

Informative Appendix

Sample of Technical Specification for Material Procurement

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Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	1 of 9

TECHNICAL SPECIFICATION FOR THE SUPPLY OF CRYOSTAT COMPONENTS TO THE ITER ORGANISATION

INFORMATIVE APPENDIX APB1_E

SAMPLE OF TECHNICAL SPECIFICATION FOR MATERIAL PROCUREMENT

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Informative Appendix
Sample of Technical Specification for Material
Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	2 of 9

Specification for the supply of dual marked type
304/304L austenitic stainless steel plates for the ITER
Cryostat

Table of Contents

1. Scope	3
2. Referenced documents	3
2.1 Design and Construction Code	3
2.2 ASTM and EN Standards.....	3
3. Melting process.....	4
4. Requirements	4
4.1 Chemical composition.....	4
4.2 Structure and grain size	5
4.3 Non metallic inclusions	5
4.4 Magnetic permeability	5
4.5 Delivery condition.....	5
5. Mechanical properties	6
6. Surface examination – surface defects.....	6
7. Volumetric examination	7
8. Dimensional check - tolerances	7
9. Summary and Frequency of Required Tests	7
10. Marking	8
11. Material test report and certification	8
12. Packing	9
13. Quality system requirements.....	9
14. Access of Inspectors.....	9

Informative Appendix

Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	3 of 9

1. Scope

This specification covers dual marked type 304//304L austenitic stainless steel plates for the ITER cryostat.

This steel is conventional dual marked (see ASME 2010, Section II Part D, Mandatory Appendix 7- Guidelines on multiple marking of materials) type 304/304L austenitic steel type (as defined in standard ASTM A240/A240M) with additional requirements which are specified for application for the ITER cryostat.

The supply covers the following items:

- a) Manufacture of the total quantity of stainless steel plates.
- b) Organisation of quality at works. Elaboration of all procedures required for the manufacturing, inspection (including analyses), packaging, storage and delivery. Time schedules and documentation.
- c) To perform all the inspections and tests during and after manufacturing envisaged in this specification.
- d) Storage, packaging and delivery.

2. Referenced documents

The following Codes and Standards shall be referred to in this specification:

2.1 Design and Construction Code

ASME Section VIII, Division 2, Alternative Rules, Edition 2010

ASME Section V, Article 5 Ultrasonic Examination Methods for Materials, Edition 2010

ASME Section V, Article 6 Liquid Penetrant Examination, Edition 2010

ASME Section V, Article 9 Visual Examination, Edition 2010

ASME Section II, Edition 2010

2.2 ASTM and EN Standards

ASTM A 240/A240M - 04 Specification for Chromium and Chromium-nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and For General Applications

ASTM A 370-05 Test Methods and Definitions for Mechanical Testing of Steel Products

Informative Appendix

Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	4 of 9

ASTM A 480/A 480M-03c	Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM E 112 (96(2004)e2	Test Methods for Determining Average Grain Size
ASTM E 45-05 (2005)	Standard test methods for determining the inclusion content of steel
ASTM A342-04	Standard Test Methods for Permeability of Feebly Magnetic Materials
EN 10204: 2004	Metallic products: Type of inspection documents

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

3. Melting process

The steel shall be made using an electric furnace or by any other technically equivalent process.

For vacuum application and to meet requirements for structure and inclusion contents in this specification the melting of steel should be completed by a suitable secondary metallurgy treatment. The refining processes are argon-oxygen decarburization (AOD), vacuum oxygen de-carbonised (VOD).

Definitions:

A heat is a single melt of material used to cast one or several ingots.

A lot for product analysis and other tests shall consist of plates with the same geometric shape and production route made from the same ingot.

4. Requirements

4.1 Chemical composition

The steel shall conform to the requirements as to chemical composition specified in Table 1, and shall conform to applicable requirements specified in ASTM A 480/A 480M. Heat analysis and product analysis of one plate per lot shall be reported.

Table 1 Chemical composition requirements, %

Type 304/304L	
Element	Max or range
C	0.030
Mn	2.00
P	0.030

Informative Appendix

Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	5 of 9

S	0.015
Si	0.75
Cr	18.0 - 20.0
Ni	8.0 - 12.0
N	0.10
Co	≤ 0.10
Nb	0.10
B	0.0018

4.2 Structure and grain size

A micrographic examination with photographs must be made parallel to the rolling direction of each rolled plate. The structure must be homogeneous.

The grain size number determined in accordance with ASTM E112 shall be greater than 2. The grain size homogeneity shall be ± 1 around the true average value. The presence of a few grains of index 1 or 0 is tolerated.

4.3 Non metallic inclusions

Amount and definition shall meet standard ASTM E45-05.

- Micro inclusions (indigenous inclusions detectable by microscopical test methods): method D is applicable. Severity level number shall be at most 2 for types A, B, C and D. The tolerance for acceptance may be a half-class above the set limit to the extent of 2% of the fields counted.
- Macro inclusions (exogenous inclusions from entrapped slag or refractories): they are strictly forbidden and are cause of rejection.

4.4 Magnetic permeability

The relative magnetic permeability of the finished plates shall be measured at room temperature after solution annealing. The value measured shall be lower than 1.03 for fields of over 80000A/m (1000Oe) as per Test method 2 or measured with a low μ permeability indicator as per method 3 of ASTM A342.

4.5 Delivery condition

The plates shall be delivered in a solution heat treated, pickled and passivated condition, equivalent to no. 1 Finish in accordance with ASTM A480/480M.

Informative Appendix

Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	6 of 9

Solution heat treatment shall consist of maintaining a temperature of min of 1040°C followed by water cooling.

5. Mechanical properties

The material shall conform to the mechanical properties specified in Table 2. Test shall be performed in accordance with ASTM A 370.

Table 2. Mechanical test requirements

Test Temperature, °C	Tensile Strength, min, MPa	Yield Strength (0.2%), min, MPa	Elongation, in 50 mm min, %	Hardness*, max	
				Brinell	Rockwell B
Room	515	205	40	201	92

* Either Brinell or Rockwell B Hardness is permissible.

Tension test specimens shall be taken from finished material and shall be selected in transverse directions to the final rolling direction. Retest and retreatment is allowed as described in ASTM A 480/A 480M. Retreatment conditions shall be described in the test report.

Not more than one retreatment shall be allowed.

6. Surface examination – surface defects

All plates shall be visually examined in accordance with requirements of ASME Section V, Article 9 Visual Examination. Their surfaces shall be plain, uniform and free from wrinkles, buckles, blowholes, tears, cracks and inclusions.

After cutting to the delivery dimensions, the edges shall be visually examined. The absence of cleavage or lamination (for example comprised by a fine layer of inclusions drawn out during rolling) shall be checked. If in doubt, a liquid penetrant examination shall be performed in accordance with ASME Section V, Article 6 Liquid Penetrant Examination and requirements of the ITER Vacuum Handbook.

Informative Appendix
Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	7 of 9

7. Volumetric examination

All plates shall be examined.

All plates shall be ultrasonically examined in accordance with the requirements of SA-578. The acceptance standard shall be Level B of SA-578 as indicated in ASME Sec VIII Div 2.

8. Dimensional check - tolerances

The dimensions of the plates shall comply with requirements of the purchase order. The tolerances for length, width, flatness shall comply with ASTM A480/480M.

The roughness Ra shall be less than 12.5 μm .

Under thickness shall not be allowed for all the plates used in the Cryostat.

Method of roughness testing shall be proposed by Supplier and agreed with DA and IO.

9. Summary and Frequency of Required Tests

The number of tensile tests is specified in Table 3.

Table 3 Frequency of tests

Test		Frequency of test	Comments
Chemical composition		1 test per heat 1 test per lot	
Mechanical properties		2 tests from 1 plate per lot	Full thickness samples (2 total) taken from beginning and end of plate; not less than thickness from edge, long direction of specimen is perpendicular to final rolling direction.
Hardness test		1 test per lot	
Magnetic permeability		1 test per lot	
Structure	Photographs	1 test per lot	
	Grain size	1 test per lot	
	Non-metallic inclusions	Per each lot	
Surface examination conditions		Per each plate	
Ultrasonic examination		Per each plate	See specification for details
Dimensional check and roughness		Per each plate	In accordance with drawing

Informative Appendix
Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	8 of 9

10. Marking

The Supplier shall specify the identification and marking method used.

Each plate shall be legibly identified with the following information:

- manufacturer name or symbol,
- plate number or unique identification number related to quality history,
- grade of material,
- heat number,
- lot number.

11. Material test report and certification

The Supplier shall provide the Inspection Certificate type 3.1 in accordance with EN 10204:2004. *Material Test Report and certificate have to be provided to the Purchaser prior to delivery. Material and certification shall be in compliance with this specification. Material cannot be accepted if it does not comply with this specification.*

Certification

A certificate, that the material was manufactured, sampled, tested and inspected in accordance with requirements of the material specification and has been found to meet those requirements shall be supplied to the purchaser.

The following reports shall be drawn up by the Supplier after each individual test and prior to the delivery of the part:

- heat and product analyses,
- melting process method,
- records of micrographic examination, inclusions and grain size,
- magnetic permeability,
- results of mechanical property tests,
- non-destructive examination,
- dimensional check and roughness.

These reports shall include:

- material designation and marking,
- the heat number and part reference number,
- identification of the Supplier,
- identification of the purchase order number,
- test and retest results together with required values,
- Packaging data.

Informative Appendix
Sample of Technical Specification for Material Procurement

IDM #	ITER_D_45N2WS
Version	3.0
Date	30/03/2011
Ref.#	APB1_E
Page	9 of 9

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.

12. Packing

The packaging of the plates and forgings shall be strong enough to preserve the surface condition and evenness during transport and shall comply with ASTM A700.

13. Quality system requirements

The quality organisation shall comply with the requirements defined in Part 1 of the Tender.

14. Access of Inspectors

The access of Inspectors shall comply with the requirements defined in Part 1 of the Tender.