Ice Class IA or Ice Class PC7 for Arctic Operations

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ABSTRACT

Additional strengthening of vessels intended to operate in ice range from very light scantling increases to accommodate minor interaction with ice up to the creation of very significant icebreaking structures. These structures are measured by an Ice Class notation assigned by the vessel’s Classification Society. The two main rule sets used in the marine industry are the International Association of Classification Societies (IACS) Polar Class rules and the Finnish Swedish Ice Class Rules (FSICR). The two lowest Polar Classes overlap with the two highest FSICR Ice Classes, and at this ice strengthening level, there continues to be a tendency to select the FSICR over the Polar Class for ships intended for summer / autumn service in Polar waters. This paper explores the structural scantling differences between these ice classes.

KEY WORDS:
Ice; Class; IA; PC7; Polar; FSICR; Ice Class

INTRODUCTION

In 2007, the International Association of Classification Societies (IACS) published the Polar Class Rules (IACS 2007). The rules were adopted by all IACS members as the rules for high ice class ships intended to operate in Polar ice conditions. The Finnish and Swedish Administrations jointly develop, maintain, and publish the Finnish-Swedish Ice Class Rules (FSICR) (Traficom 2021). Nearly all IACS members have duplicated the FSICR within their own rule sets (Traficom 2017). The two highest FSICR ice classes, IA-Super and IA, are notionally comparable to the two lowest Polar Classes, PC6 and PC7 (ABS 2023b). The FSICRs are intended for vessels operating in the Baltic Sea during winter, sailing in first year ice while being escorted by an icebreaker (Traficom 2019). The Polar Class rules are based on vessels operating independently and with ice impacts from much harder multyear ice (ABS 2023b). It is noted that first year ice in the Baltic Sea may be stronger than first year ice in Polar waters due to lower brine concentrations, however Baltic Sea ice is weaker and lighter than multi-year ice in Polar waters. This stronger ice is the design point for polar classed ships whereas vessels designed for the Baltic are intended to encounter first year Baltic ice. Most ice classed vessels observed operating in the Arctic (where multyear ice is present) have a FSICR ice class (PAME 2022) even though the intent behind the FSICR is for operations in Baltic Sea first year ice. It is postulated that due to the low number of Polar Class ships in comparison to the FSICR ice class ships, there is a lack of detailed understanding of the subtleties and differences between PC6 / IA Super and PC7 / IA scantlings.

This study focused on the evaluation of an Ice Class IA vessel against its Polar cousin, PC7. An ABS developed tool, ABS Ice Quick Check, was used to create minimum scantling designed structures. The Ice Class IA vessel’s frame spacing, and layout is representative from an actual vessel’s structure but reduced scantlings to meet the minimum FSICR requirements. As an Ice Class IA is notionally similar to a PC7, the PC7 structural arrangement is based on the IA arrangement with modifications to create a minimum passing PC7 grillage. Neither structure is optimized but intended to be representative for this study. Finite Element models of the structures were created and loaded to the defined “failure”. The structural response to a load level at the point where structural repair may be required provides an indication of the relative strength of the structures for each ice class. Outcomes from the analysis are a measure of safety of operation in sea ice containing harder ice floes. The minimum passing structures were also compared on the basis of steel weight, and weld length. This comparison aimed to provide information on the potential cost differences between an IA and a PC7 vessel. The vessels are also compared from an operational perspective. The ice classes are evaluated for transit possibilities through the Northwest Passage (NWP), around Alaska and through the Northern Sea Route (NSR). This analysis utilized an in-house ABS tool and historical ice data from various sources.

BACKGROUND

The IACS Polar Class rules originated from a drive to harmonize ice class requirements. Most Class Societies had ice class notations within their rules and there was very little correlation between them. This made using these ice classes difficult for any regulatory purposes such as the then newly proposed Arctic regulatory framework being developed at the IMO. In the Canadian Arctic Shipping Pollution Prevention Regulations (Government of Canada 2012) there were several Arctic Classes included, meanwhile the Finnish and Swedish governments were publishing their own ice class rules. An effort was commenced by Canada to create a new series of ice classes to be used as the harmonized ice class rules for Polar waters. Since IACS was in the best position to help develop, house, and implement these new ice classes, the development was passed to IACS in the late 1990s. In 2008, ABS published the Guide for Building and Classing Vessels Intended for Navigation in Polar Waters (ABS 2008), and in 2012 ABS removed their own high ice class rules Ice Class A1 up to Ice Class A5 and replaced them with Ice Class PC7 up to Ice Class PC1 (ABS 2012). All IACS members adopted the Polar Class rules around the same time, but several