Kronprins Haakon ice trials

22 May- 1 June 2018

Model testing in ice during design development (HSVA Hamburg)

- Straight line icebreaking
- Ability to change or reverse course in solid ice ("Break-out" ability)









Contractual performance for full scale ice test based on model test results

The Vessel is designed for operation under the following ice conditions:

- Winter ice with pressure ridges and multi-year ice-floes and glacial ice inclusions.
- Nominal ice thickness average : 1,0m
- Minimum ship speed requirement : 3,0 knots
- Continuous ship speed when breaking 1,0m ice thickness with 0,2m snow: 3,75 knots
- Continuous ship speed when breaking 0,4m ice thickness: 10,0 knots
- Design ramming speed to break heavy ice: 5,8 knots

Additional test points

- The ice test shall prove that the Vessel is capable of withstanding operating in Arctic Climate.
- The test shall be a technical verification that all the systems function in the ice; Electrical production, propulsion and manoeuvring, communication, ventilation, heating- and cooling systems, bilge and ballast systems, hydraulic systems, A-frames, cranes, winches, ice gallows etc.
- The test shall also prove that the underwater ice windows are not being damaged and that ice sea chests and ice slush separator functions when breaking ice.
- Furthermore, the test shall prove that hatches and doors in the hull are functioning properly and are not damaged (Hangar doors, moonpool hatches and drop keel hatches etc.)
- All equipment on board, interior and exterior shall withstand the test, i.e. not break or get damaged.
- The Vessel shall be whole after the ice-test, without bulges or any other damages.
- In other words the ice test will be a stress test of all systems functions in relevant ice conditions.

Execution – North of Svalbard May 2018



Ice chart produced by MET Norway

Execution



- Using «EM-bird» from AWI for real-time measurement of ice thickness.
- Test execution and measurements subcontracted to HSVA

Execution



- Confirming ice thickness along test track using drill
- On site testing of ice strength



Test results

 The vessel can break first year level ice of 1.00 m thickness with a snow layer of 20 cm, having a flexural strength of 500 kPa with a speed of 4.05 knots when sailing ahead and using full power (vs. contractual requirement of 3,75 knots)

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- Ice ridges up to 8m thick were sucessfully broken when ramming
- No major system malfunctions experienced

Lessons learned

- Profound absence of interior noise and vibration during icebreaking (COMF class)
- Moonpool fills up with slush even with bottom hatches shut. Slush removed using fixed steam nozzles in moonpool sides.
- Drop keel trunk also fills up with slush. Disappeared quickly when returning to open water.
- Evaporator sea chest showed a tendency to clog.





Lessons learned

- Azimuth thrusters provide superb manoeuvrability in solid ice.
- Azimuth thrusters can be used to break and flush away solid ice around the vessel to create an open «duck pond» enabling 180° turns on the spot.
- Acceleration was above expectations. Starting from zero, max ramming speed of 5,8 knots was reached after 90m.



Straight line icebreaking 0,9m ice

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Turning in ice using azimuth thrusters

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Ramming test

Polarimetric radar – lessons learned





- Equipped with Seahawk polarimetric radar in addition to 3GHz and 9GHz nav. radars.
- Enables identification of floes, open water, ridges etc. where conventional radar pictures are virtually unreadable.
- Enables radar identification of individual floes seen on Sentinel satellite pictures making it much easier to pick the easiest way through the ice.

3Cm nav radar







Questions?