

Technical Specification

Steel_14404_grade_316L_Plates_less 5 mm

Material specification for 316L(N) thin lids for hot isostatic pressing manufacture.

Approval Process			
	Name	Action	Affiliation
Author	Edwards P.	25 Oct 2022:signed	IO/DG/ENG/EDD/INC/BKT
Co-Authors			
Reviewers	Gicquel S.	30 Nov 2022:recommended	IO/DG/ENG/EDD/INC/BKT
	Hunt R.	18 Nov 2022:recommended	IO/DG/ENG/EDD/INC/BKT
	Hyun Y.- J.*	08 Nov 2022:recommended	IO/DG/SQD/QMD
	Kim G. *	08 Nov 2022:recommended	IO/DG/ENG/CIO/IEA
Approver	Escourbiac F.	12 Dec 2022:approved	IO/DG/ENG/EDD/INC
Document Security: Internal Use RO: Barabash Vladimir			
Read Access	LG: Blanket add right persons, LG: Blanket Materials, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: IDM_Controller, AD: Auditors, AD: ITER Management Assessor, project administrator, RO		

<i>Change Log</i>			
Steel_14404_grade_316L_Plates_less 5 mm (U8M5ZZ)			
<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v0.0	In Work	14 Dec 2016	
v1.0	Approved	20 Dec 2016	<p>First upload.</p> <p>This is the material specification for steel thin lid (internal to parts) for HIP manufacturing route.</p> <p>This specification is first drafted by the material expert (VBH), and reviewed and amended by the manufacturer (F4E).</p> <p>The Co content is relaxed</p> <p>Material quantity is estimated here : Estimates of thin lid quantity and wetted area (U8M8U6 v1.0) (current)</p>
v2.0	Approved	25 Oct 2022	<p>Update includes:</p> <ul style="list-style-type: none"> • Conversion to DOORS; • Option of air quenching; • Determination of resistance to intergranular corrosion; • Clarification of Boron limits apply to welding applications only.

Table of Contents

1	SCOPE.....	2
2	REFERENCED DOCUMENTS.....	2
3	INFORMATION TO BE SUPPLIED BY THE PURCHASER.....	2
4	STEELMAKING PROCESS.....	3
5	DELIVERY CONDITIONS	3
6	CHEMICAL COMPOSITION	3
7	STRUCTURE AND GRAIN SIZE	4
8	MECHANICAL PROPERTIES	4
8.1	REQUIRED VALUES	4
8.2	SAMPLING	4
8.3	TEST METHODS	4
9	VISUAL EXAMINATION	4
10	DIMENSIONAL CHECK	5
11	EXTEND OF TESTING	5
12	MARKING	5
13	CLEANLINESS-PACKAGING-TRANSPORTATION.....	5
14	DOCUMENTATION AND TEST REPORT	6
15	QUALITY SYSTEM REQUIREMENTS	6
16	ACCESS OF INSPECTORS	6

1 SCOPE

- [I] This specification covers grade **X2CrNiMo17-12-2 [No. 1.4404]** (similar to ASTM steel 316L, UNS Number S31603) austenitic stainless steel cold rolled plates/strips with thickness less than 5 mm for the First Wall for the ITER Blanket System.
- [II] This document is based on standard EN 10028-7:2007 Flat products made of steels for pressure purposes, Part 7: Stainless steels with additional requirements established for the ITER application.
- [II] The supply covers the following items:
- Manufacture of the total quantity of stainless steel plates/strips grade X2CrNiMo17-12- 2 [No. 1.4404];
 - Organization of quality at works;
 - Elaboration of all procedures required for the manufacturing, inspection (including analysis), packaging, storage and delivery;
 - Time schedules and documentation;
 - To perform all the inspections and tests during and after manufacturing envisaged in this specification;
 - Storage, packaging and delivery.

2 REFERENCED DOCUMENTS

[MS thin plate -12-R] The following Codes and Standards shall be referred to in this specification (latest editions of standards shall be used):

- EN 10028-7:2007 Flat products made of steels for pressure purposes, Part 7: Stainless steels;
- EN 10028-1:2007, Flat products made of steels for pressure purposes — Part 1: General requirements;

And all applicable standards referred in EN 10028-7:2007 and EN 10028-1.

- EN ISO 6892-1:2009, Metallic materials — Tensile testing — Part 1: Method of test at room temperature;
- EN ISO 6892-2:2011, Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature;
- EN ISO 643: 2012 Steels - Micrographic determination of the apparent grain size;
- EN 10204: 2004 Metallic products: Type of inspection documents;
- EN ISO 3651-2 Determination of resistance to intergranular corrosion of stainless steels.

[I] In case of change of edition year or issuing standard which supersede above mentioned, the use of new standards is allowed only in case of demonstration of equivalency with prior written IO approval

[II] Other equivalent national or international standards and codes proposed by the supplier may be acceptable with prior written IO approval, provided conformity assessment to all criteria is satisfied.

3 INFORMATION TO BE SUPPLIED BY THE PURCHASER

[MS thin plate -24-R] The complete designation for ordering a product according to this document shall contain the information described in Chapter 7 of standard EN 10028-7.

[MS thin plate -25-R] The purchaser shall specify a surface finish. The surface condition shall be defined in the purchase order.

[MS thin plate -26-R] Test unit: Same cast, same nominal thickness $\pm 10\%$, same heat treatment batch. Test unit shall not exceed 2000 kg in weight.

4 STEELMAKING PROCESS

[MS thin plate -28-R] The steel shall be made using electric furnace or by any other technically equivalent process and refined by argon-oxygen decarburization (AOD) or vacuum oxygen de-carbonization (VOD).

5 DELIVERY CONDITIONS

[MS thin plate -30-R] Plates/strips shall be delivered in the solution heat treated condition. Solution heat treatment shall consist of holding at a temperature between 1030°C and 1110°C followed by water cooling.

[MS thin plate -31-R] In the event of air quenching, the resistance to intergranular corrosion shall be determined according to EN ISO 3651-2.

[MS thin plate -32-R] Plates/strips shall be delivered after cold-rolling and solution annealing in pickled and passivated condition.

6 CHEMICAL COMPOSITION

[MS thin plate -34-R] The Steelmaker shall supply a ladle (cast) analysis certified by the Mill Manager or his duly accredited representative. The choice of a suitable physical or chemical analytical method for the product analysis shall be at the discretion of the manufacturer. The chemical composition determined by ladle (cast) and product analyses, shall comply with the requirements given in Table 1.

[MS thin plate -35-R] The product analysis may deviate from the limiting values for the cast analysis as described in EN 10028-7. For the product analysis one sample per cast (heat) shall be taken for determining the elements indicated with numerical values in Table 1.

Table 1. Chemical composition requirements

Element	Alloying elements and impurities, wt. %	
	Min	Max
Fe		
C		0.030
Si		1.00
Mn		2.00
P		0.045
S		0.015
Cr	16.5	18.5
Mo	2.00	2.50
Ni	10.0	13.0
N		0.10
Co ¹		0.20
Ta ¹		0.01
Nb ¹		0.10
B ²		0.0018

[I] ¹ Radiation protection requirements

[I] ² Requirement only applies to welding applications

7 STRUCTURE AND GRAIN SIZE

[MS thin plate -40-R] A micrographic examination, with photographs at 200X magnification, shall be performed parallel to the maximum direction of extension. The structure must be homogeneous.

[MS thin plate -41-R] The grain size number determined in accordance EN ISO 643 shall not be less than 3. The presence of a few grains of index 1 or 2 is tolerated. Test shall be performed per test unit.

8 MECHANICAL PROPERTIES

8.1 Required values

[MS thin plate -44-R] The material shall conform to the mechanical property requirements specified in Table 2 in solution-annealed condition.

Table 2. Mechanical properties

Test Temperature (°C)	Tensile Strength, (R _m) (MPa)	Yield Strength (R _{p0.2%}) min (MPa)	Elongation A, min (%)
Room	530 - 680	240	40
250	385 min	127	-

The yield strength at 1% offset (at RT and elevated temperature shall be recorded for information purposes.

8.2 Sampling

[MS thin plate -48-R] Sampling and sample preparation shall be in accordance with the requirements of standard EN 10028-1.

Specimens shall be cut in direction transvers to main rolling direction.

8.3 Test methods

[MS thin plate -51-R] The test shall be performed on specimens taken from samples subjected to no heat treatment after sampling.

[MS thin plate -52-R] Frequency of testing shall be according to EN 10028-1.

[MS thin plate -53-R] Test methods – for details refer to requirements of EN 10028-1 Chapter 11 and the following standards:

- **[MS thin plate -54-R]** EN ISO 6892-1:2009, Metallic materials — Tensile testing — Part 1: Method of test at room temperature;
- **[MS thin plate -55-R]** EN ISO 6892-2:2011, Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature.

[MS thin plate -56-R] Re-tests (if any) shall be according to EN 10028-1.

9 VISUAL EXAMINATION

[MS thin plate -58-R] Both faces of the plates/strips shall be visually examined and should have plane, uniform surfaces free of ripples, pitting, suck-backs, cracks, blisters, inclusions or foreign bodies.

10 DIMENSIONAL CHECK

[MS thin plate -60-R] The dimensions and tolerances shall be checked in accordance with the requirements of purchase order (see EN 10028-1, Chapter 4). The main dimensions shall be recorded.

11 EXTEND OF TESTING

[MS thin plate -62-R] Table 3 specifies the required tests that shall be undertaken.

Table 3. Scope of Mechanical Testing

[I] Test	Extend of test	Number of test pieces per test
Chemical analysis - cast	1 per cast	
Chemical analysis - product	1 per cast	
Tensile test at room temperature	Per test unit	1
Tensile test at elevated temperature	Per test unit	1
Structure and grain size	Per test unit	1
Visual inspection	Each product	
Dimensional inspection	Each product	

12 MARKING

[MS thin plate -66-R] The Supplier shall specify the identification and marking method used, in compliance with requirements EN 10028-1. Marking shall include:

- Manufacturer name, trade mark or logo;
- Steel name or number;
- Type of finish;
- Identification number (identification shall allow the product(s) to be related to the relevant inspection certificate.);
- Nominal thickness;
- Direction of rolling;
- Customer's order number.

13 CLEANLINESS-PACKAGING-TRANSPORTATION

[I] Requirements are specified in the purchase order.

14 DOCUMENTATION AND TEST REPORT

[MS thin plate -77-R] The Supplier shall provide the Inspection Certificate type 3.1 in accordance with EN 10204:2004.

[MS thin plate -78-R] The following reports shall be drawn up by the Supplier after each individual test and prior to the delivery of the part:

- Ladle (cast) and product analyses;
- Melting process method;
- Records of micrographic examination and grain size;
- Results of mechanical property tests;
- Results of visual examination;
- Dimensional check.

These reports shall include:

- Material designation and marking;
- The cast (heat) number and part reference number;
- Identification of the Supplier;
- Identification of the purchase order number;
- Test and retest results together with required values.

[MS thin plate -90-R] All documents shall be in the English language and all measures shall be given in the metric system SI. Each document shall be provided as an electronic file in PDF format.

15 QUALITY SYSTEM REQUIREMENTS

[MS thin plate -92-R] The quality organisation shall comply with the requirements defined in Annex A of the Procurement Arrangement as specified in the contract and purchase order.

16 ACCESS OF INSPECTORS

[MS thin plate -94-R] Representatives of the IO, DA and/or Third Party Inspectors (TPI) shall at reasonable notice have the right to check at the Supplier's premises or at those of the sub-contractor the progress and status of the work forming the subject matter of the procurement and to witness specified tests. The supplier shall hold at the disposal of the IO, DA and TPI and make available to them such information and documents as are necessary to determine the progress and status of the work.

- End of the Document -