches or doors are hydraulically operated, the requirements of 4/1.2 are applicable.

Materials selected for hatch and door seals are to remain pliant at the minimum anticipated temperature. If covers are to be opened in low temperatures, a means is to be provided to de-ice the seals prior to opening.

4.6.3 Cargo Pumps *(1 September 2015)*

Cargo pumps and their auxiliary equipment (e.g., valves) exposed to the weather are to be suitable for operation at the minimum anticipated temperature. If the cargo pumps are hydraulically operated, the requirements of 4/1.2 are applicable. Electric motors driving cargo pumps are to be provided with space heaters.

4.6.4 Deck Cargo Securing Equipment

Deck cargo securing equipment (e.g., container lashings) is to be suitable for the minimum anticipated temperature.

5 Piping Systems

5.1 General *(1 September 2015)*

Piping of auxiliary machinery systems and equipment subjected to low temperatures, ice accumulation and/or ice ingestion in areas exposed to the weather or in unheated enclosed areas of the vessel are to meet the requirements of this Subsection. Piping systems are to be operable for the minimum anticipated temperature, (see Subsections 1/4 and 2/3).

All piping systems throughout the vessel should be designed to minimize exposure of crew to low temperature environmental hazards during normal operation and routine maintenance. If possible, valves and controls should be automated, and pipe tunnels should be considered if feasible.

See also Section 6, “Specific Vessel Requirements” for any additional requirements.

5.1.1 Materials

Materials subjected to the minimum anticipated temperature are to be resistant to brittle fracture and are to meet the requirements of Subsection 2/3.

5.1.2 Flexible Hoses

Seals and hoses are to remain flexible at the minimum anticipated temperature. Lubricants and working fluids are to be suitable for the design service temperature.

5.1.3 Valves

Valves and closures in exposed primary and secondary essential service systems listed in 4-8-1/Tables 1 and 2 of the *Steel Vessel Rules* are to be selected and located or otherwise protected to avoid freezing of fluids on either side of the valve and to prevent the accumulation of snow and spray ice. Moving parts may require to be heated, continuously or prior to operation.

Canvas covers with electric heating device may be considered. If a hazardous area is present, the covers are to be of a certified safe type as per 4-8-3/13 of the *Steel Vessel Rules*.

5.1.4 Pipes *(1 September 2015)*

Components, such as valves, valve control units, manifolds, vents, fittings, sounding pipes, and other piping components exposed to the minimum anticipated temperature should be protected from ice accumulation or be provided with a means to provide for continued functionality such as positioning in sheltered locations, installing trace heating or heated covers.

Horizontal runs of piping may be unavoidable on certain vessel types, such as a tanker. Effective drainage of these pipes can be accomplished by trimming the vessel aft or installing drain lines in the piping.

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5.1.5 Tank Vents

The blockage of vent pipes by ice accumulation at the deck or by the freezing of plugs inside the pipe from the vapors rising from the tank contents or ingress of air into the tank can result in safety hazards, for example, due to over-pressurization. It is common to fit, or provide for, heat tracing.

If the there is a heated liquid in the tank being vented, anti-icing equipment may not necessarily be installed provided supporting calculations are provided.

5.1.6 Pipe Drainage

All piping within areas that can be expected to freeze shall be designed to prevent freezing or shall be able to be drained of contained fluids. This applies to exposed pipes, valves, pumps and fittings, including those found in areas onboard with no heating available such as voids, cofferdams, etc. Additional heat tracing and insulation should be installed on all safety-related piping exposed to extreme cold temperatures unless other means to provide for operability have been introduced.

Drain cocks (valves) should be provided as these are quick-acting devices. Drain plugs may be provided; but drainage of the piping will take much longer because the operator will have to remove each one with a tool.

5.2 Ship Piping Systems and Tanks

5.2.1 Ballast Water Tanks

Ballast water tank freeze prevention requirements are listed in 3/2.3. The piping requirements in 4/5.3.2(b) are to be applied.

Convection-inducing systems are to extend the entire length of the tank.

5.2.2 Ballast Water Tanks for Design Service Temperatures Below –30°C (–22°F)

For design service temperatures below –30°C (–22°F), each ballast water tank is to be fitted with steam heating coils.

5.3 Piping Systems for Prime Movers

5.3.1 Fuel Oil System

5.3.1(a) Fuel Oil Heating. Fuel oil heating systems are to be designed to provide uninterrupted service of fuel oil to the prime movers.

5.3.1(b) Fuel Oil Filling Stations. Fuel oil filling stations are to be located in an area sheltered from the weather for access and operation. For fuel oil filling pipes located on the deck, alternative arrangements to protect the filling pipes are to be provided such as a removable or hinged cover may be installed.

5.3.2 Cooling System

5.3.2(a) Seawater Systems for Ice Class Vessels (1 September 2015). Seawater systems draw their supply from the sea around the vessel, and therefore must be designed to reduce the risk of the inlets becoming blocked by ice or ice forming within them. Seawater system requirements for ice class vessels are provided in the *Steel Vessel Rules*. See 6-1-5/45.13, “Sea Chests” (**Ice Class A0**, **B0**, **C0**, **D0**, and **E0**); 6-1-4/23.13, “Cooling Water Arrangements” (**Ice Class PC1, Enhanced** through **PC5, Enhanced**); or 6-1-6/29.3, “Sea Inlet Chests for Cooling Water Systems and Fire Main for Baltic Ice Classes”.

Alternative arrangements, such as heat exchangers integral with the hull bottom, will be specially considered.

5.3.2(b) Seawater Piping – All Vessels (1 September 2015). The requirements of 4/1.3 are applicable.

5.3.2(c) Engine Cooling. Main and auxiliary engine cooling lines, if exposed to freezing temperatures, are to be suitably insulated or heated. Alternatively, antifreeze may be used in the cooling water.

5.3.2(d) Non-Ice Classed Vessels. The above requirements are applicable exclusively for ice classed vessels; accordingly, there are no requirements for non-ice classed vessels.

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5.3.3 Fresh Water Systems

i) See 3/2.1.

ii) Fresh water pipe runs through void spaces are to be insulated and heat traced.

iii) All water lines exposed to freezing temperatures are to be fitted with drain cocks at the lowest part of the piping arrangement.

iv) Fresh water generation systems' inlet temperatures are to be in accordance with the manufacturer's requirements.

5.4 Other Piping Systems *(1 September 2015)*

Exhaust gas outlets and pressure/vacuum arrangements (e.g., for prime movers and/or their associated spaces) are to be protected from ice buildup that could interfere with effective operation.

5.5 Waste Storage and Disposal Systems *(1 September 2015)*

Regulations in the Baltic, Arctic and Antarctic regions vary among the administrations. See Appendix 12. Information is provided in A4/5.5.

Waste storage systems (grey and black water) including piping are to be protected from freezing by either placement into a heated compartment or insulation and heat tracing. The system is to be protected enough to prevent freezing at the minimum anticipated temperature.

5.6 Compressed Air Systems *(1 September 2015)*

5.6.1 General

The compressed air supplied to the control air system is to have a dew point 20°C (36°F) below the design service temperature.

5.6.2 Starting Air System – Ice Class Vessels

The requirements of 4-6-5/9 in the *Steel Vessel Rules* for diesel or turbine propulsion are applicable with the exception that the requirements in 4-6-5/Table 4 are to be replaced with the following:

TABLE 1
Required Number of Starts for Propulsion Engines

Engine Type	*Single Propeller Vessels*		*Multiple Propeller Vessels*	
	One engine coupled to shaft directly or through reduction gear	*Two or more engines coupled to shaft through clutch and reduction gear*	*One engine coupled to each shaft directly or through reduction gear*	*Two or more engines coupled to each shaft through clutch and reduction gear*
Reversible	16	20	20	20
Non-reversible	6	8	8	8

For diesel-electric or turbine-electric propulsion see 4-6-5/9.5.1(b) of the *Steel Vessel Rules*.

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6 Fire Safety Systems

6.1 Fire Fighting System

6.1.1 Fire Extinguishing Design and Location *(1 September 2015)*

Fire extinguishing systems are to be designed or located so that they are not made inaccessible or inoperable by ice or snow accumulation or the minimum anticipated temperature. System configuration should take into account the need for operators to be wearing bulky and cumbersome cold weather gear. Alternative fire fighting system designs suitable for use in a low temperature environment, [e.g., aerosol fire fighting system for enclosed spaces (engine room, pump room, etc.)], will be considered upon submittal of substantiating data. The fire extinguishing system is to be such that:

i) Equipment, appliances, extinguishing agents and systems are always to be protected from freezing and operable at the minimum anticipated temperature.

ii) Precautions are taken to prevent nozzles, piping, hydrants and valves from freezing or becoming clogged due to internal or external ice buildup.

6.1.2 Water or Foam Extinguishers

Portable and semi-portable water and foam extinguishers should be located in positions protected from freezing temperatures, as practicable. Locations subject to freezing are to be provided with extinguishers capable of operation at the minimum anticipated temperature.

6.1.3 Fire Pumps and Associated Equipment

i) Where fixed fire fighting systems or alternative fire extinguishing systems are situated in a space separate from the main fire pumps and utilizing their own independent sea suction, this sea suction is to be also capable of being cleared of accumulations of ice. See 4/5.3.2(a).

ii) Fire pumps, including emergency fire pumps, are to be located in heated compartments. The pumps and their auxiliaries are to be adequately protected from freezing at the minimum anticipated temperature.

iii) Isolating valves are to be in accessible locations. Isolating valves located in exposed locations are to be protected from freezing spray. The fire main is to be arranged so that external sections can be isolated and means of draining are to be provided.

iv) Hydrants are to be positioned or designed to remain operable at the minimum anticipated temperature. Ice accumulation and freezing are to be taken into account.

v) All hydrants are to be installed with a two-handed valve lever or hand wheels and provided with quick connects for hoses.

vi) *(1 September 2015)* Valves and hydrants exposed to minimum anticipated temperatures less than or equal to –30°C (–22°F) are not to be of gray cast iron.

6.1.4 Protection Against Ice Buildup

Components of the fire fighting system that may be exposed to icing that could interfere with the proper functioning of that component are to be adequately protected so as to remain operable at the minimum anticipated temperature. Portable fire fighting equipment such as portable foam applicators are to be stored in a protected space and are to be readily available.

6.1.5 Fire-fighter's Outfits

i) Fire-fighter's outfits are to be located within accommodation areas and other spaces, as appropriate, suitably protected from low temperature conditions. The outfits are to be stored in positions as widely separated as practicable and readily accessible by the crew.

ii) *(1 September 2015)* In addition to the fire-fighter's outfits required in the *Steel Vessel Rules* 4-7-3/15.5, for vessels operating in remote areas one spare fire-fighter's outfit is to be provided. The spare outfit is to be stored in a location protected from low temperatures where access is provided to the open deck, such as a steering gear room.

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7 Electrical Systems

7.1 System Design

7.1.1 Main Source of Electrical Power

Where central electric power plants or shaft generators are installed, the requirements in 4-8-2/3 of the *Steel Vessel Rules* are applicable.

7.1.2 Emergency Source of Electrical Power

7.1.2(a) Additional Systems, Equipment and Spaces. In addition to those listed in 4-8-2/5.5 of the *Steel Vessel Rules*, the following systems and equipment are to be provided with an emergency source of power:

- Operation and control of the auxiliary boiler, if fitted.
- Heat tracing for any piping associated with the emergency services listed in 4-8-2/5.5 of the *Steel Vessel Rules*.

In addition to the emergency services listed in 4-8-2/5.5 of the *Steel Vessel Rules*, emergency heating is to be available for a period of 18 hours for the following spaces:

- Navigation Bridge
- Radio Room
- Engine Control Room
- Centralized Control Station
- Cargo Control Room
- Machinery Space Workshop
- Emergency Generator Room
- Battery Room
- Two common areas (e.g., Mess Room and Recreation Room)
- Hospital
- Heated Compartments for Fire Control Station and Fire Fighting Equipment

7.1.2(b) Increased Emergency Services Time. As an option, the time periods listed in 4-8-2/5.5.2 through 4-8-2/5.5.9 of the *Steel Vessel Rules* and 4/7.1.2(a) of this Guide may be increased from 18 hours or greater for vessels anticipated to operate in remote areas. This increased time is optional and will be shown in the classification notation.

7.1.3 Specific Systems

7.1.3(a) Navigation Light System. Exposed lights are to be suitable for operation at the design service temperature and environmental conditions.

7.2 Electrical Equipment

7.2.1 Rotating Machines

7.2.1(a) Motors and Generators. Electric motors and generators in unheated spaces are to be:

i) Fitted with means to prevent moisture condensation in the machine when idle.

ii) Provided with lubricating oil suitable for the design internal temperature if the bearings require forced lubrication or pre-lubrication.

7.2.1(b) Motors. Electric motors in exterior locations are to be:

i) Fitted with means to prevent moisture condensation in the machine when idle.

ii) Provided with lubricating oil or grease suitable for the minimum anticipated temperature.

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7.2.2 Switchboards, Motor Controllers, etc.

Switchboards, power and lighting distribution boards, motor control centers and motor controllers and battery charging panels located in compartments that may be subject to low temperatures are to be provided with space heaters.

These components are to be suitable for continuous operation resulting from vibrations from ice impacts and vessel maneuvering and are not to trip inadvertently. The manufacturer's certification or specification sheet is to be submitted for review.

7.2.3 Cables *(1 September 2015)*

Electric cables in exposed areas are to be suitable for operation at the design service temperature. Sheathing is to be provided to protect the cables from mechanical damage. Electric cables are to be in accordance with one of the recognized standards listed in 4-8-3/9.1 of the *Steel Vessel Rules*.

Cables on exposed decks are to be protected from the effects of mechanical ice removal.

7.2.4 Accumulator Batteries – Storage Space

A battery storage space is required to be provided with mechanical ventilation to supply heated air.

7.3 Electronic Equipment – Monitoring and Control *(1 September 2015)*

Indicators and alarms for critical systems are to be duplicated as far as possible. The use of components that have demonstrated a high level of reliability operating in low temperatures are to be used where possible.

The intended operation of the vessel and the equipment is to be considered. Vessels that are expected to enter a lay-up period in low temperatures are to have systems rated for survival at the minimum anticipated temperature while inactive. Systems that are required to operate in low temperatures are to be rated for operation at the minimum anticipated temperature. Systems to consider include but are not limited to:

- Systems used to meet the requirements of 4-7-3/9 and 4-7-3/11 of the *Steel Vessel Rules*
- System required to support ABS notations requirements
- Displays and monitors
- Computers and integrated circuits
- Human interface, including touch screen monitors
- Sensors
- Cameras

8 Heating and Ventilation

The following requirements apply to the accommodations and other spaces that are normally manned or occasionally manned for certain vessel operations.

i) The heating and ventilation systems are to be designed for satisfactory distribution of heating at the minimum anticipated temperature.

ii) Supplementary electric heaters *may* be used in cabins and other manned spaces provided they are permanently installed. High amperage permanently installed heaters are not to be wired to the same circuit breakers as vital electronic equipment. Portable electric heaters are not permitted.

iii) The relative humidity is to be maintained in the range between 30% to 70%.

iv) *(1 September 2015)* Heating systems for accommodation spaces and the spaces listed in 4/7.1.2(a) with the following exceptions are to have a rated capacity sufficient for maintaining the temperature to 20°C (68°F) at the minimum anticipated temperature. However, the machinery space workshop, emergency generator room, battery room and compartments for fire fighting equipment are to be fitted with heating systems with a rated capacity sufficient to maintain the compartments to 10°C (50°F) at the minimum anticipated temperature.

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v) Recirculation of air in the accommodation spaces is to be in accordance with a recognized standard. The standard applied is to be provided for information.

vi) Air ventilation ducting is to be insulated with non-combustible insulation.

vii) The closing apparatus for all ventilation inlets and outlets are to be located so as to be protected from snow and ice accumulation that may interfere with effective operation of the closures and recirculation of exhaust gases. Alternatively, heat tracing may be provided in lieu of a protected location.

viii) *(1 September 2015)* All other spaces that are normally manned and/or have equipment installed within are to be provided with a heating system with a rated capacity sufficient to maintain 0°C (32°F) at the minimum anticipated temperature. Consideration will be given if it is unpractical to heat the space due to its arrangement or size.

A summary of the heating, ventilation, and air conditioning calculations confirming compliance with the above requirements is to be submitted for review.

9 Remote Propulsion Control and Automation

9.1 Monitoring

Standby propulsion and auxiliary machinery are to be provided with either:

i) Low temperature monitoring with an alarm installed on each machine; or

ii) Low temperature monitoring with an alarm for the compartment.

These alarms are to alert the operator in the Engine Control Room and/or Centralized Control Station when the temperature is too low for the machinery to start.

10 Remote Control and Monitoring for Auxiliary Machinery and Systems Other Than Propulsion

No additional requirements.

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SECTION 5 Safety Systems

1 General

This Section lists requirements for various equipment necessary for the protection and survival of the personnel onboard the vessel operating in low temperatures and accretion of ice. It should be noted that for vessels operating in low temperature environments, rescue and medical services may be significantly delayed because of weather conditions or remoteness of the area.

Additional information has been provided in Appendix 5.

A list of Administrations with coasts on the Arctic and Antarctic Oceans and the Baltic Sea are listed in Appendix 12.

2 Heating for Survival

Heating systems are considered essential for safety and survival. Therefore, the emergency generator is to be sized to maintain crew survivability. The spaces listed in 4/7.1.2 are to be fitted with heating systems with a rated capacity sufficient for maintaining 10°C (50°F) at the design service temperature.

3 Navigational Equipment in Ice-Covered Waters

Navigation in ice-covered waters is assisted by specialized equipment and services to support both strategic (route planning) and tactical (ice avoidance) decisions. All navigational equipment is to be capable of being operated in the environmental conditions at the design service temperature.

3.1 Equipment

The following equipment is to be installed onboard:

i) *(1 September 2015)* Equipment capable of receiving high resolution ice and weather charts.

ii) Radar systems capable of picking up ice targets.

iii) Adequate communications and signaling equipment.

iv) High powered xenon arc searchlights remotely operated and positioned to provide 360 degrees of lighting capability, if possible.

v) Sound reception system for navigation bridge with enclosed bridge wings for reception of exterior noises/signals.

vi) *(1 September 2015)* Navigation lights are to be self-heating, provided with heating or another adequate means to maintain ice-free lenses.

4 Lifesaving Appliances and Survival Arrangements

(1 September 2015) This Subsection lists requirements for various lifesaving appliances. They are based in part on the following International Maritime Organization (IMO) documents:

- IMO Guidelines for Ships Operating in Arctic Ice-Covered Waters or the IMO Guidelines for Ships Operating in Polar Waters.
- IMO Life Saving Appliance Code (2003) (as amended).
- IMO International Code for Ships Operating in Polar Waters (Polar Code), MSC.385(94)

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The flag State administration and the administrations responsible for the coastal areas that the vessel will be operating in may have requirements in addition to those listed.

Adequate supplies of protective clothing and thermal insulating materials are to be supplied for all vessels operating in low temperature environments for all persons onboard expected to perform tasks in low temperatures.

Lifesaving appliances are to be of a type that is rated to perform its functions at the lowest temperature of:

- Its design service temperature or
- A temperature of –30°C (–22°F)

Additional rations and drinking water are to be provided onboard all lifeboats and life rafts. Extra rations (caloric intake) are required by personnel subjected to extremely cold temperatures. Drinking water containers are to be suitable to allow for thermal expansion while frozen. Consideration should be given to storing rations and drinking water, in addition to those in the lifeboats and life rafts, inside the deckhouse/ accommodations to protect them from freezing. These additional rations and drinking water are to be stored in such a space or container so as to be convenient for placement into the survival craft should evacuation become necessary. See Chapter 11 of the IMO *Guidelines for Ships Operating in Polar Waters*.

It should be understood that most EPIRBs and Personal Floatation Device (PFD) lights are automatically activated by contact with water, which may not happen when vessels are evacuated in ice-covered waters. Crews need to be aware of this fact, and are to be provided with equipment (e.g., manually activated) that facilitates other ways of transmitting distress and location information. EPIRBs and PFD lights selected are to be rated for operation at the design service temperature. Note that most EPIRBs work only down to –20°C according to manufacturers' instructions. Care must be taken to verify that the selected EPIRBs are suitable for the design service temperature. The manufacturer should be consulted for guidance.

4.1 Lifeboats *(1 September 2015)*

Partially or totally enclosed lifeboats are required for all vessels operating in low temperature environments, as they offer shelter to the occupants from the environment. Lifeboats are to meet the requirements of the IMO Life Saving Appliance Code and the flag State administration. The following additional requirements are to be complied with:

i) The capacity of the lifeboats are to be sized for 125% of crew size based on increased dimensions as crews are presumed to be dressed in bulky cold weather clothing. Lifeboat access and operations are to be based on these increased dimensions. Most lifeboats will not accommodate their SOLAS capacities when crews or passengers are dressed in bulky clothing.

ii) The lifeboat engine is to be suitable for cold starting and continuous operation at the design service temperature in lieu of the test temperature specified in the LSA Code. Engine block heaters may be considered for oil sumps. Cooling water, fuel and lubricating oils for engines are to be suitable for engine operation at the design service temperature.

iii) For ice class vessels, the propeller is to be protected from contact with ice.

iv) Lifeboat steering systems should be designed so that it does not directly transmit ice forces on the rudder to the coxwain's hands.

v) For ice class vessels, the lifeboat's keel is to be adequately strengthened to withstand an impact with ice.

vi) Lifeboats are to be provided with radio equipment and batteries suitable for operation at the minimum anticipated temperature.

vii) Lifeboat releasing gear is to be shielded or protected from freezing for ready release or reattachment.

viii) Lifeboats are to be provided with heaters and heating fans to reduce humidity and prevent icing and blockage of entrance doors. For design service temperatures less than –30°C (–22°F), heater cables are to be installed for hatches and doors to prevent freezing. Lifeboat internal spaces are to be heated both when the lifeboats are onboard as well as when the boats are operating independently, the power for these heat sources need not be the same. Heating for lifeboats when deployed is to be capable of maintaining a temperature of at least 10°C with no one onboard at the design service temperature, and be capable of temperature adjustment. Air flow inside the lifeboat is to ventilate all areas including the bow area with fresh heated air.

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ix) Lifeboat windows in way of the control station are to be provided with heating or other means to prevent icing and frost.

x) Lifeboats are to be equipped so as to be capable of deterring native animal invasion (e.g., polar bears).

4.2 Life Rafts *(1 September 2015)*

Life rafts are to meet the requirements of the IMO Life Saving Appliance Code and the flag State administration.

Inflation of inflatable life rafts is to be completed within a period of 3 minutes at the lowest temperature of:

- Its design service temperature or
- A temperature of –30°C (–22°F)

After inflation, the life raft is to maintain its form when loaded with its full complement of persons and equipment.

A manual inflation pump is to be stored near the inflatable liferafts if not provided within the pack.

The hydrostatic release mechanisms are to be protected from icing.

4.3 Rescue Boat

A rescue boat, if provided, is to meet the requirements of the IMO Life Saving Appliance Code and the flag State administration. The following additional equipment is to be provided onboard the rescue boat:

i) Radio equipment with batteries suitable for the minimum anticipated temperature is to be installed.

ii) A battery charger

iii) An engine block heater

iv) *(1 September 2015)* Cooling fluid, fuel and lubricating oils for engines are to be suitable for engine operation at the design service temperature.

4.4 Launching Stations and Arrangements

The requirements of this Paragraph are applicable for lifeboats, life rafts and rescue boats.

For ice class vessels, launching appliances onboard need to be designed with the following special considerations. Free-fall lifeboats cannot be released onto ice-covered waters without risking the safety of occupants because of impact with the ice and/or surfacing under ice floes. Standard lifeboats have almost no ice-transit capability, and they should be launched into the vessel's track to maximize their ability to get clear of a sinking or burning vessel. Launching stations are to be located considering their suitability to facilitate abandoning the vessel during navigation in ice-covered waters.

Arrangements are to be provided to permit lowering life rafts onto the ice rather than into the water. Life raft storage arrangements should be provided to permit this operation.

For ice class and non-ice class vessels, the forward end of the lifeboat stations is to be shielded with a roof and wind walls to reduce ice and snow accretion on the lifeboat canopy, davits, sheaves and wires. The launching arrangements for boats and their retrieval are to be protected with a cover over the sheaves and wires.

Grease or lubricant used for the sheaves is to be suitable and is not to exhibit degraded performance at the design service temperature.

4.5 Ice Gangway, Personnel Basket and Escape Chutes for Ice Class Vessels

An ice gangway or personnel basket used in conjunction with a crane may be considered as an additional means of evacuation, subject to approval of the flag State administration.

Escape chutes, if provided, are to meet the requirements of the IMO Life Saving Appliance Code and the flag State administration. The escape chute is to provide a means of landing safely on the ice pack.

Equipment is to be provided for shelter of all personnel.

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4.6 Immersion Suits and Life Jackets

The requirements in Chapter 11 of the IMO Guidelines for Ships Operating in Arctic Ice-Covered Waters or the IMO Guidelines for Ships Operating in Polar Waters with regard to immersion suits and life jackets and the flag State administration are to be complied with.

Adequate supplies of immersion suits and life jackets are to be provided on the vessel for all persons onboard at any time.

Personal immersion suits may be stored in cabins to be used during lifeboat musters in order to avoid moisture accumulating in suits stored at lifeboat stations.

4.7 Alarms, Escape Routes and Access Routes *(1 September 2015)*

The requirements in Chapter 4, Accommodation and Escape Measures of IMO Guidelines for Ships Operating in Arctic Ice-Covered Waters or the IMO Guidelines for Ships Operating in Polar Waters, and the flag State administration are to be complied with.

All vessels are to have arrangements or procedures to maintain escape routes free of snow and ice.

Public Announcement and General Alarms are to remain functional and audible considering snow and ice accumulation and operation at the minimum anticipated temperature.

The fog horn is to remain operational at the minimum anticipated temperature, and to be capable of being safely de-iced or designed to be anti-iced.

4.8 Lighting *(1 September 2015)*

The lighting and emergency lighting on open decks are to be designed to prevent icing,

Exterior lighting systems, including emergency lighting, are to be designed such that the decks are illuminated with consideration of fog or falling snow.

5 Drills and Emergency Instructions

Emergency and evacuation procedures including instructions for at sea and ice covered waters are to be developed with an appropriate emphasis to changes to standard procedures made necessary by operations in low temperature environments. Refer to the requirements of Chapter 13, Operational Guidelines of the IMO Guidelines for Ships Operating in Polar Waters (2009) (Resolution A.1024(26)). The procedures are to include the following topics:

i) For ice class vessels, the propeller is to be protected from contact with ice

ii) Vessel evacuation

iii) Operation of safety equipment and supporting vessel systems, such as cranes or lifting appliances during an emergency or vessel evacuation

iv) Survival at sea

v) Survival on ice/ashore

vi) Fire and damage control equipment and system

vii) Cross-training of crew members

Crew members are to be provided with proper onboard instructions and be regularly trained

6 Provisions and Spares

The flag State administration and the administrations responsible for the coastal areas that the vessel will be operating in may have additional requirements related to provisions and spares.

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SECTION 6 Specific Vessel Requirements

1 Application

Many vessel types have design and operational characteristics which require special consideration. This Section of the Guide addresses those additional requirements for specific vessel types which are now operating or under consideration for operation in low temperature environment services.

Additional information has been provided in Appendix 6.

2 Vessels Intended to Carry Liquefied Gases in Bulk

2.1 General

These requirements are intended to apply to vessels with the classification ✠ **A1 Liquefied Gas Carrier** or ✠ **A1 Liquefied Natural Gas Carrier** and subject to the requirements in Part 5C, Chapter 8 of the *Steel Vessel Rules*. These are additional requirements to those in the other Sections of this Guide.

2.1.1 Design Loads

The requirements of this Section will only consider Liquefied Natural Gas Carriers operating in waters without any significant ice cover. Loads resulting from interaction with ice and loads caused by navigation in ice are to be verified as part of the overall design development, and considered when assigning a suitable Ice Class Notation in accordance with Part 6 of the *Steel Vessel Rules*.

2.1.2 Plans and Data to be Submitted

The following systems/components are subject to the additional requirements in this Subsection for operation at the design service temperature:

- Ballast Tank Heating Arrangements
- Cargo Piping Diagram
- Cargo Pressure and Temperature Control Systems
- Cargo Tank Vent Systems
- Interbarrier and Insulation Space Venting Systems
- Environmental Control Systems (e.g., nitrogen purging systems)
- Inert Gas System
- Electrical Installations
- Additional Fire Safety Requirements, including Water Spray System
- Mechanical Ventilation in Cargo Area
- Instrumentation for Gauging, Gas Detection, and Cargo Handling Controls
- Details of the arrangements for the use of cargo as fuel and associated fuel gas piping diagrams and other arrangements for utilization or burn-off of boil-off gas (BOG)
- Details and arrangements of re-liquefaction systems, if installed
- Details of additional Personnel Protection arrangements

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2.2 Material Selection

Materials entering into the construction of Liquefied Gas Carriers and associated equipment and cargo containment systems are to be in accordance with the requirements in Section 2 of this Guide, Part 5C, Chapter 8 of the *Steel Vessel Rules* and the ABS *Rules for Materials and Welding (Part 2)*.

2.3 Hull Construction and Equipment

2.3.1 Ice Loads

Loads attributable to ice and snow accumulation on the containment system or any cover for the containment system are to be determined, taking into account both the static load and dynamic load from sliding or dropped ice

2.3.2 Weather Deck Equipment

Due to the nature of the cargo, many cargo-related systems and equipment are designed for operation at low temperatures. However, it is necessary to consider both external and internal low temperatures in the design and selection of materials.

For cargo piping and piping supports installed on the main deck and exposed to the weather, including ventilation piping, the design loads are to include the expected amount of ice and snow accumulation.

The supports for liquid and vapor cargo piping systems on deck are to be arranged so that free expansion and contraction of the pipes during cargo operations cannot be blocked by accumulated ice or snow.

2.3.3 Stability

Liquefied gas carriers with cargo tanks or tank covers protruding from deck and/or with many exposed piping systems and features in elevated locations are likely to accumulate large amounts of ice in the upper part of the vessel, adversely affecting stability.

Intact and damage stability calculations are to take into account the weight of ice accumulation in exposed areas by means of an allowance for ice accretion based on the specific configuration of decks, piping systems and features in the cargo area for the particular vessel.

2.4 Machinery and Electrical Equipment

Many LNG carriers utilize cargo boil-off as fuel for propulsion power. The normal rate of boil-off (NBOR) depends on the insulation of the cargo tanks and the external temperatures. For vessels capable of operating in the “gas only mode” and operating near the design service temperature, the expected boil-off volumes are to be determined to verify the provisions for forced boil-off are adequate.

2.4.1 Valves *(1 September 2015)*

Safety relief valves and other valves exposed to the weather, as described in Part 5C, Chapter 8 of the *Steel Vessel Rules*, are to be arranged in such a way as to provide their local and remote activation under all circumstances. Means of ice removal and heat tracing of the valves are to be provided. Valve actuators with local position indicators are to be of the enclosed type.

Valves for cryogenic service are more susceptible to packing gland leaks at low ambient temperatures. Data is to be submitted to confirm that these valves will be suitable for service at the minimum anticipated temperature.

2.4.2 Cargo Tank and Inter-barrier Space, Venting and Pressure Regulating Arrangements

All piping and pressure/vacuum preventing systems including valves are to be provided with a heat tracing system to provide for their functionality at all times.

Operational procedures for local testing are to be provided to the operator.

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