GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Guidance Part 2 Materials and Welding)

-External Opinion Inquiry-

2019.10.

Machinery Rule Development Team

- Main Amendments -

(1) Enter into force on 1 January 2020 (the date of application for certification of material & welding or the contract date for ship construction)

◉ To reflect Request for Establishment/Revision of Classification Technical Rules

Present	Amendment	reason
CHAPTER 1 MATERIALS **Section 1 General** **101. Application** [See Rule] **1. ~ 4. <Omitted>** **5. <New>** **102. ~ 109. <Omitted>** **Section 2 ~ Section 8 <Omitted>** **CHAPTER 2 WELDING <Omitted>**	**CHAPTER 1 MATERIALS** **Section 1 General** **101. Application** [See Rule] **1. ~ 4. <Sames as the present guidance>** **5.** The high manganese austenitic steel for cargo tank in ships carrying liquefied natural gases in bulk or for fuel tank in ships using liquefied natural gases as fuels is to comply with **Annex 2-11**. *(2020)* **102. ~ 109. <Sames as the present guidance>** **Section 2 ~ Section 8 <Sames as the present guidance>** **CHAPTER 2 WELDING <Sames as the present guidance>**	* It is reflected Request for Establishment/Revision of Classification Technical Rules(MRD4800-75-2019). - IMO MSC. 1/Circ.1599 Annex

Present	Amendment	reason
Annex 2-1 ~ Annex 2-10 <Omitted>	**Annex 2-1 ~ Annex 2-10** <Omitted>	
Annex 2-11 High manganese austenitic steel <New>	**Annex 2-11 High manganese austenitic steel**	* It is reflected Request for Establishment/Revision of Classification Technical Rules(MRD4800-75-2019).
	1. Application (1) This Guidance applies to the high manganese austenitic steel plate(hereinafter referred to as "high manganese austenitic steel") for cargo tank in ships carrying liquefied natural gases in bulk or for fuel tank in ships using liquefied natural gases as fuels. (2) The high manganese austenitic steel used for purposes other than (1) may be applied this Guidance with the approval of the Society. (3) The requirements other than those specified in this Guidance are comply with the requirements specified in **Pt 2**, **Ch 1**, **301.** of the Rules.	Interim guideline, Part I, 3. Definitions
	2. Definitions (1) High manganese austenitic steel is the steel with a high amount of manganese in order to retain austenite as its primary phase at atmospheric and service temperature. (2) Controlled cooling is a method of cooling from high temperature in accordance with designed cooling rate.	
	3. Manufacturing process (1) Where the high manganese austenitic steel plates are manufactured from the continuous casting slabs, the maximum thickness for approval is to be determined, as a rule, with the roll ratio of 6 as standard. However, upon consideration of the manufacturing process, the roll ratio may be reduced to 4. (2) The grade, thickness, deoxidation practice and chemical composition are to comply with the requirements given in **Table 1**.	Interim guidelines, Part II 5 Table 1

Table 1 Grade, Thickness, Deoxidation Practice and Chemical Composition

Grade	Thickness, t(mm)	Deoxidation Practice	Chemical Composition (%)								
			C	*Si*(1)	*Mn*	*P*	*S*	*Cu*	*Cr*	*N*	*B*
HMN40	$6 \le t \le 30$	Killed and Fine grain treated	0.35 ~ 0.55	0.10 ~ 0.50	22.50 ~ 25.50	0.030 max.	0.010 max.	0.30 ~ 0.70	3.00 ~ 4.00	0.050 max.	0.005 max.

NOTES:

(1) Silicon(Si) may be less than 0.10 %, provided total aluminum is 0.03 % or higher, or provided acid soluble aluminum is 0.025 % or higher.

Present	Amendment	reason
	4. Heat treatment (1) The heat treatment for high manganese austenitic steel is to be hot rolled and subsequent controlled cooling as necessary. (2) Heat treatment following the final rolling process is not permitted. **5. Selection of test samples** (1) One test sample is to be taken from every similarly heat treated piece as rolled directly from one slab or ingot. (2) The requirements specified in **Pt 2**, **Ch 1**, **301. 6** (4) of the Rules are to be applied to the selection of the test samples. **6. Selection of test specimens** (1) Tensile test specimens are to comply with the requirements shown in (a) to (c) below: (a) Tensile test specimens are to be taken according to the requirements specified in **Pt 2**, **Ch 1**, **301. 7** (2) of the Rules. (b) Normally flat tensile test specimens are to be prepared in such a manner as to maintain the rolling scale at least at one side. (c) When instead a machined round tensile test specimen is used then the axis must be located at a position lying at a distance of t/4 from the surface or as near as possible to this position. (2) Impact test specimens are to be taken according to the requirements specified in **Pt 2**, **Ch 1**, **301. 7** (3) of the Rules. **7. Mechanical properties** The mechanical properties of high manganese austenitic steel plates are classified as specified in **Table 2**.	- Interim guideline, Part II, 4.2 - ASTM A1106 4.3

Present	Amendment	reason
	Table 2 Mechanical properties for high manganese austenitic steel plates	Interim guidelines, Part II, 6 Mechanical properties Table 2

Grade	Tensile test			Impact test		
	Yield Strength (N/mm^2)	Tensile Strength (N/mm^2)	Elongation ($L=5.65\sqrt{A}$) (%)	Test Temp. (℃)	Average Impact Energy(J) min.(1)	
					L(2)	T(2)
HMN40	min. 400	800～970	22	-196	41	27

NOTE:
(1) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified average absorbed energy or when the absorbed energy of a single test specimen is less in value than 70 % of the specified average absorbed energy, the test is considered to be failed.
(2) L (or T) denotes that the longitudinal axis of the test specimen is arranged parallel (or transverse) to the final direction of rolling.

8. Welding consumables for high manganese austenitic steel

(1) Where no special requirements are given in **8**, those as specified in **Pt 2, Ch 2, 607.** of the Rules apply in analogous manner.
(2) Welding consumables are classified as specified in **Table 3**.

Table 3 Grades and Marks of Welding Consumables

Material for TIG welding	Flux cored wire welding	Consumables for submerged welding
RY HMN	*RW HMN*	*RU HMN*

(3) Submerged arc welding consumables which have passed the tests for each welding process are to be appended with the suffixes shown in **Table 4** at the end of their marks.

Present	Amendment	reason

Table 4 Marks

Welding technique	Marks
Multi-run technique	*M*
Two-run technique	*T*
Multi-run and Two-run technique	*TM*

(4) Deposited metal test

(A) Chemical composition

(a) Deposited metals of welding consumables for flux cored wire welding and submerged arc welding are to have the chemical composition given in **Table 5** and **Table 6** respectively.

(b) TIG welding consumables are to have the chemical composition of ladle analysis value complied with the requirements as given in **Table 7**.

Table 5 Chemical Composition of Deposited Metal for Flux Cored Wire Welding

Grade	Chemical composition (%)									
	C	*Si*	*Mn*	*P*	*S*	*Ni*	*Cr*	*Mo*	*N*	Others
RW HMN	0.2～0.5	0.2～1.0	18.0～26.0	0.02 max.	0.015 max.	5.0 max.	5.0 max.	2.5 max.	0.1 max.	—

Table 6 Chemical Composition of Deposited Metal for Submerged Arc Welding

Grade	Chemical composition (%)									
	C	*Si*	*Mn*	*P*	*S*	*Ni*	*Cr*	*Mo*	*N*	Others
RU HMN	0.2～0.6	1.5 max.	18.0～26.0	0.020 max.	0.015 max.	3.0 max.	5.0 max.	2.5 max.	0.10 max.	—

Present	Amendment	reason
	Table 7 Chemical Composition of Deposited Metal for TIG Electrodes	

Grade	Chemical composition (%)									
	C	*Si*	*Mn*	*P*	*S*	*Ni*	*Cr*	*Mo*	*N*	Others
RY HMN	0.2~0.5	0.1~1.0	18.0~26.0	0.020 max.	0.015 max.	5.0 max.	5.0 max.	2.5 max.	0.10 max.	—

(B) Mechanical properties for deposited metal are to comply with the requirements in **Table 8**.

Table 8 Mechanical properties for Deposited Metal

Tensile test			Charpy V notch Impact test	
Yield strength (N/mm^2)	Tensile strength (N/mm^2)	Elongation (%)	Test temp. (℃)	Average absorbed energy (J)
400 min.	660 min.	22 min.	-196	27 min.

- IMO MSC. 1/Circ.1599 Annex 6.2 Table 3

(5) Butt weld test

Mechanical properties for butt weld test are to comply with the requirements in **Table 9**.

Table 9 Mechanical properties for butt weld test

Yield strength (N/mm^2)	Bend test	Charpy V notch Impact test	
		Test temp. (℃)	Average absorbed energy (J)
660 min.	The test specimens are to be capable of withstanding, without crack exceeding 3 mm long on the outer surface of the specimen or other defects.	-196	27 min.

Present	Amendment	reason
	(6) Fillet weld test Fillet weld test is to be in accordance with the requirements in **Pt 2**, **Ch 2**, **602. 7** of the Rules. **9. Welder** (1) Welders for high manganese austenitic steel are to have a qualification by welder qualification test with high manganese austenitic steel specimen in accordance with **Pt 2**, **Ch 2**, **Sec. 5** of the Rules. (2) Welders who engage in welding for high manganese austenitic steel is to have passed qualification test with high manganese austenitic steel. **10. Welding procedure qualification tests** (1) Welding procedure qualification tests for high manganese austenitic steel is to be in accordance with the requirements in **Pt 7, Ch 5, Sec 6** of Rules and **Rules/Guidances for the Classification of Ships Using Low-flashpoint Fuels**. (2) The welding procedure qualification test is carried out considering the following points. (A) Special attention is to be given to the first root pass when applying flux-cored arc welding (FCAW); reduced amperage is to be considered. And weld gas composition of FCAW is to be normally an 80/20 mix of argon and carbon dioxide. (B) Welding heat input is to be controlled equal to maximum 30 kJ/cm or below. **11. Welding practice** (1) Distance between the weld and nozzle is to be kept to a minimum to reduce the oxygen content at the vicinity of the weld pool. (2) Appropriate ventilation is to be provided to reduce exposure to hazardous welding fumes. (3) The edges to be welded are to be smooth, uniform and free from moisture, grease, rust and paint which may cause injurious defects in welded joints. **12. Marking** (1) Steel plates which have satisfactorily complied with the required tests are to be marked with the identification mark in accordance with **Pt 2**, **Ch 1**, **301. 11** of the Rules. (2) Where the plates are controlled cooling : *CC* (e.g. : *HMN40 CC*)	- IMO MSC. 1/Circ.1599 Annex 10.6.2.1.1 10.6.2.3 10.6.2.1.2 - IMO MSC. 1/Circ.1599 Annex 10.6.2.2 10.6.2.4