INTERNATIONAL MARITIME ORGANIZATION

E

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MSC.1/Circ.1519
6 June 2016

GUIDANCE ON METHODOLOGIES FOR ASSESSING OPERATIONAL CAPABILITIES AND LIMITATIONS IN ICE

1 The Maritime Safety Committee, at its ninety-fourth session (17 to 21 November 2014), adopted the new chapter XIV of SOLAS and the International Code for Ships Operating in Polar Waters (Polar Code), by resolutions MSC.386(94) and MSC.385(94), respectively. In accordance with the Polar Code, new and existing ships operating in polar waters shall have on board a valid Polar Ship Certificate establishing operational limitations, including limitations related to ship structural ice capabilities.

2 The Polar Code also requires that information on ship-specific capabilities and limitations in relation to the assessment required under section 1.5 of the Polar Code be included in the Polar Water Operational Manual (PWOM).

3 The annexed guidance addresses the development of methodologies for the assessment of operational limitations in ice which may be referenced on the Polar Ship Certificate and which may form part of information on ship-specific capabilities and limitations included in the PWOM.

4 This guidance has been issued as "interim guidance" in order to gain experience in its use. It should be reviewed four years after the entry into force of the Polar Code in order to make any necessary amendments based on experience gained.

5 In the meantime, Member States and international organizations are invited to report on their experience with the use of the guidance to the Maritime Safety Committee under the agenda item "Any other business".

6 Member States are invited to bring the annexed guidance to the attention of all parties concerned.

***

ANNEX

GUIDANCE ON METHODOLOGIES FOR ASSESSING OPERATIONAL CAPABILITIES AND LIMITATIONS IN ICE

1 Introduction

1.1 In order to maintain an acceptable level of risk under different ice regimes and types of operation in ice, voyage planning and operation should take into account ship structural capability, ship characteristics, type of operation and current and expected ice conditions. Where applicable, the Polar Ship Certificate should reference a practical methodology for assessing the operational capabilities and limitations in ice.

1.2 Ice class, if any, is included in the Polar Ship Certificate and gives information on structural capability. This provides the basis for assessing limiting ice conditions and determining acceptable safe operating procedures.

1.3 This guidance addresses the development of methodologies for assessing the structural capabilities and limitations in different ice regimes and operational modes when the ship is operating in ice. It may also be used as a tool for voyage planning. At the design stage, ice class selection may also be assessed by matching the anticipated ice conditions to this guidance

1.4 Any system or methodology for assessing structural capabilities and limitations based on this guidance should not be interpreted as a "Go/No Go" tool but as a decision support tool. The decision for operating in specific ice regimes should be based on the consideration of personnel on board qualified in accordance with chapter 12 of the Polar Code, taking into account the condition and characteristics of the ship; current and forecasted environmental conditions, including type and concentration of ice, sea state and visibility; and an understanding of the anticipated ship-ice interactions.

1.5 Currently, there are well established national shipping systems such as Canada's Arctic Ice Regime Shipping System and the Russian Ice Certificate. This guidance is aimed at making use of that experience to assist shipboard personnel, companies and administrations.

2 Definitions

For the purpose of this guidance, in addition to the definitions in the Polar Code, the following definition applies:

> *Ice regime* means a description of an area with a relatively consistent distribution of any mix of ice types, including open water.

3 General

3.1 Ships operating in ice should be provided with a practical methodology to assess their limitations for specific operational conditions. The methodology should take into account:

.1 hull structural capability to resist ice load and the capability of the propulsion machinery, rudders and steering gear to resist ice loads;

.2 ice regimes;

.3 independent or escorted operations; and

.4 ice decay in warmer ambient temperatures.

3.2 To determine and record the limitations for operating in ice in the Polar Ship Certificate, acceptance criteria should be established whereby the risk of structural damage and/or loss of watertight integrity are effectively assessed against the ice conditions and modes of operation for the intended area of operation.

3.3 Assessments should be practical and intended to be used on board prior to, and during polar water operation and/or transit. Masters, chief mates and officers in charge of a navigational watch should receive suitable training in the use of any system or methodology used for assessing the ship's limitations in ice. Practical examples on the use of the methodology should be included in the Polar Water Operational Manual (PWOM).

3.4 Where applicable, the methodology used for setting operational limitations should be referenced on the Polar Ship Certificate[1].

4 Acceptance of methodologies

4.1 The appendix includes an acceptable methodology for assessing limitations for ships operating in ice.

4.2 Alternative methodologies to that contained in the appendix may be accepted provided that they meet the content described above.

4.3 Alternative methodologies should have a means to describe limiting ice conditions using tables and/or curves based on ice concentration, ice type and stage of ice decay.

4.4 For ships with no ice class, measures that will keep the ship from coming into contact with ice may be adopted instead of this type of methodology.[2]

[1] The following information should be included in section 5.1 of the Certificate:
Limited to operation in Polar waters in accordance with the outcome of the accepted system for determining operational limitations appropriate to the ice strengthening applied.
Name of system:……..e.g. AIRSS, POLARIS, Ice Certificate
Reference document number:……e.g. PWOM section number / Ice Certificate report number

[2] *Where the ship is restricted to operate in ice-free waters as identified in 2.2 of the Certificate, the following information should be included in section 5.1 of the certificate:* "*Limited to ice free waters.*"

APPENDIX

METHODOLOGY FOR ASSESSING OPERATIONAL CAPABILITIES AND LIMITATIONS IN ICE: POLAR OPERATIONAL LIMIT ASSESSMENT RISK INDEXING SYSTEM (POLARIS)

Introduction

I The Polar Operational Limit Assessment Risk Indexing System (POLARIS) has been developed incorporating experience and best practices from Canada's Arctic Ice Regime Shipping System, the Russian Ice Certificate supplemented by pilot ice assistance as prescribed in the Rules of Navigation on the water area of the Northern Sea Route and other methodologies.

II The basis of POLARIS is an evaluation of the risks posed to the ship by ice conditions in relation to the ship's assigned ice class. It uses the WMO nomenclature and the ice class consistent with the ice class(es) referenced in the Polar Ship Certificate.

III POLARIS uses a Risk Index of Risk Values (RIVs) which are assigned to a ship based on the ice class. The RIVs may be used to evaluate the limitations of the ship operating in an ice regime using input either from historic or current ice charts for voyage planning or in real time from the bridge of the ship.

IV The principal features of POLARIS are:

.1 the use of a combination of IACS Polar Class ice classes and ice classes assigned equivalence to Finnish-Swedish Ice Class Rules under HELCOM[3], which are consistent with ice class references used elsewhere in the Code;

.2 the use of ice type definitions generally consistent with WMO nomenclature and which can be found on international ice charts;

.3 consideration of different ice regimes (e.g. waters with partial ice concentrations of different ice types and development stages and ice free waters);

.4 consideration of ice decay – the outcome of which is a reduced risk due to a reduction in ice strength for some ice types when operating in warmer ambient temperatures; and

.5 an acknowledgement that ships operating under icebreaker escort have a different risk profile to ships operating independently.

[3] Refer to the annex to HELCOM Recommendation 25/7, Safety of Winter Navigation in the Baltic Sea Area, available at www.helcom.fi

1 Polar Operational Limit Assessment Risk Indexing System (POLARIS)

1.1 Risk Index Values

1.1.1 Ships assigned an ice class and ships without an ice class have been assigned a Risk Index in POLARIS. The Risk Index Values (RIVs) within the Risk Index are values corresponding to a relative risk evaluation for corresponding ice types.

1.1.2 Ice types in POLARIS generally conform to WMO nomenclature used on ice charts with the exception that Medium First Year Ice and Multi Year Ice are given two RIVs. Where the operator can confidently determine that the Medium First Year Ice in a regime is less than 1 metre in thickness, the RIVs in the column "Medium First Year Ice less than 1 m thick" may be used. Otherwise the RIVs in the column "Medium First Year Ice" should be used. Similarly, where the operator can confidently determine that the Multi-Year Ice in a regime is less than 2.5 metres in thickness, the RIVs in the column "Light Multi-Year Ice" may be used. Otherwise the RIVs in the column "Heavy Multi-Year Ice" should be used.

1.1.3 Risk Index values have been developed in tables 1.3 and 1.4. Table 1.4 reflects a reduction in risk associated with decayed ice during times of higher ambient temperatures for certain ice types. The standard Risk Index Values of table 1.3 should be used unless ice decay is confirmed by ice information/visual observation by personnel on board qualified in accordance with chapter 12 of the Polar Code. Only then may table 1.4 be used.

1.2 Risk Index Outcome

1.2.1 POLARIS uses a Risk Index Outcome (RIO) value to assess limitations for operation in ice. Risk Index Values (RIVs) are assigned to the ship based on ice class and ice types present according to tables 1.3 and 1.4. For each ice regime encountered, the Risk Index Values are used to determine a RIO that forms the basis of the decision to operate or the limitation of operations.

1.2.2 The RIO is determined by a summation of the RIVs for each ice type present in the ice regime multiplied by its concentration (expressed in tenths):

$$RIO = (C_1 x RIV_1)+(C_2 x RIV_2)+(C_3 x RIV_3)+\ldots(C_n x RIV_n)$$

Where $C_1 \ldots C_n$ are the concentrations (in tenths) of ice types within the ice regime; and

$RIV_1 \ldots RIV_n$ are the corresponding Risk Index Values for each ice type.

1.3 Evaluation of the Risk Index Outcome for independent operations

1.3.1 Operational limitations for ships operating independently are determined based on the criteria in table 1.1, using the calculated value of the RIO for the ice regime encountered by the ship, given that due caution of the Mariner will be exercised, taking into account such factors as changes in weather and visibility.

1.3.2 POLARIS addresses three levels of operation, normal operation, elevated operational risk and operation subject to special consideration. For the purpose of POLARIS the RIO values in table 1.1 equal these three levels of operation.

Table 1.1: Risk Index Outcome criteria

RIO_{SHIP}	*Ice classes PC1-PC7*	*Ice classes below PC 7 and ships not assigned an ice class*
RIO ≥ 0	Normal operation	Normal operation
-10 ≤ RIO < 0	Elevated operational risk*	Operation subject to special consideration**
RIO < -10	Operation subject to special consideration**	Operation subject to special consideration**

* See section 1.4
** See section 1.5

1.4 Elevated Operational Risk

1.4.1 Ships operating in an elevated risk ice regime, based on the RIO outcome, should limit the speed to the values indicated in table 1.2. Operational measures may also include, provision of additional watch keeping or use of icebreaker support. When the speed reduction may impair the ship manoeuvrability, the operation should be avoided.

Table 1.2 Recommended speed limits for elevated risk operations

Ice Class	**Recommended Speed Limit**
PC1	11 knots
PC2	8 knots
PC3-PC5	5 knots
Below PC5	3 knots

1.4.2 Ships equipped with ice load measurement and monitoring systems can utilize these systems to calibrate recommended speeds included in table 1.2.

1.4.3 Ships having undergone full scale ice trials and/or calculation-based methodologies can utilize these results to calibrate recommended speeds included in table 1.2.

1.4.4 Recommended speed limits for elevated operational risk conditions should be included in the Polar Water Operational Manual (PWOM).

1.4.5 For voyage planning generally, areas in which the potential to encounter elevated risk operations has been identified should be avoided. Where elevated risk operations are identified and included in a voyage plan, contingency plans should be in place and documented in the PWOM.

1.5 Operations Subject to Special Consideration

1.5.1 Operations Subject to Special Consideration mean operations whereby extreme caution should be exercised by the Master and officers in charge of a navigational watch when navigating in ice.

1.5.2 Where a ship encounters an ice regime where the RIO identifies Operations Subject to Special Consideration, suitable procedures should be contained in the PWOM and should be followed. Such procedures should contain guidance to the operator on reducing the increased risks present to the ship and should include course alteration/re-routing, further reduction in speed and other special measures.

1.5.3 For voyage planning purposes, ice regimes where the RIO identifies Operations Subject to Special Consideration should be avoided.

1.6 Risk Index Outcome for ships under icebreaker escort

1.6.1 In determining the RIO for a ship under icebreaker escort, the ice immediately ahead of the ship should be considered as its ice regime. This regime should include both the track of the icebreaker and, when the icebreaker has a smaller beam than the escorted ship, any unmodified ice out to the maximum beam of the escorted ship.

1.6.2. The icebreaker itself should calculate its own RIO along the intended route.

1.6.3 In general, escorted operations should be reconsidered if the icebreaker encounters a RIO below 0 or if the escorted ship is in an ice regime for which operation is subject to special consideration.

1.6.4 For voyage planning purposes when icebreaker escort is intended to be used, the RIO derived from non-escorted historical ice data may be assumed to be modified by adding 10 to its calculated value. However, it is cautioned that this is an average value which can vary significantly. For actual operations, the RIO under escort should not be modified and should be derived as described in the previous paragraphs.

1.7 Operations in ice regimes containing glacial ice

1.7.1 The presence of glacial ice represents additional risks to the ship. Areas containing glacial ice should be approached with caution.

1.7.2 Appropriate training should be provided to the Master and officers in charge of a navigational watch when navigating in ice on identification and avoidance of glacial ice and the consequences of collision. Measures to avoid glacial ice should be documented in the PWOM.

1.7.3 Where glacial ice is encountered, in addition to the RIO, a safe stand-off distance should be observed by the ship. This stand-off distance should be recorded in the PWOM.

Table 1.3 Risk Index Values

Ice Class	Ice-Free	New Ice	Grey Ice	Grey White Ice	Thin First Year ice 1st Stage	Thin First Year Ice 2nd Stage	Medium First Year Ice less than 1 m thick	Medium First Year Ice	Thick First Year Ice	Second Year Ice	Light Multi Year Ice, less than 2.5 m thick	Heavy Multi Year Ice
PC1	3	3	3	3	2	2	2	2	2	2	1	1
PC2	3	3	3	3	2	2	2	2	2	1	1	0
PC3	3	3	3	3	2	2	2	2	2	1	0	-1
PC4	3	3	3	3	2	2	2	2	1	0	-1	-2
PC5	3	3	3	3	2	2	1	1	0	-1	-2	-2
PC6	3	2	2	2	2	1	1	0	-1	-2	-3	-3
PC7	3	2	2	2	1	1	0	-1	-2	-3	-3	-3
IA Super	3	2	2	2	2	1	0	-1	-2	-3	-4	-4
IA	3	2	2	2	1	0	-1	-2	-3	-4	-5	-5
IB	3	2	2	1	0	-1	-2	-3	-4	-5	-6	-6
IC	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8
Not Ice Strengthened	3	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-8

Table 1.4 Risk Index Values – decayed ice conditions

Ice Class	Ice-Free	New Ice	Grey Ice	Grey White Ice	Thin First Year ice 1st Stage	Thin First Year Ice 2nd Stage	Medium First Year Ice, less than 1 m thick	Medium First Year Ice	Thick First Year Ice	Second Year Ice	Light Multi Year Ice, less than 2.5 m thick	Heavy Multi Year Ice
PC1	3	3	3	3	2	2	2	2	2	2	1	1
PC2	3	3	3	3	2	2	2	2	2	1	1	0
PC3	3	3	3	3	2	2	2	2	2	1	0	-1
PC4	3	3	3	3	2	2	2	2	1	0	-1	-2
PC5	3	3	3	3	2	2	2	2	1	-1	-2	-2
PC6	3	2	2	2	2	1	2	1	0	-2	-3	-3
PC7	3	2	2	2	1	1	1	0	-1	-3	-3	-3
IA Super	3	2	2	2	2	1	1	0	-1	-3	-4	-4
IA	3	2	2	2	1	0	0	-1	-2	-4	-5	-5
IB	3	2	2	1	0	-1	-1	-2	-3	-5	-6	-6
IC	3	2	1	0	-1	-2	-2	-3	-4	-6	-7	-8
Not Ice Strengthened	3	1	0	-1	-2	-3	-3	-4	-5	-7	-8	-8