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**Wide and heavy steel plate for sour service petroleum
and natural gas pipe lines**

石油天然气输送管用抗酸性宽厚钢板

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Wide and heavy steel plate for sour service petroleum and natural gas pipe lines

1 Scope

This Standard specifies the designation representation, order content, size, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificates of wide and heavy steel plate for sour service petroleum and natural gas pipe lines.

This Standard applies to wide and heavy steel plate (hereinafter referred to as “steel plate”) for sour service petroleum and natural gas pipe lines, of which the thickness is not greater than 50 mm.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

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

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

GB/T 223.12, Methods for chemical analysis of iron, steel and alloy - The sodium carbonate separation-diphenyl carbazide photometric method for the determination of chromium content

GB/T 223.19, Methods for chemical analysis of iron, steel and alloy - The neocuproine-chloroform extraction photometric method for the determination of copper content

GB/T 223.26, Iron, steel and alloy - Determination of molybdenum content - The thiocyanate spectrophotometric method

GB/T 223.40, Iron, steel and alloy - Determination of niobium content by the sulphochlorophenol S spectrophotometric method

GB/T 4336, Carbon and low-alloy steel - Determination of multi-element contents - Spark discharge atomic emission spectrometric method (routine method)

GB/T 4340.1, Metallic materials - Vickers hardness test. Part 1: Test method

GB/T 6394, Determination of estimating the average grain size of metal

GB/T 8170, Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 8363, Steel - Drop-weight tear tests method

GB/T 8650-2015, Evaluation of pipeline and pressure vessel steels for resistance to hydrogen - induced cracking

GB/T 10561-2005, Steel - Determination of content of nonmetallic inclusions - Micrographic method using standards diagrams

GB/T 14977, General requirement for surface condition of hot-rolled steel plates

GB/T 15970.2, Corrosion of metals and alloys - Stress corrosion testing - Part 2: Preparation and use of bent-beam specimens

GB/T 17505, Steel and steel products General technical delivery requirements

GB/T 20066, Steel and iron. Sampling and preparation of samples for the determination of chemical composition

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 20124, Steel and iron - Determination of nitrogen content - Thermal conductimetric method after fusion in a current of inert gas

GB/T 20125, Low-alloy steel - Determination of multi-element contents - Inductively coupled plasma atomic emission spectrometric method

3 Designation representation

3.1 The designation of steel consists of four parts, namely the first English letter of the pipe line "Line", the minimum yield strength value that is specified by the steel pipe, the characteristic letter (M, N or Q) of the delivery state, and the first English letter of "Sour".

Note: For S_0 , take the smaller of a) 485mm^2 and b) the cross-section area of the sample (nominal thickness $\times$ specified width of the sample); it is rounded to the nearest 10mm^2 .

6.5.3 If the supplier can guarantee that the bending test results are acceptable, no inspection is required.

6.5.4 For steel plates, of which the thickness is greater than 25mm , the drop weight tear test (DWTT) shall be negotiated between the supplier and the buyer.

6.5.5 Through negotiation between the supplier and the buyer, the temperature of Charpy (V-notch) impact test and drop weight tear test (DWTT) can also be other temperatures; the impact absorption energy and the drop weight tear test (DWTT) minimum shearing area percentage can also be negotiated separately and specified in the contract.

6.5.6 The impact absorption energy is calculated according to the arithmetic mean of a group of three samples; one of the sample values is allowed to be lower than the value that is specified in Table 2, but it shall not be lower than 70% of the specified value.

6.5.7 When the Charpy (V-notch) impact test results do not meet the above requirements, three more samples shall be taken from the same steel plate or the same blank for testing; the arithmetic average of the six samples before and after the two groups shall not be less than the value that is specified in Table 2; two sample values are allowed to be lower than the value that is specified in Table 2, but only one of them is allowed to be less than 70% of the specified value.

6.5.8 For steel plates whose thickness is less than 12mm , the Charpy (V-notch) impact test shall use small-sized samples. For the steel plate whose thickness is $6\text{mm} \sim 8\text{mm}$, its size is $5\text{mm} \times 10\text{mm} \times 55\text{mm}$, and its test result shall not be less than 50% of the value that is specified in Table 2; for the steel plate whose thickness is $>8\text{mm} \sim <12\text{mm}$, its size is $7.5\text{mm} \times 10\text{mm} \times 55\text{mm}$, and its test result shall not be less than 75% of the value that is specified in Table 2.

6.5.9 The hardness measurement points of the steel plate are shown in Figure 1. At $1/4$ of the width on the transverse section of the steel plate, after polishing, perform a 10kg load Vickers hardness test. On the positions that are 1.5mm from the upper and lower surfaces of the steel plate and the center of the thick plate, namely 3 positions, measure 9 points in total. For steel plates whose thickness is less than 6mm , the determination of Vickers hardness measurement points shall be negotiated. The Vickers hardness HV10 of each designation shall not exceed 240.

6.8.2 SSC test

Perform the 4-point bending test in the A solution of GB/T 4157-2017. The test load stress is 72% of the minimum specified total yield strength, and the test time is 720 hours. Test result: observe the tensile surface of the sample under a 10x magnifying glass. There shall be no surface cracking or crack on the tensile surface of the sample, unless it can be proven that these cracks are not SSC cracks.

6.8.3 Through negotiation between the supplier and the buyer, the above test solution can also be the B solution of GB/T 8650-2015 or GB/T 4157-2017 or other alternative media. CSR, CTR, CLR indicators of HIC test and SSC test requirements can also be negotiated separately, and specified in the contract. The test frequency and sampling location are determined through consultation between the supplier and the buyer.

6.8.4 HIC test and SSC test may be performed by the buyer; however, the supplier shall guarantee HIC performance and SSC performance.

6.9 Surface quality

6.9.1 The surface of the steel plate shall be free from defects such as cracks, bubbles, scars, folds, inclusions and pressed scales, and other deep sharp scratches. Steel plates shall not be visually layered.

6.9.2 The surface of the steel plate is allowed to have local flat-bottom defects such as thin oxide scales, rusts, and slight surface roughness and indentation that are caused by the falling of scales, which do not hinder the inspection of the surface defects; but its depth shall not be greater than half of the thickness tolerance, and the minimum thickness of the steel plate shall be guaranteed.

6.9.3 The surface defects of the steel plate shall not be repaired by welding; grinding and cleaning are allowed; but the minimum thickness of the steel plate shall be guaranteed. The grinding and cleaning site shall be smooth and without edges; the breadth depth ratio shall not be less than 10:1; the grinding area shall not be greater than 2% of the surface area of the steel plate.

6.9.4 The surface quality may also be implemented in accordance with the provisions of GB/T 14977 after consultation between the supplier and the buyer.

6.10 Non-destructive testing

The steel plates shall be ultrasonically inspected one by one. The inspection method is GB/T 2970. The acceptance level shall be specified in the contract. If it is negotiated between the supplier and the buyer, and specified in the contract, other ultrasonic inspection methods can also be used.

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