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EXTERNAL REFERENCE / VERSION

Technical Requirements Specification

Steel 316L Grade A4-80 for non-DT in-vessel usage

This specification covers the supply of Grade 316L steel (Grade A4-80) for fasteners and nuts for non-DT in-vessel usage.

Approval Process			
	Name	*Action*	*Job Title / Affiliation*
Signatory	**Bao L.**	**23 Apr 2026:signed**	**First Wall Engineer**
Co-signatories			
Reviewers	**Rem M.**	**24 Apr 2026:recommended (Short Cycle)**	**Quality Engineer**
Previous Versions Reviews	**Barabash V.** **Kim G.**	**15 Apr 2026:recommended v1.4** **15 Apr 2026:recommended v1.4**	**IO/DG/ESD/NSE** **IO/DG/ESD/IMES**
Approver	**Hunt R.**	**27 Apr 2026:approved**	**Project Leader**
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Read Access	**LG: Blanket add right persons, LG: Blanket Assembly Section Team, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: OBS - Configuration Management Section (CMS), AD: External Management Advisory Board, AD: IDM_Controller, AD: OBS - Configuration Management Section (CMS) - EXT, AD: N...**		

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Change Log			
Steel 316L Grade A4-80 for non-DT in-vessel usage (3FR65U)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v0.0	In Work	18 Jun 2020	
v1.0	In Work	23 Jun 2020	First uploading
v1.1	Signed	23 Jun 2020	Conversion form word to pdf was not correct
v1.2	Approved	23 Jun 2020	Second upload as pdf
v1.3	Signed	03 Mar 2026	Update scope for non DT in-vessel usage (VQC-1B application)
v1.4	Signed	13 Apr 2026	Add impurity requirements for Co, Ta and Nb in Table 1 Chemical Composition
v1.5	Signed	22 Apr 2026	Incorporating QARO's comments
v1.6	Approved	23 Apr 2026	Incorporating QARO's comments on Quality Assurance Requirements

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1 Scope

This specification covers grade **A4-80 stainless steel fasteners and nuts** for non DT in-vessel usage (VQC-1B application as per ITER Vacuum Handbook, ITER_D_2EZ9UM).

This specification is based on the European Standard EN ISO 3506-1:2009 (for fasteners), EN ISO 3506-2:2009 (for nuts) and includes some additional requirements established for the ITER application.

Fasteners and nuts shall conform to the requirements of Standard EN ISO 3506-1:2009 and EN ISO 3506-2:2009, respectively. These requirements include marking, finish, test program, test methods, and others.

The amount of the fasteners and nuts to be procured shall be specified by the Contractor and shall include appropriate contingency to face unexpected difficulties, to remake rejected parts and to repair parts with insufficient quality.

Note: The term “fasteners” is used when bolts, screws and studs are considered all together.

The supply covers the following items:

- Manufacture of the total quantity of stainless steel fasteners and nuts with grade A4-80.
- Organization of quality at works.
- Elaboration of all procedures required for the manufacturing, inspection (including analyses), 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.

Item	Grade	Applicable Size	Applied Spec.
Fasteners (Bolts, Screws and studs)	A4-80	Less than M40 (nominal thread diameter $d \leq 39$ mm)	EN ISO 3506-1:2009
Nuts	A4-80	Less than M40 (nominal thread diameter $d \leq 39$ mm)	EN ISO 3506-2:2009

2 Referenced documents

The following Codes and Standards shall be referred to in this specification (latest editions of standards shall be used):

- EN ISO 3506-1:2009 Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs
- EN ISO 3506-1:2009 Mechanical properties of corrosion-resistant stainless steel fasteners – Part 2: Nuts

- EN 10204:2004 Metallic products: Type of inspection documents.
- ASTM A342/A342M-14 Standard test methods for permeability of weakly Magnetic Materials
- ISO 898-2:2013 Mechanical properties of fasteners made of carbon steel and alloy steel – Part 2: Nuts with specified property classes – Coarse thread and fine pitch thread
- ISO 898-6:2010 Mechanical properties of fasteners made of carbon steel and alloy steel – Part 6: Nuts with specified proof load values – Fine pitch thread
- EN 13018:2016 Non-destructive testing – Visual testing – General principles
- EN ISO 16426:2002 Fasteners – Quality assurance system
- EN ISO 9712:2012 Non-destructive testing. Qualification and certification of NDT personnel
- ISO 16048:2003 Passivation of corrosion resistant stainless steel fasteners

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.

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

Following documents are applicable for implementation of the contract:

- ITER_D_82MXQK – General Management Specification for Service and Supply
- ITER_D_22MFG4 – Quality Requirements for IO Performers
- ITER_D_2LZJHB – Procedure for the management of Deviation Request
- ITER_D_22F53X – MQP L2 Procedure for Management of Nonconformities

3 Information to be presented by the purchaser

Mandatory information is presented in EN ISO 3506-1:2009 and EN ISO 3506-2:2009.
Additional requirements are presented in this specification.
The nominal dimensions and tolerances on dimensions shall be in accordance with the relevant dimensional standards listed in EN ISO 3506-1 and EN ISO 3506-2.

4 Melting process

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

5 Delivery conditions

The purchaser shall specify in his enquiry and order the delivery condition required. The fasteners and nuts in accordance with ISO 3506 shall be supplied clean and bright.

Fasteners and nuts shall be supplied after passivation in accordance with ISO 16048:2003.

For the fasteners manufactured, the Process for making the Threads shall be done specifically by thread rolling operation.
The surface condition shall be plain during delivery.

6 Chemical composition

The material shall conform to the chemical composition requirements given in Table 1.

Table 1 Chemical Composition

Element	Alloying elements and impurities, wt. %	
	Min	Max
Fe	balance	
C		0.080
Si		1.00
Mn		2.00
P		0.045
S		0.03
Cr	16.00	18.50
Mo	2.00	3.00
Ni	10.00	15.00
Cu		4.00
Co*		0.2
Ta*		0.1
Nb*		0.1

* Radioprotection requirement

7 Magnetic permeability

The relative magnetic permeability of the finished fasteners shall be measured at room temperature. The value measured shall be lower than or equal to 1.03. Test shall be performed as per ASTM A342. One test per batch/lot is required.

Alternatively, it is allowed to use permeability-meter apparatus (Foerster, Ferromaster, etc.). In this case, the type, trademark and relevance (for this material, thickness, shape, etc.) of the apparatus shall be included in the Technical Manufacturing Program. The type, trademark and copy of its calibration certificate shall be provided with the material certificate.

8 Mechanical properties

8.1 Required values

The fasteners shall conform to the mechanical property requirements specified in Table 2, which is given in Table 2 and Table 4 of the standard EN ISO 3506-1:2009.

Table 2 Mechanical properties for bolts, screws and studs

	Tensile properties			
Test Temp. (°C)	**Tensile Strength *Rm*[a], min (MPa)**	**Yield Strength *Rp0.2*[a], min (MPa)**	**Elongation *A*[b], min (mm)**	**Breaking torque *MB*, min (Nm)**
Room	800	600	0.3*d*	depend on Thread, see Table 4 of EN ISO 3506-1

[a] The tensile stress is calculated on the stress area (See Annex A in EN ISO 3506-1).

[b] This is determined according to 7.2.4 of EN ISO 3506-1, on the actual screw length and not on a prepared test piece.

Symbol; *d*: nominal thread diameter

The nuts shall conform to the mechanical property requirements specified in Table 3, which is given in Table 2 of the standard EN ISO 3506-2:2009.

Table 3 Mechanical property for nuts

	Mechanical property
Test Temperature (°C)	**Stress under proof load S_p, min (MPa) Nuts with $m \geq 0.8D$**
Room	800

Symbols; *m*: height of the nut (nominal value), *D*: nominal thread diameter

8.2 Test programme and test methods

The test programme and test methods of mechanical properties for fasteners shall be in accordance with EN ISO 3506-1:2009.
The test procedure and criterial of the proof load for nuts shall be in accordance with ISO 898-2 and ISO 898-6, which are given in EN ISO 3506-2:2009.

9 Visual examination

All surfaces shall be thoroughly examined during all phases of production and machining to check the soundness of metal.

100% of the external surfaces shall be visually examined as per EN 13018.

The testing and inspection personnel as well as their supervisors shall be qualified and certified in accordance with EN ISO 9712. Certificates of Inspectors shall be provided together with the material certificate

10 Dimensional check

The dimensions and tolerances shall be checked in accordance with the requirements of purchase order.
The main dimensions shall be recorded.

11 Marking

The Manufacturer shall specify the identification and marking method used, in compliance with EN ISO 3506-1:2009 and EN ISO 3506-2:2009.

Marking shall include:

- Manufacturer's identification mark
- Steel grade
- Property class

Markings or codes which provide clear reference to documents containing the information required for production control will always be acceptable.

Samples delivered with the part shall be marked in accordance with provisions of the purchaser order.

12 Cleanliness-packaging-transportation

Requirements are specified in the purchase order.

All packages for all types of fasteners and nuts shall be legibly identified with following information (e.g. through labelling), as defined in ISO 16426:2002.

- Manufacturer name or symbol
- Grade of material
- Property class
- Lot number, Product number or a unique identification number related to quality history
- Order's number
- Specification number
- Dimensions of fasteners and nuts

13 Acceptance

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.

14 Documentation and test report

The Manufacturer shall provide the Inspection Certificate type 3.1 in accordance with EN 10204:2004.

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

- Chemical analyses.
- Melting process method.
- Results of mechanical property tests.
- Non-destructive examination.
- Dimensional check.

These reports shall include:

- Material designation and marking.
- The heat number and part reference number.
- Identification of the Manufacturer.
- Identification of the purchase order number.
- Test and retest results together with required values.

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

The Quality class under this contract is QC2.

The Manufacturer shall have either an ITER Organization (IO) approved QA Program or an ISO 9001 certified Quality Management System.

The Manufacturer shall ensure that the quality of supply meets the requirements. In case of any questions, the Manufacturer shall seek clarification from the Purchaser prior to proceeding with the work.

The Manufacturer shall submit the reports according to chapter 14, including all required information.

For materials that are custom-made for this contract, i.e. materials that are not off-the-shelf, the Manufacturer shall also comply with the IO quality requirements specified in Table 4, including the following:

- submission of the Quality Plan (QP), describing the implementation of IO requirements, the Manufacturing and Inspection Plan (MIP), and the reports containing all required information for IO approval;
- conduct of the Manufacturing Readiness Review (MRR) as a gate review, and obtaining authorization for the manufacture of such materials prior to the start of manufacturing.

Table 4 IO Quality requirements

IO Quality Requirements	Associated IO Quality Documents
Overall quality requirements applicable throughout the implementation of the contract	▪ Chapter 8 of "General Management Specification for Service and Supply" (ITER_D_82MXQK)
Prior to contract implementation: ▪ Obtain IO acceptance of a dedicated Quality Plan	▪ "Quality Requirements for IO Performers" (ITER_D_22MFG4)
Prior to start of manufacturing: ▪ Obtain IO acceptance and mark up of an Manufacturing and Inspection Plan (MIP) ▪ Complete MRR Gate review	▪ "Quality Requirements for IO Performers" (ITER_D_22MFG4), ▪ "Working Instruction for Manufacturing Readiness Review" (ITER_D_44SZYP) ▪ "Inspection Plan Template" (ITER_D_QV7GQF).
During manufacture: ▪ Notify IO representatives of any Inspection Points as marked up in the MIP ▪ Complete the relevant entries in the MIP as work progresses.	▪ "Quality Requirements for IO Performers" (ITER_D_22MFG4),
During contract implementation – issue as necessary: ▪ Deviation Request (DR) ▪ Non-Conformance Reports (NCR)	▪ "Procedure for the management of Deviation Request" (ITER_D_2LZJHB). ▪ "Procedure for Management of Nonconformities" (ITER_D_22F53X).
Contractor release note (CRN)	▪ "Quality Requirements for IO Performers" (ITER_D_22MFG4)

The Manufacturer shall implement, in compliance with its Quality Management System, the monitoring activities including the quality audits and any inspections to verify the compliance with the requirements.

The IO reserves the right to perform the visits to any premises where the IO related work is being performed.

Documentation developed as the result of this supply shall be retained by the Contractor for a minimum of 5 years from the completion of this supply.