



Oil Companies International Marine Forum

Maintaining Structural and Operational Integrity on Tankers Carrying Cold Oil Cargoes

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The OCIMF mission is to be the foremost authority on the safe and environmentally responsible operation of oil tankers, terminals and offshore support vessels, promoting continuous improvement in standards of design and operation.

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1 Introduction

Cold climate oil and gas production continues to increase along with the expansion and use of cold climate ports and sea routes. As trade opportunities increase, operators are faced with the challenges of trading in extreme conditions.

The purpose of this document is to remind operators of the structural hazards and restrictions in the carriage of Cold Oil Cargoes (<0 °C). Operators considering the carriage of Cold Oil Cargoes should consider consulting appropriate experts, their Classification Society and insurance providers, while developing a safe operating plan.

2 Structural Hazards – Brittle Fracture

Owners and operators are reminded of Class restrictions and general hazards related to the carriage of Cold Oil Cargoes.

Oil and chemical tankers are not typically approved to undertake a sea voyage with cargoes having a temperature of less than 0 °C. Some classification societies however will accept loading temperatures of cargoes down to -10 °C.

The steel used on a tanker is typically Grade A steel and it is generally assumed that the temperature of cargoes will be above 0 °C. Steel becomes embrittled at reduced temperatures so that structures fabricated from it can fracture or shatter unexpectedly at low temperatures when loaded to stress levels at which performance would be satisfactory at normal temperatures. Brittle fracture is generally characterized by little or no deformation of the metal in the vicinity of the fracture. The loading of Cold Oil Cargoes introduces the possibility of brittle fracture in the steel structure and cargo piping. These fractures may appear immediately when material is exposed to the cold cargoes, resulting in possible cargo spillage from either tanks or pipework. By their nature, brittle fractures occur suddenly and without warning.

Loading cargoes below the temperature allowed by Class Rules for the grades of steel used is in principle a violation of Class and may lead to denial of insurance coverage. Class should be contacted for advice before loading such cargoes.

Additional information on brittle fracture can be obtained from Class.

3 Cold Climate Operations and Procedures

Loading products with a temperature of less than 0 °C will result in any free water in the cargo system freezing.

Classification societies typically provide cold climate operational procedures and general vessel winterisation guidelines. These should be considered in planning for the carriage of Cold Oil Cargoes.

Operators may refer to the OCIMF publication *'The Use of Large Tankers in Seasonal First-Year Ice and Severe Sub-Zero Conditions'* and the Briefing Paper *'Shipping Operations in the Arctic Region'* for detailed guidance on operations in cold climates.

Operators should ensure that vessels have in place a 'sub-zero cargo procedure' specific for the equipment and the systems installed on individual vessels. This procedure should cover, but not be limited to, details for the safe operation of:

- cargo tank venting system
- cargo valves
- cargo pumping system
- cargo stripping system

- inert gas or vapour return system
- gauging system
- high and high-high level system
- ballast system
- ballast venting system.

The suitability of tank coatings should be verified for use at low temperatures.

4 References

The following publications and papers were referenced in the preparation of this Paper and provide valuable additional information on the topic.

- 1 IACS Technical Background, UR S6, Rev.5 (Sept. 2007).
- 2 IACS UR S6, "Use of steel grades for various hull members – ships of 90 m in length and above", Rev.5, Sept. 2007.
- 3 Lloyds Register, "Review of the Fracture Properties of LR Grade A Ship Steel", Materials and NDE Department, 1999.
- 4 "Marine Investigation Report, Hull Fracture, Bulk Carrier Lake Carling, Gulf of St. Lawrence, Quebec, 19 March 2002", Transportation Safety Board of Canada, Marine Reports – 2002 – M02L0021.
- 5 "Toughness of Steel", Transportation Safety Board of Canada, Marine Reflexions Magazine, Issue 22, July 2005.
- 6 ABS Vessels Operating in Low Temperature Environments (http://www.eagle.org/eagleExternalPortalWEB/ShowProperty/BEA%20Repository/Rules&Guides/Current/151_VesselsOperatinginLowTemperatureEnvironments/LTE_Guide)
- 7 Lloyds Register Rules Part 8 Rules for ice and cold operations – Specific hull and machinery requirements for ships intended for navigation in ice-covered waters.
- 8 DNV Memo No. MGGNO893/SEI/29-J-10376 Low Temperature Cargos (<http://www.safety4sea.com/images/media/pdf/DNV%20-%20coldcargo.pdf>)
- 9 Standard ASTM A 131M covers structural steel-shapes, plates, bars, and rivets intended primarily for use in ship construction. Material under specification A 131M is available in the following categories:
 - Ordinary Strength — Grades A, B, D, DS, CS, and E with a specified minimum yield point of 235Mpa, and
 - Higher Strength — Grades AH, DH, and EH with specified minimum yield points of either 315 MPa or 350 MPa.