# GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

## (Guidance Part 7 Ships of Special Service[Ch 5,6] )

-External Opinion Inquiry-

2019.10.

Hull Rule Development Team

# - Main Amendments -

(1) Enter into force on 1 January 2020 (the contract date for ship construction)

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

| Present | Amendment | reason |
|---|---|---|
| **CHAPTER 1 SHIPS CARRYING LIQUEFIED GASES IN BULK** | **CHAPTER 1 SHIPS CARRYING LIQUEFIED GASES IN BULK** | |
| **Section 1 ~ Section 3 <Omitted>** | **Section 1 ~ Section 3 <Sames as the present guidance>** | |
| **Section 4 Cargo Containment** | **Section 4 Cargo Containment** | |
| **401. ~ 418. <Omitted>** | **401. ~ 418. <Sames as the present guidance>** | |
| **419. Materials [See Rule]** | **419. Materials [See Rule]** | |
| **1. ~ 8. <Omitted>** | **1. ~ 8. <Sames as the present guidance>** | |
| **9. <New>** | **9. Materials of primary and secondary barriers**<br>(1) The high manganese austenitic steel for cargo tank for the carriage of liquefied natural gases is to comply with **Annex 7A-4**. *(2020)* | IMO MSC. 1/Circ.1599 Annex, Interim Guidelines |
| **Section 5 ~ Section 19 <Omitted>** | **Section 5 ~ Section 19 <Sames as the present guidance>** | |

| Present | Amendment | reason |
|---|---|---|
| **Annex 7A-1 ~ Annex 7A-3**<br><Omitted><br>**Annex 7A-4 High manganese austenitic steel for Cryogenic Service <New>** | **Annex 7A-1 ~ Annex 7A-3** <Omitted><br>**Annex 7A-4 High manganese austenitic steel for Cryogenic Service** | * MSC.1/Circ.1599 Annex Interim guidelines 반영 |
| | **Section 1 General** | Interim guideline Part I |
| | **101. Scope**<br>**1.** This Annex provides the designer and manufacturer with practical information on the design and construction of cargo tanks using high manganese austenitic steel for cryogenic service to comply with the Design Conditions defined in **Pt7, Chapter 5, 418**. | Interim guideline Part I, 1. Scope |
| | **102. Application**<br>**1.** This Annex are not intended to replace any requirements of **Pt7, Chapter 5**. They are intended as complementary guidelines on how to utilize high manganese austenitic steel in the design and fabrication of cargo tanks complying with the **Pt7, Chapter 5**. | Interim guideline Part I, 2. Application |
| | **103. Definitions**<br>**1. Under-matched welds** means for welded connections where the weld metal has lower yield- or tensile-strength than the parent metal. | Interim guideline Part I, 3. Definition |
| | **Section 2 Application** | Interim guideline Part III |
| | **201. Design application**<br>**1.** The relevant load conditions and design conditions should be established in accordance with **Pt7, Chapter 5, 418**. A guidance on special considerations to the high manganese austenitic steel is described beolw.<br>**2.** For the selection of relevant safety factors for high manganese austenitic steels(see **Pt7, Chapter 5, 421 to 423**), the safety factors specified for “Austenitic Steels“ should be applied both for base material and for as welded condition | Interim guideline Part III, 10.1 General |

<table>
<tr><th>Present</th><th>Amendment</th><th>reason</th></tr>
<tr><td></td><td>

**202. Ultimate design condition**

**1.** It should be noted that high manganese austenitic steels normally have under-matched welds and, therefore, it is of great importance that the design values of the yield strength and tensile strength are based on the “minimum mechanical properties“ for the base material and as welded condition(see 6 Mechanical Properties). Note the limitation to under-matched welds defined in **Pt7, Chapter 5, 418.1.(3).(B)**.

</td><td>Interim guideline Part III, 10.2 Ultimate design condition</td></tr>
<tr><td></td><td>

**203. Buckling strength**

**1.** Buckling strength analysis should be carried out based on recognized standards. Functional loads as defined in **Pt7, Chapter 5, 403.4** should be considered. Note that design tolerances should be considered where relevant and be included in the strength assessment as required in **Pt7, Chapter 5, 606.2.(1)**.

</td><td>Interim guideline Part III, 10.3 Bucking strength</td></tr>
<tr><td></td><td>

**204. Fatigue design condition**

**1.** The fatigue design curves for base material and for butt weld joint should use S-N curve of D grade in IIW.

**2.** The fatigue design curves for other weld joints except butt weld joint should be agreed with the Society.

**3.** Design S-N curve given in Table 1 correspond to a probability of survival of 97.6%.

</td><td>Interim guideline Part III, 10.4 Fatigue design condition</td></tr>
<tr><td></td><td>

Table 1 S-N curves in air

<table>
<tr><th rowspan="2">S-N curve</th><th colspan="2">$N \leq 10^7$ cycles</th><th>$N > 10^7$cycles</th><th rowspan="2">Fatigue limit at $10^7$ cycle(MPa)</th><th rowspan="2">Thickness exponent k</th></tr>
<tr><th>$m_1$</th><th>$\log \bar{a}_1$</th><th>$\log \bar{a}_2$<br>$m_2 = 5.0$</th></tr>
<tr><td>D</td><td>3.0</td><td>12.164</td><td>15.606</td><td>52.63</td><td>0.20</td></tr>
</table>

</td><td>Interim guideline Part III, 10.4 Fatigue design condition, Table 4</td></tr>
</table>

| Present | Amendment | reason |
|---|---|---|
| | **205. Fracture mechanics analyses**<br>**1.** For a cargo tank where a reduced secondary barrier is applied, fracture mechanics analysis should be carried out in accordance with **Pt7, Chapter 5**.<br>**2.** Fracture toughness properties should be expressed using recognized standards. Depending on the material, fracture toughness properties determined for loading rates similar to those expected in the tank system should be required. The fatigue crack propagation rate properties should be documented for the tank material and its welded joints for the relevant service conditions. These properties should be expressed using a recognized fracture mechanics practice relating the fatigue crack propagation rate to the variation in stress intensity, $\triangle K$, at the crack tip. The effect of stresses produced by static loads should be taken into account when establishing the choice of fatigue crack propagation rate parameters.<br>**3.** Note that for the application where very high static load utilization is relevant, alternative methods such as ductile fracture mechanics analysis should be considered.<br>**4.** A fracture mechanics analysis is required for type B tank(**Pt7, Chapter 5, 422.4**) where a reduced secondary barrier is applied. Fracture mechanics analysis may also be required for other tank types as found relevant to show compliance with fatigue and crack propagation properties. Note that CTOD values used in fracture mechanics analysis may in any case be an important property to analyze to ensure that materials are considered suitable for the application. | Interim guideline Part III, 10.5 Fracture mechanics analyses |

| Present | Amendment | reason |
|---|---|---|
|  | **206. Welding**<br>**1.** Welding should be carried out in accordance with **Pt7, Chapter 5, 605**.<br>**2.** For welding the following points can be considered:<br>(1) For reducing the heat input during production:<br>(A) special attention should be given to the first root pass when applying flux-cored arc welding(FCAW); reduced amperage should be considered;<br>(B) welding heat input is to be equal to 30 kJ/cm or below;<br>(2) Distance between the weld and nozzle should be kept to a minimum to reduce the oxygen content at the vicinity of the weld pool;<br>(3) Weld gas composition of FCAW should normally be an 80/20 mix of argon and carbon dioxide; and<br>(4) Appropriate ventilation should be provided to reduce exposure to hazardous welding fumes. | Interim guideline Part III, 10.6 Welding |
|  | **207. Non-destructive testing(NDT)**<br>**1.** The scope of non-destructive testing(NDT) should be as required by **Pt7, Chapter 5, 605.6**. NDT procedures should be in accordance with recognized standards to the satisfaction of the Society. For high manganese austenitic steel suitable NDT procedure normally applicable for austenitic steels should be used. | Interim guideline Part III, 10.7 Non-destructive testing |
|  | **208. Corrosion resistance**<br>**1.** High manganese austenitic steel is not considered a very strong corrosion resistant material in line with several similar materials such as 304 stainless steel Particularly for LNG cargo tanks that may not be in operation, appropriate environment should be maintained to prevent corrosion. | Interim guideline Part III, 10.8 Corrosion resistance |