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Beijing

PART ONE METALLIC MATERIALS

CHAPTER 3 STEEL PLATES, FLAT BARS AND SECTIONS

Section 7 STEELS FOR LOW TEMPERATURE SERVICE

The whole section is replaced by the following:

"**3.7.1 Application**

3.7.1.1 This Section applies to carbon-manganese and nickel alloy steels having a thickness not exceeding 40 mm, intended for use in the construction of cargo tanks of liquefied gas carriers and the hull structures adjacent to these tanks. Steels of this kind are to comply with the relevant requirements of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk in addition to the provisions of this Section.

3.7.1.2 Carbon-manganese and nickel alloy steels having a thickness exceeding 40 mm are to be specially considered.

3.7.1.3For carbon-manganese steels complying with the requirements of 3.7.1.1, the minimum specified yield strength is categorized as 315, 355 and 390 N/mm^2, and the toughness grade is represented by symbol CL-I, CL-II and CL-III respectively (where C stands for the first letter of CCS and L for low temperature).

3.7.1.4 In addition to the purposes mentioned in 3.7.1.1 above, the steels specified in this Section may apply to other purposes where the operating temperature is below 0℃.

3.7.2Deoxidation and chemical composition

3.7.2.1All materials are to be of fully killed steels and fine grain treated with aluminum.

3.7.2.2 See Table 3.7.2.2 for the chemical composition of carbon-manganese steels.

3.7.2.3 See Table 3.7.2.3 for the chemical composition of nickel alloy steels.

3.7.2.4Carbon equivalent C_{eq} may be calculated according to the chemical composition of ladle samples, using the following formula:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (\%)$$

The maximum value of the carbon equivalent is not to exceed the agreed permissible value.

Chemical Composition of Carbon-manganese Steels Table 3.7.2.2

Grade	Chemical composition (%)					
	C	Mn	Si	P	S	Other elements
CL-I-2,CL-II-2 CL-I-3, CL-II-3CL-I-4, CL-II-4	≤0.18	0.7~1.60	0.1~0.50	≤0.025	≤0.025	Ni≤0.80, Cr≤0.25 Mo≤0.08, Cu≤0.35 Nb≤0.05, V≤0.10
CL-III-2 CL-III-3 CL-III-4	≤0.16					
Total content of Al≥0.02% (acid soluble≥0.015%)						

Chemical Composition of Nickel Alloy Steels Table 3.7.2.3

Grade	Chemical composition (%)						
	C	Mn	Si	P	S	Ni	Other elements

1.5Ni	≤0.14	0.3~1.50	0.1~0.35	≤0.025	≤0.02	1.3~1.70	Cr≤0.25 Mo≤0.08 Cu≤0.35 Cr+Mo+Cu≤0.60 Al(acid soluble)≥0.015
2.25	≤0.14	≤0.7	≤0.3	≤0.025	≤0.025	2.10~2.50	
3.5Ni	≤0.12	0.3~0.80	0.1~0.35	≤0.025	≤0.02	3.2~3.80	
5Ni	≤0.12	0.3~0.90	0.1~0.35	≤0.025	≤0.02	4.7~5.30	
9Ni	≤0.10	0.3~0.90	0.1~0.35	≤0.025	≤0.02	8.5~10.0	

Note:① Nitrogen content is not to exceed 0.009% (or 0.012% where aluminium is present).

3.7.3 Heat treatment and mechanical properties

3.7.3.1The conditions of supply and the mechanical properties of carbon and carbon-manganese steels are to comply with the provisions given in Table 3.7.3.1.

3.7.3.2The conditions of supply and the mechanical properties of nickel alloy steels are to comply with the provisions given in Table 3.7.3.2.

Condition of Supply and Mechanical Properties of Carbon-manganese Steels①Table 3.7.3.1

Grade	Condition of supply②	Yield strength R_{eH} min. (N/mm^2)	Tensile strength R_m (N/mm^2)	Elongation A_5 min. (%)	Charpy V-notch impact tests				Min. Design Temp. (℃)
					Materiel thickness t (mm)	Test Temp. T (℃)	Average energy of test specimens, min.(J)		
							Long.	Trans.	
CL-I-2	Normalized or quenched and tempered	315	440-570	22	t≤25 25<t≤30 30<t≤35 35<t≤40	-20 -25 -30 -35	41	27	-15
CL-II-2		315	440-570	22	t≤25 25<t≤30 30<t≤35 35<t≤40	-40 -45 -50 -55	41	27	-35
CL-III-2		315	440-570	22	t≤25 25<t≤30 30<t≤35 35<t≤40	-60 -65 -70 -75	41	27	-55
CL-I-3		355	490-630	21	t≤25 25<t≤30 30<t≤35 35<t≤40	-20 -25 -30 -35	41	27	-15
CL-II-3		355	490-630	21	t≤25 25<t≤30 30<t≤35 35<t≤40	-40 -45 -50 -55	41	27	-35
CL-III-3		355	490-630	21	t≤25 25<t≤30 30<t≤35 35<t≤40	-60 -65 -70 -75	41	27	-55
CL-I-4		390	510-660	20	t≤25 25<t≤30 30<t≤35 35<t≤40	-20 -25 -30 -35	41	27	-15
CL-II-4		390	510-660	20	t≤25 25<t≤30 30<t≤35 35<t≤40	-40 -45 -50 -55	41	27	-35
CL-III-4		390	510-660	20	t≤25 25<t≤30 30<t≤35 35<t≤40	-60 -65 -70 -75	41	27	-55

Grade	Condition of supply②	Yield strength R_{eH} min. (N/mm^2)	Tensile strength R_m (N/mm^2)	Elongation A_5 min. (%)	Charpy V-notch impact tests				Min. Design Temp. (℃)
					Materiel thickness t (mm)	Test Temp. T (℃)	Average energy of test specimens, min.(J)		
							Long.	Trans.	
①This requirement applies to materials having a thickness not exceeding 40 mm. Values of Charpy V-notch impact energy for materials having a thickness exceeding 40 mm are subject to agreement of CCS. ②Controlled rolling process or TMCP may replace normalized or quenched and tempered. ③In the table, the transverse and longitudinal values of impact tests are applicable to sheets and sections respectively									

Condition of Supply and Mechanical Properties of Nickel Alloy Steels Table 3.7.3.2

Grade	Condition of supply	Proof strength $R_{p1.0}$ min. (N/mm^2)	Tensile strength R_m (N/mm^2)	Elongation A_5 min. (%)	Charpy V-notch impact tests				Min. Design Temp. (℃)
					Materiel thickness t (mm)	Test Temp. T (℃)	Average energy of test specimens, min. (J)		
							Long.	Trans.	
1.5Ni	Normalized or normalized and tempered or quenched and tempered or TMCP①	275	470~640	22	t≤25 25<t≤30 30<t≤35 35<t≤40	-65 -70 -75 -80	41	27	-60
2.25Ni	Normalized or normalized and tempered or quenched and tempered or TMCP①	295	420~570	19	t≤25 25<t≤30 30<t≤35 35<t≤40	-70 -75 -80 -85			-65
3.5 Ni		345	440~690	21	t≤25 25<t≤30 30<t≤35 35<t≤40	-95 -100 -105 -110			-90
5Ni	Normalized or normalized and tempered or quenched and tempered or TMCP①②	390	520~710	21	t≤25 25<t≤30 30<t≤35 35<t≤40	-110 -115 -120 -125			-105
9Ni	Double normalized and tempered or quenched and tempered	490	640~830	19	t≤40	-196			-165
① Nickel steels are subject to agreement of CCS if the condition of supply is TCMP. ②5% nickel steels subject to special heat treatment, such as three-degree heat treatment (double quenched and tempered), can be used in locations where the minimum temperature is -165℃. However, impact tests are to be carried out if the temperature is below -196℃. ③This requirement applies to materials having a thickness not exceeding 40 mm. Values of Charpy V-notch impact energy for materials having a thickness exceeding 40 mm are subject to agreement of CCS. ④ The transverse and longitudinal values of impact tests are applicable to sheets and sections respectively									

3.7.3.3 Preparation of the specimens for mechanical tests

(1) For plates: one tensile test specimen and a set of three impact test specimens are to be taken from one end of each rolled piece.

(2) For sections and other steels: one tensile test specimen and a set of three impact test specimens are to be taken from one piece in each batch with similar dimensions, originating from the same heat treatment regime and the same heat of steel by the same rolling procedure. The mass of each batch is not to exceed10t.

(3) The direction of cut, shape and dimensions of the tensile and impact test specimens are to

comply with the relevant requirements of Chapter 2 of this PART and Section 1 of this Chapter. For plates intended for the applications as detailed in 3.7.1.1 above, transverse specimens are to be taken for impact tests. The locations where the specimens are taken and test values are to comply with the relevant requirements of 6.1.4.1, 6.1.4.2 and 6.1.5, Chapter 6 of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.

3.7.3.4 Drop weight test

(1) In addition to the above-mentioned mechanical tests, where required by purchase agreements, a drop weight test may be carried out on plates and sections having a thickness more than 12 mm and working under the following designed operating temperatures:

① carbon-manganese steels intended for use at a designed operating temperature below -40℃;

② 1.5Ni steels intended for use at a designed operating temperature below -60℃;

③ 2.25Ni steels intended for use at a designed operating temperature below -65℃;

④ 3.5Ni steels intended for use at a designed operating temperature below -80℃;

⑤ 5Ni steels intended for use at a designed operating temperature below -90℃.

(2) For drop weight tests, one set of two specimens are to be taken from the thickest plate or section of each batch from the same cast, there is not crack during the test.

(3)Drop weight test is to be carried out at a temperature 5℃ lower than the designed operating temperature."

PART THREE WELDING

CHAPTER 3 APPROVAL OF WELDING PROCEDURES

Section 1 GENERAL PROVISIONS

The existing subparagraph 3.1.4.3(5) is replaced by the following:

"(5)For steels with delivery conditions other than those tested, CCS will put forward test requirements as appropriate except for those specified below:

①the approval of quenched and tempered steels does not qualify thermo-mechanically rolled steels (TMCP steels) and vice versa;

②in general the approval of normalized, as rolled, controlled rolling steels can qualify TMCP steels but not vice versa."