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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 713.5-2023

**Steel plate, sheet and strip for pressure equipment - Part 5:
High manganese steel with specified low temperature
properties**

承压设备用钢板和钢带 第5部分：规定低温性能的高锰钢

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Table of Contents

- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Designation representation
- 5 Order content
- 6 Size, shape, weight
- 7 Technical requirements
 - 7.1 Designation and chemical composition
 - 7.4 Mechanical properties and technological properties
- 8 Test methods...
- 9 Inspection rules...

1 Scope

Part 5 of China's national series on steel for pressure equipment, covering high manganese steel with specified low temperature properties. This is a genuinely new material in the cryogenic field and it exists because of liquefied natural gas. LNG is stored at minus 162 degrees C, and until recently the only materials tough enough at that temperature were nine per cent nickel steel, austenitic stainless steel and aluminium - all expensive, and the first dependent on nickel, whose price and supply are volatile. High manganese steel achieves the same austenitic structure and the same low temperature toughness using manganese, which is cheap and abundant, in place of nickel. Its adoption has been rapid in LNG tank and vessel construction, and it is qualified here down to minus 196 degrees C, the boiling point of nitrogen. The part specifies the designation system, order content, dimensions, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificate, for plate from 5 to 60 mm thick.

This document stipulates the designation representation, order content, size, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificate of high manganese steel with specified low temperature properties for pressure equipment. This document applies to high manganese steel with specified low temperature properties (hereinafter referred to as steel plates) with an operating temperature of not less than -196 °C and a thickness of 5 mm ~ 60 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 version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 223.5, Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdosilicate spectrophotometric method

GB/T 223.9, Iron, steel and alloy - Determination of aluminium content - Chrom azurol S photometric method

GB/T 223.11, Iron, steel and alloy - Determination of chromium content - Visual titration or potentiometric titration method

GB/T 223.17, Methods for chemical analysis of iron, steel and alloy - The dianityprylmethane photometric method for the determination of titanium content

GB/T 223.18, Methods for chemical analysis of iron steel and alloy - The sodium thiosulfate separation iodimetric method for the determination of copper content

GB/T 223.23, Iron, steel and alloy - Determination of nickel content - The dimethylglyoxime spectrophotometric method

GB/T 20123, Steel and iron - Determination of total carbon and sulfur content Infrared absorption method after combustion in an induction furnace (routine method)

GB/T 20125, Low-alloy steel - Determination of multi-element contents - Inductively coupled plasma atomic emission spectrometric method NB/T 47013.3, Nondestructive testing of pressure equipments - Part 3: Ultrasonic testing

3 Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 713.1 apply.

4 Designation representation

The designation of steel consists of three parts, i.e., the first letter of the Chinese pinyin of the word "Qu" (yield) for yield strength, the specified minimum yield strength (specified plastic elongation strength) value, the first letters of the Chinese pinyin of the characters "Gao" (high) and "Meng" (manganese) representing high manganese and the characters "Di" (low) and "Rong" (vessel) representing low temperature vessel. Example: Q400GMDR. Where: Q - the first letter of the Chinese pinyin of the word "Qu" for yield strength; GM - the first letters of the Chinese pinyin of the characters "Gao" and "Meng" for "high manganese"; DR - the first letters of the Chinese pinyin of the characters "Di" and "Rong" for "low temperature vessel"; 400 - the specified minimum yield strength, in megapascals (MPa), which is the specified plastic elongation strength Rp0.2.

5 Order content

The order content of steel plates shall comply with the regulations of GB/T 713.1.

6 Size, shape, weight

The size, shape, and weight of steel plates shall comply with the regulations of GB/T 713.1.

7.1 Designation and chemical composition

7.1.1 The steel designation and chemical composition (melting analysis) shall comply with the requirements of Table 1.

7.1.2 To improve the properties of steels, other alloying elements than those in Table 1 can be added, such as Ni, Mo, Nb, V, Ti, Al, etc., where $Ni \leq 1.0\%$, $Mo \leq 0.30\%$, $Nb+V+Ti \leq 0.30\%$, $Al \leq 0.10\%$; the corresponding element content shall be indicated in the quality certificate. When $Ni \geq 0.30\%$, Cu can be lower than 0.30%.

7.1.3 The allowable deviation of the chemical composition of finished steel plates shall comply with the provisions of GB/T 713.1.

7.2 Manufacturing method The manufacturing method of steel plates shall comply with the regulations of GB/T 713.1.

7.3 Delivery state Steel plates shall be delivered in a thermomechanical processed state.

7.4 Mechanical properties and technological properties

7.4.1 The general requirements for mechanical properties and technological properties of steel plates shall comply with the provisions of GB/T 713.1.

7.4.2 The mechanical properties and technological properties of steel plates shall comply with the requirements in Table 2.