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Ships and marine technology — Specification of high manganese austenitic steel thin strips used for LNG tanks on board ships

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives.

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

There have been several requirements regarding metallic materials for cryogenic applications since the adoption of the IGC and IGF Codes. Recently, a new high manganese austenitic steel has been proposed for thick plates and piping systems of LNG carriers and LNG-fuelled ships[2]. However, only plates with a thickness ranging from 6 mm to 30 mm are specified and the target tank capacity is limited to 30 000 m^3.

This document covers a newly developed high manganese austenitic steel for thin strip application. This steel has mechanical properties comparable or even higher than those of materials for cryogenic service listed in both the IGC Code[3] and IGF Code[4], with good weldability and good resistance to atmospheric corrosion. Consequently, this high manganese austenitic steel is intended to satisfy the strength requirements of the structure of cargo tanks and fuel tanks of LNG carriers and LNG-fuelled ships.

This document provides a standard specification of high manganese austenitic steel for thin strip applications for material suppliers, ship owners, ship yards, manufacturers and shipping companies with regard to producing, purchasing, and using such materials.

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1 Scope

This document describes the specification of high manganese (Mn) austenitic steel thin strips with good weldability and good resistance to atmospheric corrosion intended to be used for LNG tanks on board ships.

It covers strips with a thickness ranging from 0,3 mm to 6,0 mm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7438, *Metallic materials — Bend test*

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

IACS UR W1 rev 3 Aug 2016, *Material and welding for gas tankers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
high manganese austenitic steel
high Mn austenitic steel
steel
steel with high amount of Mn to retain austenite as its primary phase at atmospheric and service temperature

Note 1 to entry: Refer to Table 1 in Clause 6.1.

3.2
design temperature
minimum temperature for the selection of materials at which cargo or fuel can be loaded or transported in the cargo or fuel tanks

Note 1 to entry: See References [2] and [3].

4 Required specification

The manufacturing, forming and weldability of high manganese austenitic steel thin strips shall comply with recognized international, regional or national standards.

Effective quality, process and production controls during manufacturing are the steelmaker's responsibility within the manufacturing specifications. The quality management systems of the steelmaker should be effectively implemented.

Minimum design temperature and the impact test temperature shall be –165 °C and –196 °C, respectively.

5 Manufacture

5.1 Steel-making practice

Austenitic steel shall be manufactured by fusion in an electric furnace followed by a ladle refining in order to reduce residual elements contents such as sulphur and phosphorus.

5.2 Steel strips

The steel strip shall be produced from hot rolled plates obtained by either ingot blooming or from continuous casting slabs.

A pickling process or a reducing heat treatment shall be applied on hot rolled plates.

The steel thin strip shall be produced by cold rolling and recrystallization annealing under reducing atmosphere to obtain the final thickness.

5.3 Dimension

The cold-rolled steel thin strip may be produced as sheets or coils.

The width of the cold-rolled steel thin strip should be 1 500 mm max., −0/+0,8 mm.

6 Chemical composition and mechanical properties

6.1 Chemical composition

The chemical composition (%) of samples taken from each ladle of each cast of the steel shall meet the requirements of Table 1.

Table 1 — Chemical composition of high manganese austenitic steel

% by mass

Mn	Ni	P	S	Si	Cr	C	Al	N
24,0 to 34,0	0,50 to 3,50	0,020 max.	0,010 max.	0,35 max.	7,50 to 12,50	0,05 max.	0,1 max.	0,050 to 0,25

6.2 Mechanical properties

6.2.1 Requirements of tensile strength and yield strength

The tensile strength and yield strength of the thin strip steel as represented by tensile test specimens shall meet the requirements specified in Table 2, where S_0 is the initial transversal section of the calibrated part before starting the tensile test.

Table 2 — Mechanical properties for high manganese austenitic steel

Minimum yield strength (0,2 % offset) N/mm²	Minimum tensile strength N/mm²	Minimum elongation at $5{,}65\sqrt{S_0}$ %
300	670	40
S_0 is the initial transversal section of the calibrated part before starting the tensile test		

6.2.2 Toughness requirements

Unless otherwise agreed, impact tests shall be conducted at –196 °C.

For each heat, three impact tests shall be carried out on standard specimens taken from a slab of the same heat. When possible, sub-size specimens may be used from cold rolled material (3 mm thickness) or from hot rolled material. Minimum average energy values for sub-sized specimens in accordance with Clause 6.3.2.1 of IGC Code, 2016 Edition[3], may be accepted.

The average absorbed energy for each set of three standard test specimens with their longitudinal axis transverse to the final direction of rolling of the plates shall be 27 J or more.

In case the steel is used as a section member, the Charpy V notch test specimens shall be taken in the longitudinal direction and its average Charpy impact value shall be 41 J or more.

Each impact test value shall constitute the average of three values obtained from different specimens, with not more than one value below the specified minimum value of 27 J, but in no case below 20 J for transverse specimens.

6.2.3 Bend test

The 180° bending test shall be carried out on base material in accordance with ISO 7438.

For each coil, three samples taken in the transversal direction should be tested. No fracture shall be acceptable.

A dye penetrant test shall be carried out on one sample to confirm that no crack was observed after the test.

6.3 Supplementary requirements

Supplementary requirements for steel do not apply unless specified in the order. Several supplementary requirements can apply at the option of the purchaser.

The following tests can be performed by agreement between the supplier and the purchaser:

— product analysis;

— ultrasonic examination[1];

— corrosion test;

— macrosection observation;

— microsection observation;

— hardness test.