Amendment on 25 December 2025
Resolved by Technical Committee on 30 July 2025

Application of High Manganese Austenitic Steel for Cryogenic Service

Object of Amendment

Rules for the Survey and Construction of Steel Ships Part GF and N
Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Reason for Amendment

At the 106th meeting of the Maritime Safety Committee (MSC 106) held in November 2022, amendments to the IGF Code and IGC Code were adopted as Resolutions MSC 523(106) and MSC 524(106) to incorporate requirements for high manganese austenitic steels. Since such steel is expected to be used as a tank material equivalent to nickel steel, it will start being allowed by both codes on 1 January 2026.

The properties of high manganese austenitic steels and the requirements for approval tests and shipping tests to verify said properties are specified in MSC.1/Circ.1599/Rev.3, which is referred to in the above resolutions.

Accordingly, related requirements are amended based on Resolutions MSC 523(106), MSC 524(106) and MSC.1/Circ.1599/Rev.3.

Outline of the Amendment

The main contents of this amendment are as follows:

(1) Specifies high manganese austenitic steel as acceptable for use with respect to tanks in Part GF and Part N of the Rules.
(2) Specifies the requirements of MSC.1/Circ.1599 as Annex 6.4.1-1, Part N of the Rules.
(3) Amends requirements referencing MSC.1/Circ.1599 in the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use to refer to relevant requirements in Annex 6.4.1-1, Part N of the Rules.

Effective Date and application

Effective date of this amendment is 1 January 2026.

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

ID:DH24-10

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part GF SHIPS USING LOW-FLASHPOINT FUELS** **Chapter 7 MATERIAL AND GENERAL PIPE DESIGN** **7.4 Regulations for Materials** (with reference to *IGF Code* 7.4) **7.4.1 Metallic Materials*** **1** Materials for fuel containment and piping systems are to comply with the minimum regulations given in the following tables: (1) **Table GF7.1**: Plates, pipes (seamless and welded), sections and forgings for fuel tanks and process pressure vessels for design temperatures not lower than 0°C. (2) **Table GF7.2**: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to -55°C. (3) **Table GF7.3**: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below -55°C and down to -165°C. (4) **Table GF7.4**: Pipes (seamless and welded),	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part GF SHIPS USING LOW-FLASHPOINT FUELS** **Chapter 7 MATERIAL AND GENERAL PIPE DESIGN** **7.4 Regulations for Materials** (with reference to *IGF Code* 7.4) **7.4.1 Metallic Materials*** **1** Materials for fuel containment and piping systems are to comply with the minimum regulations given in the following tables: (1) **Table GF7.1**: Plates, pipes (seamless and welded), sections and forgings for fuel tanks and process pressure vessels for design temperatures not lower than 0°C. (2) **Table GF7.2**: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to -55°C. (3) **Table GF7.3**: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below -55°C and down to -165°C. (4) **Table GF7.4**: Pipes (seamless and welded),	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
forgings and castings for fuel and process piping for design temperatures below 0°C and down to -165°C. (5) **Table GF7.5**: Plates and sections for hull structures required by **6.4.13-1(1)(b)**. **2** Materials having a melting point below 925°C are to not be used for piping outside the fuel tanks. **3** For *CNG* tanks, the use of materials not covered above may be specially considered by the Society. **4** Where required the outer pipe or duct containing high pressure gas in the inner pipe is to fulfil the material regulations for pipe materials in **Table GF7.4**. **5** The outer pipe or duct around liquefied gas fuel pipes is to fulfil the material regulations for pipe materials with design temperature down to -165°C in **Table GF7.4**. **6** Metallic materials specified in this Part, according to the requirements in **1.1.1-2**, **Part K of the Rules**, are to comply with the requirements of **Part K of the Rules** in addition to those specified in this Part. **7** The materials listed in **-1(2)** through **(4)** above may be used at temperatures higher than the specified design temperature in cases where permitted by the Society.	forgings and castings for fuel and process piping for design temperatures below 0°C and down to -165°C. (5) **Table GF7.5**: Plates and sections for hull structures required by **6.4.13-1(1)(b)**. **2** Materials having a melting point below 925°C are to not be used for piping outside the fuel tanks. **3** For *CNG* tanks, the use of materials not covered above may be specially considered by the Society. **4** Where required the outer pipe or duct containing high pressure gas in the inner pipe is to fulfil the material regulations for pipe materials in **Table GF7.4**. **5** The outer pipe or duct around liquefied gas fuel pipes is to fulfil the material regulations for pipe materials with design temperature down to -165°C in **Table GF7.4**. **6** Metallic materials specified in this Part, according to the requirements in **1.1.1-2**, **Part K of the Rules**, are to comply with the requirements of **Part K of the Rules** in addition to those specified in this Part. **7** The materials listed in **-1(2)** through **(4)** above may be used at temperatures higher than the specified design temperature in cases where permitted by the Society.	
7.4.2 Marking **1** Steels which have satisfactorily complied with the required test are to be marked with identification mark in accordance with the requirements in **Part K** and in case the impact test has been required, the impact testing temperature and "*T*" are to be suffixed to the markings. (Example: *KL*33-50*T*. -0*T* as suffix for 0°C.)	**7.4.2 Marking** Steels which have satisfactorily complied with the required test are to be marked with identification mark in accordance with the requirements in **Part K** and in case the impact test has been required, the impact testing temperature and "*T*" are to be suffixed to the markings. (Example: *KL*33-50*T*. -0*T* as suffix for 0°C.)	
2 In addition to **-1** above, in the case of high manganese austenitic steels that have been corrosion tested for ammonia compatibility in accordance with **Annex 6.4.1-1, Part N** during manufacturing process approval testing and	(Newly added)	Specify requirements for identification to distinguish steel plates when ammonia compatibility corrosion

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
confirmed to be suitable for ammonia environments, "*A*" is added to the marking. (Example: *KHMA*400-*A*)		tests for optional compliance requirements have been performed.

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks

Table GF7.3 Plates, Sections and Forgings[1] for Fuel Tanks, Secondary Barriers and Process Pressure Vessels for Design Temperatures below -55°C and down to -165°C[2]
(Maximum Thickness 25 *mm*[3],[4])

Minimum design temp. (°C)	Chemical composition[5] and heat treatment	Impact test temp. (°C)
-60	1.5%nickel steel - normalized or normalized and tempered or quenched and tempered or TMCP[6]	-65
-65	2.25%nickel steel - normalized or normalized and tempered or quenched and tempered or TMCP[6][7]	-70
-90	3.5%nickel steel - normalized or normalized and tempered or quenched and tempered or TMCP[6][7]	-95
-105	5%nickel steel - normalized or normalized and tempered or quenched and tempered[6][7][8]	-110
-165	9%nickel steel - double normalized and tempered or quenched and tempered[6]	-196
-165	Austenitic stainless steels, such as types *304*, *304L*, *316*, *316L*, *321* and *347* solution treated[9]	-196
-165	High manganese austenitic steel – hot rolling and controlled cooling[11][12]	-196
-165	Aluminium alloys[10]: such as type *5083* annealed	Not required
-165	Austenitic *Fe-Ni* alloy (36% nickel) Heat treatment as agreed	Not required

Tensile and Toughness (Impact) Test Requirements:

Sampling frequency:	
Plates	Each “piece” to be tested
Sections and Forgings	Each “lot” to be tested
Toughness (Charpy *V*- Notch Impact Test):	
Plates	Transverse test pieces. Minimum average energy value (*KV*) 27*J*
Sections and Forgings	Longitudinal test pieces. Minimum average energy value (*KV*) 41*J*

Resolutions MSC 524(106)

Amended	Original	Remarks

Notes

(1) The impact test required for forgings used in critical applications is to be subject to special consideration by the Society.

(2) The regulations for design temperatures below -165°C are to be specially agreed with the Society.

(3) For materials 1.5% *Ni*, 2.25% *Ni*, 3.5% *Ni* and 5% *Ni*, with thicknesses greater than 25 *mm*, the impact tests are to be conducted as follows:

Material thickness (*mm*)	Test temperature (°C)
$25 < t \leq 30$	10°C below design temperature
$30 < t \leq 35$	15°C below design temperature
$35 < t \leq 40$	20°C below design temperature
$40 < t \leq 45$	25°C below design temperature
$45 < t \leq 50$	30°C below design temperature

In no case is the test temperature to be above that indicated in **Table GF7.3**.

The minimum average energy value is to be in accordance with the table for the applicable type of test specimen. For material thickness of more than 40 *mm*, minimum average energy values are to be specially considered.

Where thickness is greater than 40 *mm*, in addition to **16.2.2-2**, test specimens are to be taken at a portion where the axis of the test specimen corresponds to approximately 1/2 of the thickness from the surface.

(4) For 9% *Ni* steels, high manganese austenitic steels, austenitic stainless steels, and aluminium alloys, thickness greater than 25 *mm* may be used.

(5) The chemical composition limits are to be in accordance with recognized standards deemed appropriate by the Society.

(6) Thermo-mechanical controlled processing (TMCP) *Ni* steels will be subject to acceptance by the Society.

(7) A lower minimum design temperature for quenched and tempered steels may be specially agreed with the Society.

(8) A specially heat treated 5% *Ni* steel, for example triple heat treated 5% nickel steel, may be used down to -165°C, provided that the impact tests are carried out at -196°C.

(9) The impact test may be omitted subject to agreement with the Society.

(10) For aluminimum alloys other than type 5083, additional tests may be required to verify the toughness of the material.

(11) The use of high manganese austenitic steel is to be subject to the required conditions specified in **Annex 6.4.1-1, Part N**, except in cases where specified by the Administration.

(12) The impact test may not be omitted for high manganese austenitic steel.

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK** **Chapter 6 MATERIALS OF CONSTRUCTION AND QUALITY CONTROL** **6.4 Requirements for Metallic Materials (with reference to *IGC Code* 6.4)** **6.4.1 General Requirements for Metallic Materials*** **1** The requirements for materials of construction are shown in the tables as follows: (1) **Table N6.1**: Plates, pipes (seamless and welded), sections and forgings for cargo tanks and process pressure vessels for design temperatures not lower than 0°C. (2) **Table N6.2**: Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to -55°C. (3) **Table N6.3**: Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below -55°C and down to -165°C. (4) **Table N6.4**: Pipes (seamless and welded), forgings and castings for cargo and process piping for design	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK** **Chapter 6 MATERIALS OF CONSTRUCTION AND QUALITY CONTROL** **6.4 Requirements for Metallic Materials (with reference to *IGC Code* 6.4)** **6.4.1 General Requirements for Metallic Materials*** **1** The requirements for materials of construction are shown in the tables as follows: (1) **Table N6.1**: Plates, pipes (seamless and welded), sections and forgings for cargo tanks and process pressure vessels for design temperatures not lower than 0°C. (2) **Table N6.2**: Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to -55°C. (3) **Table N6.3**: Plates, sections and forgings for cargo tanks, secondary barriers and process pressure vessels for design temperatures below -55°C and down to -165°C. (4) **Table N6.4**: Pipes (seamless and welded), forgings and castings for cargo and process piping for design	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
temperatures below 0°C and down to -165°C. (5) **Table N6.5**: Plates and sections for hull structures required by **4.19.1-2** and **4.19.1-3**. (6) Castings for cargo and process piping for design temperatures not lower than 0°C are to be as deemed appropriate by the Society. **2** Metallic materials specified in this Part, according to the requirements in **1.1.1-2**, **Part K of the Rules**, are to comply with the requirements of **Part K of the Rules** in addition to those specified in this Part. **3** The materials listed in **-1(2)** through **(4)** above may be used at temperatures higher than the specified design temperature in cases where permitted by the Society. **6.4.2 Marking** **1** Steels which have passed the required tests are to be marked with identification marks in accordance with the requirements in **Part K**; in addition, in the case of steel for which impact tests are required, the impact testing temperature and "*T*" are to be added to the markings. (Example: *KL*33-50*T*. -0*T* as suffix for 0°C.) **2** In addition to **-1** above, in the case of high manganese austenitic steels that have been corrosion tested for ammonia compatibility in accordance with **Annex 6.4.1-1** during manufacturing process approval testing and confirmed to be suitable for ammonia environments, "*A*" is added to the marking. (Example: *KHMA*400-*A*)	temperatures below 0°C and down to -165°C. (5) **Table N6.5**: Plates and sections for hull structures required by **4.19.1-2** and **4.19.1-3**. (6) Castings for cargo and process piping for design temperatures not lower than 0°C are to be as deemed appropriate by the Society. **2** Metallic materials specified in this Part, according to the requirements in **1.1.1-2**, **Part K of the Rules**, are to comply with the requirements of **Part K of the Rules** in addition to those specified in this Part. **3** The materials listed in **-1(2)** through **(4)** above may be used at temperatures higher than the specified design temperature in cases where permitted by the Society. **6.4.2 Marking** Steels which have passed the required tests are to be marked with identification marks in accordance with the requirements in **Part K**; in addition, in the case of steel for which impact tests are required, the impact testing temperature and "*T*" are to be added to the markings. (Example: *KL*33-50*T*. -0*T* as suffix for 0°C.) (Newly added)	Specify requirements for identification to distinguish steel plates when ammonia compatibility corrosion tests for optional compliance requirements have been performed.

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks

Table N6.3 Plates, Sections and Forgings[1] for Cargo Tanks, Secondary Barriers and Process Pressure Vessels for Design Temperatures below -55℃ and down to -165℃[2]
(Maximum Thickness 25 *mm*[3][4])

Minimum design temp. (℃)	Chemical composition[5]and heat treatment	Impact test temp (℃)
-60	1.5% nickel steel - normalized or normalized and tempered or quenched and tempered or *TMCP*[6]	-65
-65	2.25% nickel steel - normalized or normalized and tempered or quenched and tempered or *TMCP*[6][7]	-70
-90	3.5% nickel steel - normalized or normalized and tempered or quenched and tempered or *TMCP*[6][7]	-95
-105	5% nickel steel - normalized or normalized and tempered or quenched and tempered[6][7][8]	-110
-165	9% nickel steel - double normalized and tempered or quenched and tempered[6]	-196
-165	Austenitic stainless steels, such as types *304*, *304L*, *316*, *316L*, *321* and *347* solution treated[9]	-196
-165	High manganese austenitic steel – hot rolling and controlled cooling[11][12]	-196
-165	Aluminium alloys[10]: such as type *5083* annealed	Not required
-165	Austenitic *Fe-Ni* alloy (36% nickel) Heat treatment as agreed	Not required
Tensile and Toughness (Impact) Test Requirements: Sampling frequency: Plates — Each “piece” to be tested Sections and Forgings — Each “lot” to be tested Toughness (Charpy *V*- Notch Impact Test): Plates Sections and Forgings — Transverse test pieces. Minimum average energy value (*KV*) 27 *J* Longitudinal test pieces. Minimum average energy value (*KV*) 41 *J*		

Resolutions MSC 523(106)

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks

Notes:

(1) The impact test required for forgings used in critical applications is to be subject to special consideration by the Society.

(2) The requirements for design temperatures below -165℃ is to be specially agreed with the Society.

(3) For materials 1.5% *Ni*, 2.25% *Ni*, 3.5% *Ni* and 5% *Ni*, with thicknesses greater than 25 *mm*, the impact tests are to be conducted as follows:

Material thickness (*mm*)	Test temperature (℃)
$25 < t \leq 30$	10℃ below design temperature
$30 < t \leq 35$	15℃ below design temperature
$35 < t \leq 40$	20℃ below design temperature
$40 < t \leq 45$	25℃ below design temperature
$45 < t \leq 50$	30℃ below design temperature

In no case is the test temperature to be above that indicated in **Table N6.3**.

The minimum average energy value is to be in accordance with the table for the applicable type of test specimen. For material thickness of more than 50 *mm*, the Charpy *V*-notch values are to be specially considered.

Where thickness is greater than 40 *mm*, in addition to **6.3.2-2**, test specimens are to be taken at portions where the axis of the test specimen corresponds to approximately 1/2 the thickness from the surface.

(4) For 9% *Ni*, high manganese austenitic steels, austenitic stainless steels, and aluminium alloys, thicknesses greater than 25 *mm* may be used at the discretion of the Society.

(5) The chemical composition limits are to be in accordance with recognized standards deemed appropriate by the Society.

(6) *TMCP* nickel steels will be subject to acceptance by the Society.

(7) A lower minimum design temperature for quenched and tempered steels may be specially agreed with the Society.

(8) A specially heat treated 5% nickel steel, for example triple heat treated 5% nickel steel, may be used down to -165℃ upon special agreement with the Society, provided that the impact tests are carried out at-196℃

(9) The impact test may be omitted subject to agreement with the Society.

(10) For aluminium alloys other than type 5083, additional tests may be required to verify the toughness of the material.

(11) The use of high manganese austenitic steel is to be subject to the required conditions specified in **Annex 6.4.1-1,** except in cases where specified by the Administration.

(12) The impact test may not be omitted for high manganese austenitic steel.

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
Annex 6.4.1-1 STANDARD ON THE APPLICATION OF HIGH MANGANESE AUSTENITIC STEEL FOR CRYOGENIC SERVICE	**(Newly added)**	MSC.1/Circ.1599/Rev.3
1.1 General	**(Newly added)**	
1.1.1 Scope The annex specifies requirements on the design and construction of cargo and fuel tanks using high manganese austenitic steel for cryogenic service, to comply with the design conditions defined in **6.4.12, Part GF** and **4.18, Part N of the Rules**.	**(Newly added)** (Newly added)	Part 1 / 1
1.1.2 Application **1** The annex is not intended to replace any requirements of **Part GF** and **Part N of the Rules**. The annex is intended as complementary requirements for the utilisation of high manganese austenitic steel in the design and fabrication of cargo and fuel tanks complying with the **Part GF** and **Part N of the Rules** subject to the following: (1) Application is suitable for the following cargoes and/or fuels if authorised by the **Part GF** and **Part N of the Rules**: (a) Ammonia, anhydrous (b) Butane (all isomers); (c) Butane-propane mixture; (d) Carbon dioxide (high purity and reclaimed quality); (e) Ethane; (f) Ethylene; (g) Methane (*LNG*);	**(Newly added)** (Newly added)	Part 1 / 2

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
(h) Pentane (all isomers); and (i) Propane. (2) Application is limited to hot rolled plates between 6 *mm* and 40 *mm* thick. (3) The post-weld stress relief heat treatment referenced in **17.12.2(2), Part N of the Rules** is waived for ammonia cargo and/or fuel tanks containing ammonia.		
2 The high manganese austenitic steel for cargo and fuel tanks is to comply withe the requirements specified in the annex.	(Newly added)	
1.1.3 Definitions	**(Newly added)**	
1 High manganese austenitic steel means steel with a high amount of manganese in order to retain austenite as its primary phase at atmospheric and service temperature.	(Newly added)	Part 1 / 3
2 Under-matched welds mean for welded connections where the weld metal has lower yield or tensile strength than the parent metal.	(Newly added)	
1.2 Material Specifications and Testing Requirements	**(Newly added)**	
1.2.1 Material Specification	**(Newly added)**	
1 The material specification is to be submitted to the Society for approval. The test requirements and acceptance criteria for the material are described in detail in **1.4**.	(Newly added)	Part 2 / 4
2 The steel is to be fully killed and fine-grained. The condition of supply for all material is to be hot rolled with subsequent controlled cooling as necessary. The reduction ratio of slab to finished product thickness is not to be less than 3:1. Other conditions of supply is to be as deemed appropriate by the Society.	(Newly added)	
3 The use of high manganese austenitic steel is limited	(Newly added)	

<table>
<tr><th>Amended</th><th>Original</th><th>Remarks</th></tr>
<tr><td>to steel plates with a thickness between 6 mm and 40 mm. For steel plate thicknesses greater than 40 mm and steels other than steel plate, special consideration may be given by the Society.

1.2.2 Chemical Composition
The chemical composition for high manganese austenitic steel is to meet the requirements of recognised standards, such as Table 1, ASTM standard A1106/A1106M-17 or ISO 21635:2018.

Table 1 Chemical Composition for High Manganese Austenitic Steel
<table>
<tr><th rowspan="2"></th><th colspan="9">Chemical Composition (%)</th></tr>
<tr><th>C</th><th>Si</th><th>Mn</th><th>P</th><th>S</th><th>Cr</th><th>Cu</th><th>B</th><th>N</th></tr>
<tr><td>High manganese austenitic steel</td><td>0.35 ~ 0.55</td><td>0.10 ~ 0.50</td><td>22.50 ~ 25.50</td><td>Max. 0.03</td><td>Max. 0.01</td><td>3.00 ~ 4.00</td><td>0.30 ~ 0.70</td><td>Max. 0.005</td><td>Max. 0.050</td></tr>
</table>
Note:
Si may be less than 0.10 %, provided total Al is 0.03 % or higher, or provided acid soluble Al is 0.025 % or higher.

1.2.3 Mechanical Properties
Mechanical properties for the base metal of high manganese austenitic steel are to meet the requirements of Part GF and Part N of the Rules, as relevant, and also recognised standards applied to chemical composition, such as ISO 21635:2018 or ASTM A1106/A1106M-17 as shown in Table 2. Compliance is also to be documented in accordance with material testing requirements and acceptance criteria outlined in 1.4.</td><td>(Newly added)
(Newly added)

(Newly added)
(Newly added)</td><td>Part 2 / 5

Part 2 / 6</td></tr>
</table>

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

<table>
<tr><th>Amended</th><th>Original</th><th>Remarks</th></tr>
<tr><td>
Table 2 Mechanical Properties for Base Metal of High Manganese Austenitic Steel
<table>
<tr><th>Minimum yield strength (N/mm^2)</th><th>Tensile strength (N/mm^2)</th><th>Minimum elongation (%)</th></tr>
<tr><td>Min. 400</td><td>800 - 970</td><td>Min. 22</td></tr>
</table>
Note:
Note the impact test requirements as specified in Table GF7.3, Part GF or Table N6.3, Part N of the Rules, as relevant.
</td><td></td><td></td></tr>
<tr><td>1.2.4 Welding of Metallic Materials and Non-destructive Testing
Welding of metallic materials and non-destructive testing are to be in accordance with Chapter 16, Part GF or Chapter 6, Part N of the Rules. See requirements as set out in 1.4. Minimum values of yield and tensile strength for welded conditions are to comply with Table 3 which specifies typical standards.</td><td>(Newly added)

(Newly added)</td><td>

Part 2 / 7</td></tr>
<tr><td>
Table 3 Typical Mechanical Properties for "As welded condition"
<table>
<tr><th colspan="3">Tensile properties</th></tr>
<tr><th>Minimum yield strength (N/mm^2)</th><th>Minimum tensile strength (N/mm^2)</th><th>Minimum elongation (%)</th></tr>
<tr><td>Min. 400</td><td>Min. 660</td><td>Min. 22</td></tr>
</table>
Note:
Note the impact test requirements as specified in Table GF7.3, Part GF or Table N6.3, Part N, as relevant.
</td><td></td><td></td></tr>
<tr><td>1.2.5 Material Testing and Acceptance Criteria
The material testing and applied acceptance criteria are to be in accordance with Chapter 16, Part GF or Chapter 6, Part N of the Rules and 1.4. Compliance is also to be documented in accordance with the material testing requirements and acceptance criteria outlined in 1.4.</td><td>(Newly added)
(Newly added)</td><td>
Part 2 / 8</td></tr>
<tr><td>1.2.6 Manufacturer Approval Scheme
Approval of the manufacturer is to be carried out in accordance with 16.1.1, Part GF or 6.2.2, Part N of the Rules and to the satisfaction of the Society.</td><td>(Newly added)
(Newly added)</td><td>
Part 2 / 9</td></tr>
</table>

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
1.3 Design Application	**(Newly added)**	
1.3.1 General	**(Newly added)**	
1 The relevant load conditions and design conditions are to be established in accordance with **6.4.12, Part GF** or **4.18, Part N of the Rules**.	(Newly added)	Part 3 / 10.1
2 For the selection of relevant safety factors for high manganese austenitic steels in **6.4.15, Part GF** and **4.21** to **4.23, Part N of the Rules**, the safety factors specified for "Austenitic Steels" are to be applied both for the base material and for as welded condition.	(Newly added)	
1.3.2 Ultimate Design Condition	**(Newly added)**	
It is to 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 in **1.2.3**. Note the limitation for under-matched welds defined in **16.3.3-5 (1), Part GF** or **4.18.1(3)(b), Part N of the Rules**.	(Newly added)	Part 3 / 10.2
1.3.3 Buckling Strength	**(Newly added)**	
1 Buckling strength analysis are to be carried out based on recognised standards. Functional loads as defined in **6.4.1-6, Part GF** or **4.3.4, Part N of the Rules** are to be considered. Note that design tolerances are to be considered where relevant and be included in the strength assessment as required in **16.4.2, Part GF** or **6.6.2-1, Part N of the Rules**.	(Newly added)	Part 3 / 10.3
2 It is to be noted that the acceptance criteria for the flooding load cases are different from other buckling load cases. Furthermore, the acceptance criteria for flooding load cases, as defined in **Part GF** and **Part N of the Rules**, are also different, as **6.4.1.-6 (3)(c), Part GF of the Rules**	(Newly added)	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

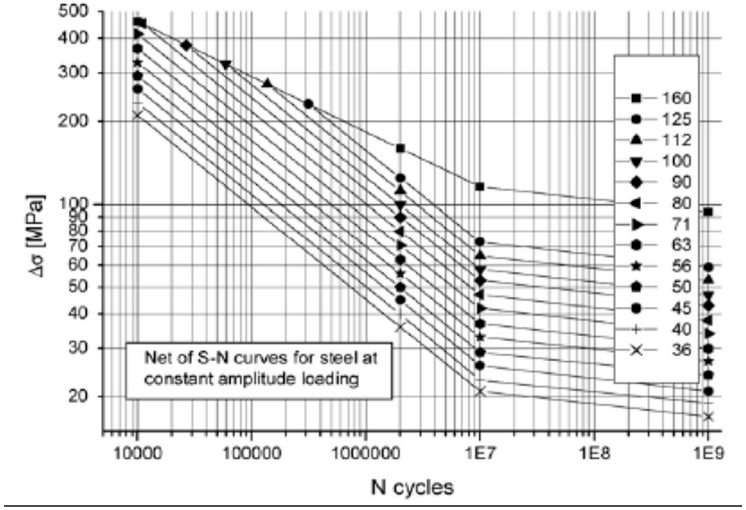
Amended	Original	Remarks
requires the tank to "keep its integrity after flooding to ensure safe evacuation of the ship", while **4.3.4(3)(c), Part N of the Rules** only refers to endangering the integrity of the ship's hull. **1.3.4 Fatigue Design Condition** The fatigue design curves for base material and for welded conditions have been documented as a comparison with recognised *S-N* curves, as provided by the *D*-curve defined in *DNVGL-RP-C203 Fatigue design of offshore steel structures* as reference in **Table 4** and *FAT* 90 defined in *IIW 1823-07 Recommendations for fatigue design of welded joints and components* provided by reference in **Fig. 1**. Fatigue tests have been carried out for butt welded joints only. However, for other details, the application of other *S-N* curves is to be to the satisfaction of the Society. **6.4.12 (2)(d), Part GF** and **4.18.2-4 (2), Part N of the Rules** specify the design *S-N* curves to be based on a 97.6% probability of survival corresponding to the mean-minus-two-standard-deviation curves of relevant experimental data up to final failure.	**(Newly added)** (Newly added)	Part 3 / 10.4

Amended	Original	Remarks

Table 4 (*S-N* curves in air): High manganese austenitic steel has been documented to be equal or better than the *D*-curve for as welded condition without stress concentration from any structural details

S-N curve	$N \le 10^7$ cycles		$N > 10^7$ cycles $\log\bar{a}_2$ $m_2 = 5.0$	Fatigue limit at 10^7 cycles (MPa) *)	Thickness exponent k	Structural stress concentration embedded in the detail (S-N class), see also equation (2.3.2)
	m_1	$\log\bar{a}_1$				
B1	4.0	15.117	17.146	106.97	0	
B2	4.0	14.885	16.856	93.59	0	
C	3.0	12.592	16.320	73.10	0.05	
C1	3.0	12.449	16.081	65.50	0.10	
C2	3.0	12.301	15.835	58.48	0.15	
D	3.0	12.164	15.606	52.63	0.20	1.00
E	3.0	12.010	15.350	46.78	0.20	1.13
F	3.0	11.855	15.091	41.52	0.25	1.27
F1	3.0	11.699	14.832	36.84	0.25	1.43
F3	3.0	11.546	14.576	32.75	0.25	1.61
G	3.0	11.398	14.330	29.24	0.25	1.80
W1	3.0	11.261	14.101	26.32	0.25	2.00
W2	3.0	11.107	13.845	23.39	0.25	2.25
W3	3.0	10.970	13.617	21.05	0.25	2.50
*) see also [2.11]						

Fig. 1 Reference *S-N* curve to high manganese austenitic steel is the *FAT* 90 curve. The *FAT* 90 curve is as welded condition without stress concentration from any structural details.

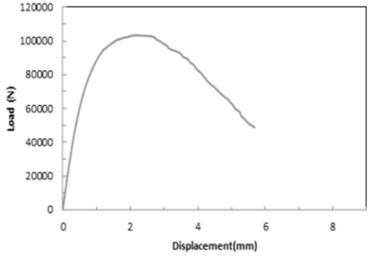


Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
1.3.5 Fracture Mechanics Analyses	**(Newly added)**	
1 For a cargo tank or fuel tank where a reduced secondary barrier is applied, fracture mechanics analysis is to be carried out in accordance with **Part GF** or **Part N of the Rules**.	(Newly added)	Part 3 / 10.5
2 Fracture toughness properties are to be expressed using recognized standards. Depending on the material, fracture toughness properties determined for loading rates similar to those expected in the tank system is to be required. The fatigue crack propagation rate properties are to be documented for the tank material and its welded joints for the relevant service conditions. These properties are to be expressed using a recognized fracture mechanics practice relating the fatigue crack propagation rate to the variation in stress intensity, ΔK, at the crack tip. The effect of stresses produced by static loads are to be taken into account when establishing the choice of fatigue crack propagation rate parameters.	(Newly added)	
3 Note that for the application where very high static load utilisation is relevant, alternative methods such as ductile fracture mechanic analyses are to be considered.	(Newly added)	
4 An example of a typical Crack Tip Opening Displacement (*CTOD*) value at cryogenic condition can be found in **Fig. 2**.	(Newly added)	
5 A fracture mechanics analysis is required for type *B* tanks based on **6.4.15.-2(3)(c), Part GF** and **4.22.4, Part N of the Rules** 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	(Newly added)	

Amended	Original	Remarks
considered suitable for the application.		

Fig. 2 Example of Typical Values for *CTOD* Test at -165°C

CTOD TEST REPORT										
				REPORT NO.						
Test Method Standard	ISO 12135/15653 Specimen No.			FCAW-2		Test Date				
Specimen configuration	Square Cross-Section 3 Point Bend(W=B)					Crack plane orientation		L-T		
Specimen Dimensions		1		2		3		Average		
	Thickness, B (mm)	40		40		40		40		
	Width, W (mm)	80		80		80		80		
	Span, S (mm)	320		Knife edge thickness, z (mm)				0		
Test Material	Young's Modulus of Elasticity, E (MPa)					182,000				
	YS(0.2% proof), σ_{YSP} (MPa)					474				
	TS, σ_{TSP} (MPa)					780				
	YS(0.2% proof), σ_{YS} (MPa)					655				
	Machined Notch (mm)	Width, N		Length, Lmc		Root Radius				
		4.7		32.4		0.1				
Test Condition	Temperature (℃)					-165				
Test Result										
	Crack Length to Tip of Fatigue Pre crack (mm)									
	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_0
	37.62	39.28	39.36	38.95	39.24	38.27	38.55	38.67	37.21	38.72
	a_0/W		0.54		Plastic Component of V, V_p (mm)				1.53	
	Critical CTOD (mm)									
	Type of CTOD				Total CTOD					
	δm				0.53					

1.3.6 Material Specification

1 Welding is to be carried out in accordance with **16.3, Part GF** or **6.5, Part N of the Rules**, and to the satisfaction

(Newly added)

(Newly added)

Part 3 / 10.6

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
of the Society. **2** For welding, the following points are to be considered: (1) For reducing the heat input during production: (a) Special attention is to be given to the first root pass when applying flux-cored arc welding (*FCAW*); (b) Welding heat input of maximum 30 *kJ*/*cm* is to be used as guidance for vertical position; (2) Distance between the weld and nozzle are to be kept to a minimum to reduce the oxygen content at the vicinity of the weld pool; (3) Weld gas composition of *FCAW* is normally to be an 4:1 mix of argon and carbon dioxide; and (4) Appropriate ventilation is to be provided to reduce exposure to hazardous welding fumes.	(Newly added)	As the welding heat input at flat welding position is generally smaller the vertical position, specify the requirements for the case for vertical position only.
1.3.7 Non-destructive Testing (*NDT*) The scope of *NDT* is to be as required by **16.3.6, Part GF** or **6.5.6, Part N of the Rules**. *NDT* procedures is to be in accordance with recognised standards to the satisfaction of the Society. For high manganese austenitic steel suitable *NDT* procedures normally applicable for austenitic steels is to be used.	**(Newly added)** (Newly added)	Part 3 / 10.7
1.3.8 Corrosion Resistance Appropriate measures with respect to corrosion protection and avoidance of a corrosive environment is to be taken. Particularly for *LNG* fuel tanks that may not be in operation, appropriate precautions are to be taken at all times to ensure that empty tanks are filled with inert gas or dry air when not in use.	**(Newly added)** (Newly added)	Part 3 / 10.8

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
1.4 Material Testing Requirements and Acceptance for High Manganese Austenitic Steel	**(Newly added)**	MSC.1/Circ.1599/Rev.3 APPENDIX 1
1.4.1 General	**(Newly added)**	
1 Test items and test acceptance criteria of base material are to comply with **Table 5**.	(Newly added)	
2 Test items and test acceptance criteria of welded condition including the heat affected zone (*HAZ*) are to comply with **Table 6**.	(Newly added)	

Amended	Original	Remarks

Table 5 Test Items and Test Acceptance Criteria of Base Material

Test items	Description	Acceptance criteria
1.1 Chemical composition	Recognised standards, such as *ASTM A*1106/*A*1106*M*-17 or *ISO* 21635:2018.	· In accordance with recognised standards as deemed appropriate by the Society.
1.2 Micrographic examination	This test is to be carried out in accordance with **16.2.4, Part GF** and **6.3.4, Part N of the Rules**, i.e. recognised standards such as *ASTM E*112.	· Microstructure to be reported (i.e., grain size/precipitations). · This test results are for reference purposes.
1.3 Tensile test	This test is to be carried out in accordance with **16.2.1, Part GF** and **6.3.1, Part N of the Rules**. Samples are to be taken from three heats of different compositions, both at room and cryogenic temperatures.	· The yield, tensile strength and elongation are to be in accordance with the recognised standard applied for chemical composition specified in **1.1.2-1**. such as *ASTM A*1106/*A*1106M-17 or *ISO* 21635:2018.
1.4 Charpy impact test	This test is to be carried out in accordance with **16.2.2, Part GF** and **6.3.2, Part N of the Rules**.	· In accordance with **Table GF7.3, Part GF** and **Table N6.3, Part N of the Rules**. In addition, impact tests are not to be omitted for high manganese austenitic steel.
1.5 Charpy impact test on strain aged specimens	Recognised standards, such as *ASTM E*23.	· In accordance with **Table GF7.3, Part GF** and **Table N6.3, Part N of the Rules**. In addition, impact tests are not to be omitted for high manganese austenitic steel.
1.6 Drop weight test	Recognised standards are to be applied, such as *ASTM E*208. Tests are to be carried out at −196°C.	· No break at test temperature as defined by the applied standard.
1.7 Fatigue test (*S-N* curve)	The basis for establishing *S-N* Curves is to be in accordance with **6.4.12 (2)(d), Part GF** and **4.18.2.-4 (2), Part N of the Rules**.	· *S-N* curves are to be minimum the fatigue strength as established curves for steel as defined in *IIW* or *DNVGL-RP-C*203.
1.8 *CTOD* (crack tip opening displacement) test	Recognised standards, such as *ASTM E*1820, *BS* 7448 or *ISO* 12135, are to be used for these purposes.	· *CTOD* minimum value is to be in accordance with design specification for testing at room and cryogenic temperatures as per design conditions. · As a guidance a minimum *CTOD* value of 0.2 *mm* is often required.
1.9 Corrosion test	These tests are to be carried out in accordance with	· In accordance with recognised standards

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended		Original	Remarks
	recognised standards as deemed appropriate by the Society.	as deemed appropriate by the Society.	
1.9.1 Intergranular corrosion test	This test is to be carried out in accordance with recognised standards, such as *ASTM A*262.	· In accordance with recognised standards as deemed appropriate by the Society.	
1.9.2 General corrosion test	This test is to be carried out in accordance with recognised standards, such as *ASTM G*31.	· In accordance with recognised standards as deemed appropriate by the Society.	
1.9.3 Stress corrosion cracking test	This test is to be carried out to the satisfaction of the Administration, in accordance with recognised standards, such as *ASTM G*36 and *ASTM G*123.	· In accordance with recognised standards as deemed appropriate by the Society.	
1.9.4 Corrosion test for ammonia compatibility	The additional test is to be carried out in accordance with the test requirements set out in **1.5** to qualify for ammonia service.	· In accordance with the acceptance criteria set out in **1.5**.	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks

Table 6 Test Items and Test Acceptance Criteria of Welded Condition

Test items	Description	Acceptance criteria
2.1 Micrographic examination	This test is to be carried out in accordance with **16.2.4, Part GF** and **6.3.4, Part N of the Rules**, i.e. recognised standards such as *ASTM E*112.	· Microstructure is to be reported for reference (i.e. grain size/precipitations). · This test results are for reference purposes.
2.2 Hardness test	This test is to be carried out in accordance with **16.2.4** and **16.3.3.-4 (5), Part GF**, **6.3.4** and **6.5.3-4(5), Part N of the Rules**, i.e. recognised standards such as *ISO* 6507-1.	· This test results are for reference purposes.
2.3 Cross-weld tensile test	This test is to be carried out in accordance with **16.3.3.-5 (1), Part GF** and **6.5.3.-5 (1), Part N of the Rules** as the relevant requirement for under-matched welds. Recognized standards, such as *ASTM E*8/*E*8*M*, are to be applied.	· In accordance with **6.4.12.(1)(a)iii), Part GF** and **4.18.1.(3)(b), Part N of the Rules**.
2.4 Charpy impact test	This test is to be carried out in accordance with **16.2.2** and **16.3.3.-4 (4), Part GF**, **6.3.2** and **6.5.3-4(4), Part N of the Rules**.	· In accordance with **16.3.3.-5 (3), Part GF** and **6.5.3.-5 (3), Part N of the Rules**.
2.5 *CTOD* (crack tip opening displacement) test	Recognised standards, such as *ASTM E*1820, *BS* 7448 or *ISO* 15653, are to be used for these purposes.	· *CTOD* minimum value is to be in accordance with design specification for testing at room and cryogenic temperatures as per design conditions. · For guidance, a minimum *CTOD* value of 0.2 *mm* is often required.
2.6 Ductile fracture toughness test, *JIc*	Recognised standards, such as *ASTM E*1820 or *ISO* 15653. The ductile fracture toughness test may be omitted at the discretion of the Administration.	· In accordance with recognized standards as deemed appropriate by the Society.
2.7 Bending test	This test is to be carried out in accordance with **16.2.3, Part GF** and **6.3.3, Part N of the Rules**.	· No fracture is to be acceptable after a 180° bend as required for welded material as per **16.3.3.-5 (2), Part GF** and **6.5.3.-5 (2), Part N of the Rules**.
2.8 Fatigue test (*S-N* curve)	The basis for establishing *S-N* Curves is to be in accordance with **6.4.12.(2)(d), Part GF** and **4.18.2.-4 (2), Part N of the Rules**.	· *S-N* curves are to be minimum the fatigue strength as established curves for steel as defined in *IIW* or *DNVGL-RP-C*203.
2.9 Corrosion test	These tests are to be carried out in accordance with recognised standards as deemed appropriate by the Society.	· In accordance with recognised standards as deemed appropriate by the Society.

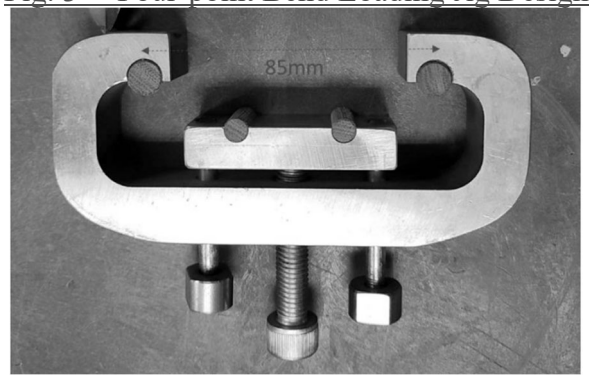
Amended	Original	Remarks
2.9.1 Intergranular corrosion test	This test is to be carried out in accordance with recognised standards, such as *ASTM A*262.	· In accordance with recognised standards as deemed appropriate by the Society.	
2.9.2 General corrosion test	This test is to be carried out in accordance with recognised standards, such as *ASTM G*31	· In accordance with recognised standards as deemed appropriate by the Society.	
2.9.3 Stress corrosion cracking test	This test is to be carried out to the satisfaction of the Administration, in accordance with recognised standards, such as *ASTM G*36, *ASTM G*58 and *ASTM G*123.	· In accordance with recognised standards as deemed appropriate by the Society.	
2.9.4 Corrosion test for ammonia compatibility	The additional test is to be carried out in accordance with the test requirements set out in **1.5** to qualify for ammonia service.	· In accordance with the acceptance criteria set out in **1.5**.	
1.5 Additional Compatibility Test Requirements for Ammonia Service	**(Newly added)**	MSC.1/Circ.1599/Rev.3 APPENDIX 2
1.5.1 General The test is to be carried out in accordance with a recognised standard such as *ASTM B*858. This standard is applicable to copper alloys and not specifically to high manganese austenitic steel. Consequently, the following additional non-standard test is to be performed:	**(Newly added)** (Newly added)	
1.5.2 Tests **1** Specimens are to be prepared in accordance with standards *ISO* 7539-2 and *ISO* 16540. The specimens are to be bent, prior to testing, using the four points bending test under constant strain. The total maximum strain of the sample is to be equal to the yield strength of the material at atmospheric temperature. Strain gauges are to be applied to measure the strain applied. In the case of welded specimens, strain gauges are to be applied to each side of the welded joint. The sample is to be constrained to maintain its form	**(Newly added)** (Newly added)	

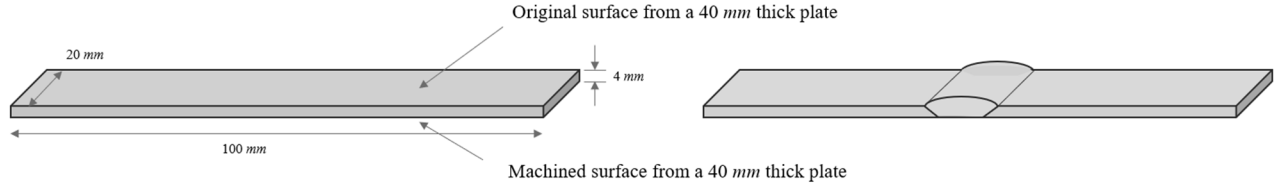
Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
during testing. The details are described in Specimen preparation.		
2 A total of 36 specimens (three welded and three base metals at each ammonia environment) are to each be immersed in the following four ammonia environments for a period of 30 days:	(Newly added)	
(1) liquid phase ammonia environments, obtained by cooling of ammonia at slightly lower temperature than the boiling temperature of ammonia e.g., -33.5 °C and at atmospheric pressure with the following liquid ammonia compositions:		
(a) 0.1 % weight of water and 2.5 *ppm* of oxygen; and		
(b) 2.5 *ppm* of oxygen;		
(2) gas phase ammonia environments at ambient temperature (25°C) and atmospheric pressure with the following gas ammonia compositions:		
(a) pure ammonia (99.99 %); and		
(b) 0.9 % volume of oxygen and 99.1 % volume of ammonia; and		
(3) gas phase ammonia environments at -20°C and atmospheric pressure with the following gas ammonia compositions:		
(a) pure ammonia (99.99 %); and		
(b) 0.9 % volume of oxygen and 99.1 % volume of ammonia.		
3 Stress corrosion cracking tests are to be performed in agreement with requirements of standards *ISO* 7539 and *ISO* 16540.	(Newly added)	
4 Test report is to provide all procedures, set up data, examinations, information about the environment, in agreement with standard *ISO* 16540 and include:	(Newly added)	
(1) the orientation, types, and dimensions of specimens;		

Amended	Original	Remarks
(2) description of materials: (a) chemistry and tensile properties of base plate; (b) chemistry and tensile properties of welding consumables; (c) type of welding, hardness of the weld metal and heat affected zones; (3) four points bending test set up data; (4) target stress and applied deflection; (5) strain measurement procedures; (6) loading procedures; and (7) test environment (temperature, water and oxygen content, and *pH*). **1.5.3 Test Acceptance Criteria** After immersion, all specimens are to be examined for stress corrosion cracking under an optical microscope with proper magnification. The location and the number of cracks is to be specified, and a fluorescent penetration test performed to confirm the results as necessary. For welded joints, the location of cracks is to be described as located in the base metal, weldment or *HAZ*. If no superficial crack is observed, a longitudinal cut is to be done at two different locations and a cross-section examination with proper magnification is to be performed. The presence of any corrosion pitting and the maximum depth is to be reported. The results are to be approved by the Society. **1.5.4 Loading Jig** The loading jig made of corrosion resistant alloys with spacing between outer rollers of 85 *mm* shown in **Fig.3** is to be used to apply a constant deflection to the specimen. The specimen is electrically isolated from the ceramic rollers in order to avoid undesirable galvanic corrosion.	**(Newly added)** (Newly added) **(Newly added)** (Newly added)	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
Fig. 3 Four-point Bend Loading Jig Design 	(Newly added)	
1.5.5 Specimen Preparation **1** The specimens are machined from a 40 *mm* thick hot rolled plate and are not subjected to post-weld heat treatment. The outer radius of the specimen subject to bending is the original surface of the hot rolled plate. They are bent prior to testing and surface would be exposed to ammonia in a tank is not machined.	**(Newly added)** (Newly added)	
2 Four-point bend specimens are flat strips of uniform rectangular cross section and uniform thickness except in the case of testing welded specimens with one face in the as-welded condition as shown in **Fig.4**. The original surface from a 40 *mm* hot rolled plate (cap bead in case of welded specimen) is the one to be observed. For weldments, the weld bead to be tested is the weld cap.	(Newly added)	

Amended	Original	Remarks
Fig. 4 Four-point Bend Specimens (Parent Specimen and As-welded Specimen)  		
1.5.6 Strain Gauging **1** Dial gauge is to be attached for measurement of deflection at the center of the face in tension. The loading of the specimen is such that it reaches to the required yield strength level and then the specimen is constrained to maintain its form during testing. The amount of deflection, y, is set as the formula below complying with *ISO* 16540. $$Y = \frac{(3H^2 - 4A^2)\sigma}{12Et}$$	**(Newly added)** (Newly added)	
2 Where σ is the required stress (yield strength in this case), E is the modulus of elasticity, t is the specimen thickness, A is the distance between the inner and outer supports, and H is the distance between the outer supports. Prior to four-point bending, a uniaxial tensile test of a 40 *mm* thick plate will be performed to determine the yield strength to be applied for the calculation of the amount of deflection required. For the simplicity of the welded specimen testing, the same amount of the deflection as for the parent plate is to be set out.	(Newly added)	

Amended-Original Requirements Comparison Table (Application of High Manganese Austenitic Steel for Cryogenic Service)

Amended	Original	Remarks
GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE **Annex 1.3 Manufacturing Approval Schemes for High Manganese Austenitic Steels** **1.4 Approval Tests** **1.4.3 Test Details** **4** Corrosion tests for ammonia compatibility carried out at the request of the manufacturer are to comply with **1.5, Annex 6.4.1-1., Part N of the Rules**.	**GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE** **Annex 1.3 Manufacturing Approval Schemes for High Manganese Austenitic Steels** **1.4 Approval Tests** **1.4.3 Test Details** **4** Corrosion tests for ammonia compatibility carried out at the request of the manufacturer are to comply with *MSC*.1/*Circ*.1599/*Rev*.2.	
EFFECTIVE DATE AND APPLICATION **1.** The effective date of the amendments is 1 January 2026.		