

# Ice class coatings

Abrasion resistant coating systems for ice class vessels



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## Abrasion resistant coating systems for ice class vessels

Ice class ships are operated in extremely cold climates and in harsh environments and therefore require higher performance coatings than that utilized by conventional non-ice class ships. Their highly specific structures by design need to be durable for such severe trading hence selection of the most suitable high performance coating system is paramount for success.

Current sea routes are expected to save fuel arising from shorter voyages. Further, the outer hull coating of ice class ships protect against impact and abrasion damage in ice infested waters and have excellent anticorrosive properties. These outer hull coating are selected in accordance with ice trading classification.



## Ice class definitions

### Major classes and some of parties establish their own ice class rules.

International Association of Classification Societies (IACS) published a document named Unified Requirements for Polar Class Ships as a complement to IMO Guidelines for Ships Operating in Arctic Ice Covered Waters. The unified common rules and regulations are referred to the IACS UR sub-section Polar Class (PC).

Finnish-Swedish Rules classifies 1A Super, 1A, 1B, 1C, the others, is based upon an elastic approach in the definition of structural capacity and was originally established to ensure safe operation in the Baltic Sea during winter.

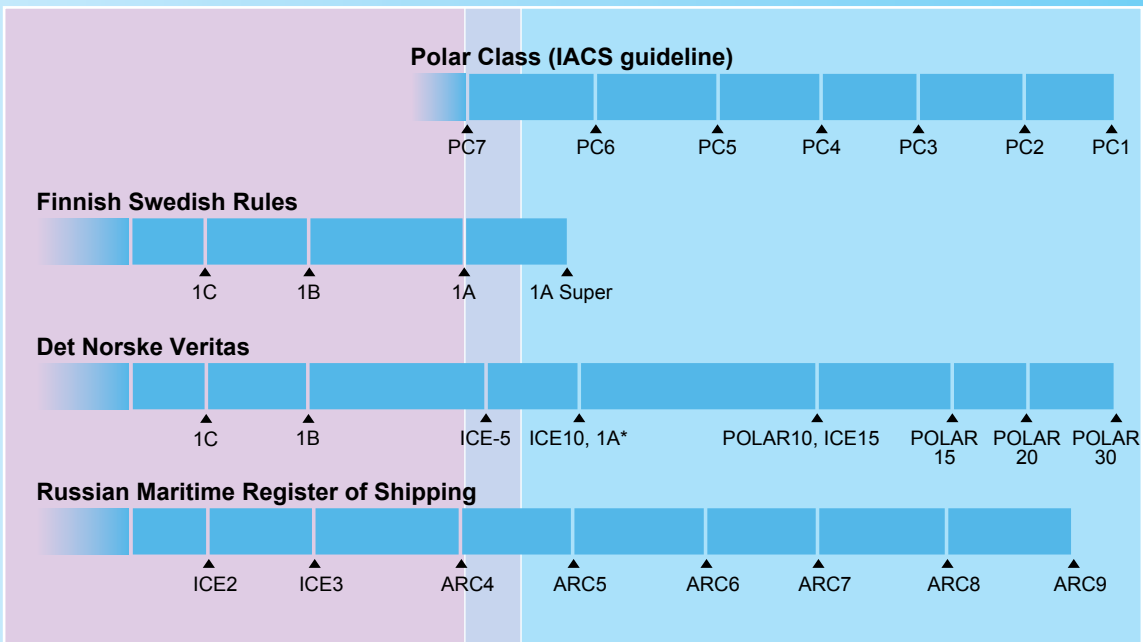
DNV have a set of rules regarding vessels for arctic and icebreaking service. The notations in this set are called ICE-05, 10, 15 and POLAR-10, 20 and 30. These rules apply to icebreakers and to passenger and cargo vessels intended to operate independently in the ice-infested waters of Arctic regions.

Russian Maritime Register of Shipping categories of ice class ships as Ice1-3, which refers to ships intended for navigation in freezing non-arctic seas, and Arc4-9, for navigation in Arctic seas.





**Ice class equivalencies**



**CMP's specification**

Specification 1	<b>PERMAX No.1000HB</b>
Specification 2	<b>PERMAX No.3000S</b>
Specification 3	<b>PERMAX No.3300</b>

All other major classification societies have a similar system of ice classes, and converting between ice classes is relatively easy. In most cases only the names of the classes are changed and the specifics of Polar class and Arctic class are identical, and in recent years, new ice class categories which are capable of independent operation in all ice conditions have been defined to have excellent icebreaking.

## Recommended coating specifications

Coating requirements of ice class are impact resistance, abrasion resistance, adhesion property and low friction property and superior anti-corrosive property with labyrinth effect by glass flake. Generally, hard coating is not so durable for ice damages in a long term, consequently, it has found that flexible glassflake coating, that coating surface is gradually eroded in areas of infested ice waters, has the best abrasion resistance.

Specification 1		POLAR class	ARCTIC class	Finnish Swedish IA Super	Lloyd's Certified abrasion resistant ice coating
Type	Product Name	DFT			
1st coat	Vinyl Ester Primer	<b>PERMAX No.1000 Primer</b>		50	
2nd coat	Vinyl Ester Glass Flake Paint	<b>PERMAX No.1000HB</b>		(*)450	
Total DFT (microns)				500	

\* PERMAX No.1000HB is capable of application to greater DFT with **standard airless spray equipment**.

Specification 2		Finnish Swedish IA	Finnish Swedish IB	Lloyd's Certified abrasion resistant ice coating
Type	Product Name	DFT		
1st coat	Epoxy Paint	<b>BANNOH series</b>		100
2nd coat	Epoxy Glass Flake Paint	<b>PERMAX No.3000S</b>		400
Total DFT (microns)				500

This specification can be replaced to Specification 3.

Specification 3		Finnish Swedish IA	Finnish Swedish IB	Lloyd's Certified abrasion resistant ice coating
Type	Product Name	DFT		
1st coat	Epoxy Glass Flake Paint	<b>PERMAX No.3300</b>		250
2nd coat	Epoxy Glass Flake Paint	<b>PERMAX No.3300</b>		250
Total DFT (microns)				500

BANNOH series are allocated in Ice class IC or later as well as non ice vessels.  
Specification of IC and ID ice class is Total 300 microns of BANNOH series. (2 coats of 150 microns)

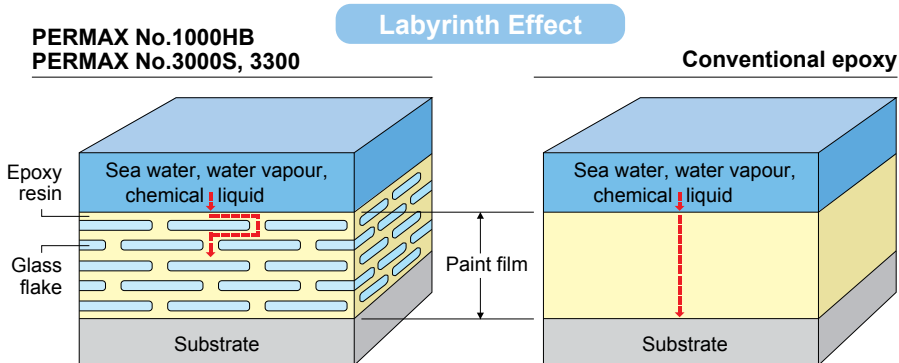
**New building application with PERMAX No.1000HB**

PERMAX No.1000HB can be applied **without any special equipment**.

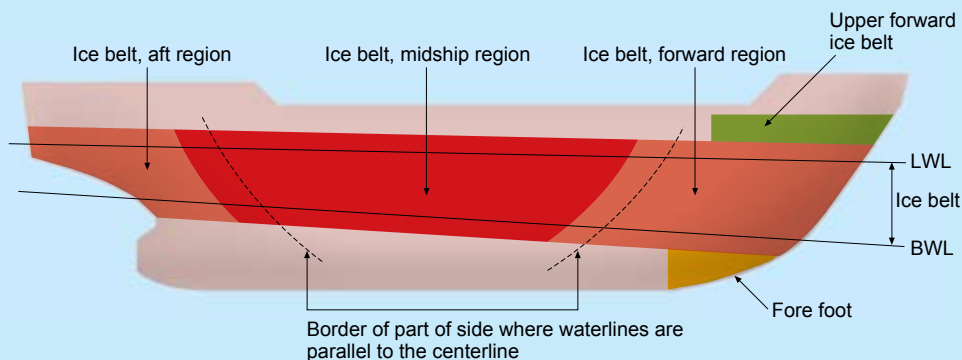




The inclusion of glass flake in the coating provides a barrier which prevents the transfer of water vapour/chemical materials to the substrate. By comparison to environmental anticorrosives parameter of water vapour/chemicals takes several times longer. In this respect, PERMAX No.1000HB, 3000S and 3300 protect the substrate over the long term. In addition to glass flake, these coatings possess and provide first class abrasion resistance due to their inherent physically strong polymer characteristics.



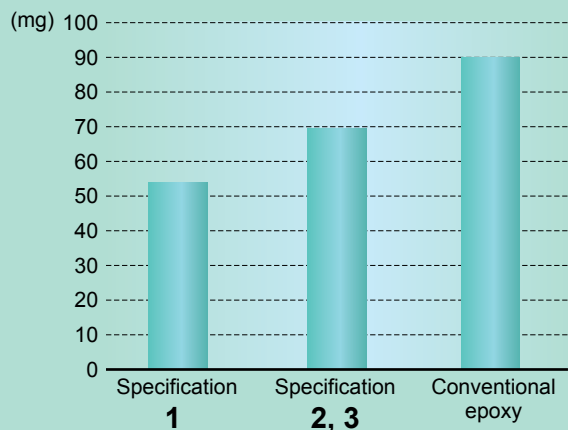
Ice class coatings are generally applied on not only ice belt zones but the whole outer hull area, whilst the coatings are intentionally introduced for limited areas such as boottop and flat bottom of non-ice class ships. They are also used on offshore facilities to protect against ice abrasion and mechanical damages.



## Test results

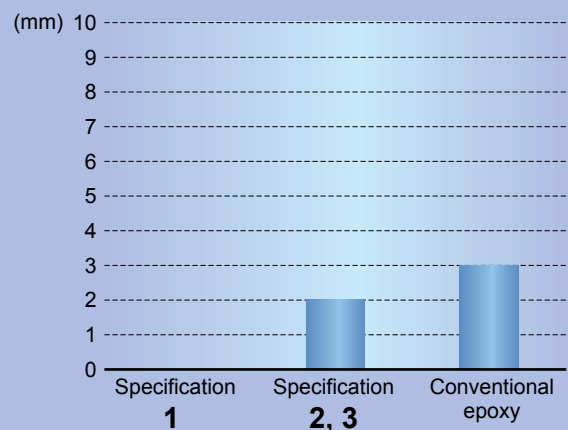
Abrasion resistance is the most significant index for ice class coating, PERMAX series (see the results of Specification 1,2 and 3) provides the best performances, and BANNOH series are also sufficient for operation in sparse Ice populated areas like Ice class IC and greater.

### Abrasion Resistance



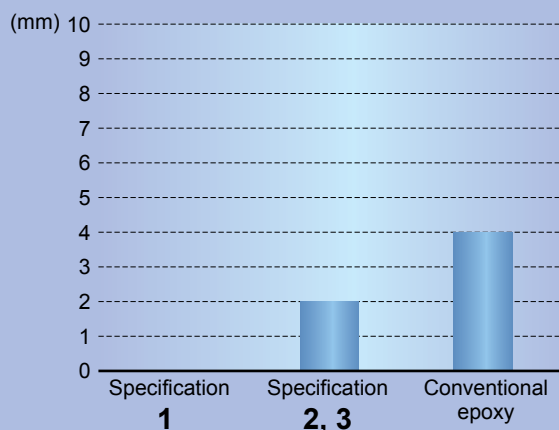
ISO 7784-3.2 : 1997  
Abrasive CS-17 / Cycles 1000 cycles / Load Weight 1000g / Curing period 720 hours

### Cathodic disbonding / Scribe



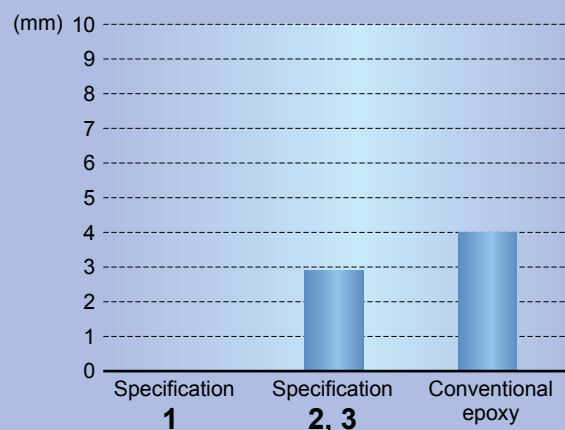
ISO 15711 : 2003  
Immersion sol. 3% NaCl sol. / Temp. 40 degC / Immersion period 720 hours

### Salt Spray test / Scribe



ISO 7253 : 1993 @ 35 degC / 720 hours

### Sea water Immersion test / Scribe



ISO 2812-1 : 1993  
Immersion sol. 3% NaCl sol. / Temp. 40 degC / Immersion period 720 hours

Specification 1  
PERMAX No.1000HB

POLAR  
class

ARCTIC  
class

Finnish Swedish  
IA Super

Specification 2, 3  
PERMAX No.3000S, 3300

Finnish Swedish  
IA

Finnish Swedish  
IB



**"UMIAK I"**

Built by JMU Maizuru in 2006. PERMAX No.1000HB was coated on the whole hull of the vessel belongs to PC4 of a high category in Polar class, and higher performances are shown during the actual service in the ice.



Rudder horn and ice knife



Midship section, Port side



Midship section, Starboard side



Bow area, Port side



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