外部委託業者の募集

References: IO/24/OT/70001185/AJI

"Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts "

（容器内パーツのベース材料の供給に関する枠組み契約）

IO 締め切り 2024 年 12 月 19 日(木)

〇はじめに

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本文書の目的は作業範囲と入札プロセスに関する技術的な内容の基本的な要約を提供することです。

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〇調達プロセスと目的

目的は、競争入札プロセスを通じて供給契約を落札することです。

この入札のために選択された調達手続きは公開入札手続きと呼ばれます。

オープン入札手順は、次の 4 つの主要なステップで構成されています。

- ステップ 1-事前情報通知（PIN）
  事前情報通知は公開入札プロセスの第一段階です。IO は、関心のある企業、機関又はその他の団体に事前に入札機会について通知するために、国内機関に対し、今後の入札に関する情

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- ステップ 2-入札への招待（ITT）
  事前指示通知（PIN）の公表から 14 日以内に、入札への招待（ITT）が公告されます。この段階では、PIN を見た関心のある入札者が入札書類を入手し、入札説明書に従って提案書を作成して提出することができます。

- ステップ 3-入札評価プロセス
  入札者の提案は、IO の公平な評価委員会によって評価されます。入札者は、技術的範囲に沿って、かつ、入札への招待（ITT)に記載された特定の基準に従って作業を実施するために、技術的遵守を証明する詳細を提供しなければなりません。

- ステップ 4-落札
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〇概略日程

概略日程は以下の通りです：

マイルストーン	暫定日程
事前指示書（PIN）の発行	2024 年 12 月 5 日
関心表明フォームの提出	2024 年 12 月 19 日
提案リクエスト（RFP）と入札への招待（ITT）の発行	2025 年 1 月 14 日
明確化のための質問（もしあれば）	2025 年 2 月 14 日
明確化のための質問回答	2025 年 2 月 19 日
iProc で入札提出	2025 年 2 月 26 日
入札評価と契約授与	2025 年 4 月
契約調印	2025 年 5 月

〇契約期間と実行

予想される契約期間は48か月の予定です。契約の最終調印前の作業はありません。

〇経験

契約者は高需要産業向けの鍛造品供給における実績が証明されていること、具体的には以下を含みます：

- 圧力容器および配管（EN 13445、EN 13480 に準拠）。
- 核、航空宇宙、石油化学分野において、認証およびトレーサビリティが必須となる分野。

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どのコンソーシアムメンバーも IPROC に登録する必要があります。

【※　詳しくは添付の英語版技術仕様書「**Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts.**」をご参照ください。**】**

ITER 公式ウェブ　http://www.iter.org/org/team/adm/proc/overview からもアクセスが可能です。

「核融合エネルギー研究開発部門」の HP：　http://www.fusion.qst.go.jp/ITER/index.html
では ITER 機構からの各募集（IO 職員募集、IO 外部委託、IO エキスパート募集）を逐次更新しています。ぜひご確認ください。

イーター国際核融合エネルギー機構からの外部委託
に関心ある企業及び研究機関の募集について

＜ITER 機構から参加極へのレター＞

以下に、外部委託の概要と要求事項が示されています。参加極には、提案された業務に要求される能力を有し、入札すべきと考える企業及び研究機関の連絡先の情報を ITER 機構へ伝えることが求められています。このため、本研究・業務に関心を持たれる企業及び研究機関におかれましては、応募書類の提出要領にしたがって連絡先情報をご提出下さい。

china eu india japan korea russia usa
Route de Vinon-sur-Verdon - CS 90 046 - 13067 St Paul Lez Durance Cedex - France

PRIOR INDICATIVE NOTICE (PIN)

OPEN TENDER SUMMARY

IO/24/OT/70001185/AJI

for

Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts.

Abstract

The purpose of this summary is to provide prior notification of the IO intention to launch a competitive Open Tender process in the coming weeks. This summary provides some basic information about the ITER Organisation, the technical scope for this tender, and details of the tender process for the award a Framework Contract for Manufacturing and Supply of Base Materials for In-Vessel Parts.

1 Introduction

This Prior Indicative Notice (PIN) is the first step of an Open Tender Procurement Process leading to the award and execution of a Supply Contract.
The purpose of this document is to provide a basic summary of the technical content in terms of the scope of work, and the tendering process.
The Domestic Agencies are invited to publish this information in advance of the forth-coming tender giving companies, institutions or other entities that are capable of providing these supplies prior notice of the tender details.

2 Background

The ITER project is an international research and development project jointly funded by its seven Members being, the European Union (represented by EURATOM), Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed in Europe at St. Paul–Lez-Durance in southern France, which is also the location of the headquarters (HQ) of the ITER Organization (IO).

For a complete description of the ITER Project, covering both organizational and technical aspects of the Project, visit www.iter.org.

3 Scope of Work

The present tender process aims to set up a Framework Contract for Manufacturing and Supply of Base Materials for In-Vessel Parts. Within the ITER Organization, The Diagnostic program will be in charge of implementing this Contract.
The Supplier is responsible for procurement of austenitic stainless steel (SS316L(N)-IG) raw materials in their different forms (forgings, plates and bars) for the manufacture of in-vessel components for the Equatorial Port Plugs (EPP) # 2, 8 &17 and Upper Port Plugs (UPP) #4, 5 and 6., its delivery to the ITER Site and for ensuring that the product meets the technical requirements defined in this Technical Specification.

4 Procurement Process & Objective

The objective is to award a Supply Contract through a competitive bidding process.

The Procurement Procedure selected for this tender is called the Open Tender procedure.

The Open Tender procedure is comprised of the following four main steps:

- Step 1- Prior Indicative Notice (PIN) :
  The Prior Indicative Notice is the first stage of the Open Tender process. The IO formally invites the Domestic Agencies to publish information about the forth-coming tender in order to alert companies, institutions or other entities about the tender opportunity in advance. **Interested tenderers are kindly requested to return the expression of interest form (Annex I) by e-mail by the date indicated in the procurement timetable below.**

- Step 2 - Invitation to Tender (ITT) :
  Within 14 days of publishing the Prior Indicative Notice (PIN), the Invitation to Tender (ITT) will be advertised. This stage allows interested bidders who have seen the PIN to obtain the tender documents and prepare and submit their proposals per the tender instructions.

- Step 3 – Tender Evaluation Process :
  Tenderers' proposals will be evaluated by an impartial, professionally competent technical evaluation committee of the ITER Organization. Tenderers must provide details demonstrating their technical compliance to perform the work in line with the technical scope and per the criteria listed in the invitation to tender (ITT).

- Step 4 – Contract award :
  A Supply contract will be awarded based on best value for money according to the evaluation criteria and methodology described in the Invitation to tender (ITT).

5 Procurement Timetable

The tentative timetable is as follows:

Milestone	Date
Publication of the Prior Indicative Notice (PIN)	05 December 24
Deadline for Submission of Expression of Interest Form	19 December 24
Request for Proposals (RFP)- Invitation to Tender (ITT) advertisement	14 January 2024
Clarification Questions (if any) and Answers deadline	14 Feb 2024
Answers to Clarifications	19 Feb 2024
Tender Submission in IPROC	26 Feb 2024
Tender Evaluation & Contract Award	April 2024
Contract Signature	May 2024

6 Quality Assurance Requirements

Prior to the commencement of any work under this Contract, the selected Contractor shall produce a "Quality Plan" and submit it to the IO for approval, describing how they will implement the ITER Procurement Quality Requirements.

7 Contract Duration and Execution

The duration shall be for 48 months. No work shall commence before the date of final signature of the Contract.

8 Experience

The Contractor is expected to provide in the following:

Experience in Manufacturing Forgings According to European Standards and RCC-MR 2007 Product Procurement Specifications

- Proven experience in producing forgings from austenitic stainless steel in nuclear grades (with limitations in Co, Ta and Nb).
- Ability to manufacture various shapes, including bars, discs, rings, shafts, and custom components.
- Proficiency in hot and cold forging processes, ensuring control of critical parameters such as temperature and deformation.

Heat Treatment and Microstructural Control:

- Experience in applying heat treatments such as **annealing and solution treatment**, crucial for optimizing corrosion resistance and mechanical properties.
- Knowledge of controlled cooling processes to prevent distortion and achieve the desired microstructure.
- Experience in production low inclusion grades and use of refining treatments (Electroslag Remelting).

Quality Assurance and Certification Compliance:

- **Relevant Standards:**
  - **EN 10204**: Inspection documents (Types 3.1 and 3.2 certification).
  - **EN ISO 9001**: Quality management systems.
- Ability to issue quality certificates (3.1 or 3.2) ensuring full traceability and compliance with chemical and mechanical specifications.
- Experience in implementing and maintaining **ISO 9001** quality management systems, including internal and external audits.

Mechanical, Chemical, and Non-Destructive Testing (NDT):

- Experience conducting **destructive tests** (tensile, hardness, impact) and **non-destructive tests** (ultrasonic, radiographic, dye penetrant).
- Personnel certified according to **EN ISO 9712** for NDT methods.

Dimensional Tolerances and Surface Finishing:

- Expertise in controlling dimensional tolerances in accordance with design specifications and relevant standards.
- Capability to deliver specific surface finishes, such as **pickling, passivation, and polishing**.

Experience in Critical Sectors:

Proven track record of supplying forgings for high-demand industries, including:

- **Pressure vessels and piping** (compliant with **EN 13445**, **EN 13480**).
- **Nuclear, aerospace, and petrochemical** sectors, where certification and traceability are essential.

Logistics and Contract Management:

- Experience in meeting **delivery deadlines**, managing the supply chain, and ensuring appropriate packaging for large or complex forgings.
- Comprehensive documentation management, including **quality manuals** and **inspection records**.

9 Candidature

Participation is open to all legal entities participating either individually or in a grouping/consortium. A legal entity is an individual, company, or organization with legal rights and obligations established within an ITER Member State.

Legal entities cannot participate individually or as a consortium partner in more than one application or tender of the same contract. A consortium may be a permanent, legally-established grouping, or a grouping constituted informally for a specific tender procedure. All consortium members (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization.

In order for a consortium to be acceptable, the individual legal entities included therein shall have nominated a leader with authority to bind each member of the consortium, and this leader shall be authorised to incur liabilities and receive instructions for and on behalf of each member of the consortium.

It is expected that the designated consortium lead will explain the composition of the consortium members in a covering letter at the tendering stage. Following this, the Candidate's composition must not be modified without notifying the ITER Organization of any changes. Evidence of any such authorisation shall be submitted to the IO in due course in the form of a power of attorney signed by legally authorised signatories of all the consortium members.

10 Sub-contracting Rules

All sub-contractors who will be taken on by the Contractor shall be declared with the tender submission in IPROC. Each sub-contractor will be required to complete and sign forms including technical and administrative information, which shall be submitted to the IO by the tenderer as part of its tender.
The IO reserves the right to approve (or disapprove) any sub-contractor which was not notified in the tender and request a copy of the sub-contracting agreement between the tenderer and its subcontractor(s). Rules on sub-contracting are indicated in the RFP itself.

ANNEX I

EXPRESSION OF INTEREST & PIN ACKNOWLEDGEMENT

To be returned by e-mail to: amankumar.joshi@iter.org copy Chloe.Perret@iter.org

TENDER No.	**IO/24/OT/70001185/AJI**
DESIGNATION of SERVICES:	**Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts**
OFFICER IN CHARGE:	**Aman Kumar Joshi – Procurement Division ITER Organization**

☐ WE ACKNOWLEDGE HAVING READ THE PIN NOTICE FOR THE ABOVE-MENTIONED TENDER

☐ WE INTEND TO SUBMIT A TENDERs

☐ WE WILL NOT TENDER FOR THE FOLLOWING REASONS:

……

Company name:.....

COMPANY STAMP

Signature:

Name: .....

Position: .....

Tel: .....

E-mail.....

Date: .....

IDM UID
CBU6PF
VERSION CREATED ON / VERSION / STATUS
09 Oct 2024 / 1.2 / Approved
EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Technical Specification for the Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts of IO Diagnostic Port Plugs

Technical Specification for the Framework Contract of Manufacturing and Supply of Base Materials for In-Vessel Parts of IO Diagnostic Port Plugs

SUPPLY

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1 Preamble

This Technical Specification is to be read in combination with the General Management Specification for Service and Supply (GM3S) [1] that constitutes a full part of the technical requirements. In case of conflict, the content of the Technical Specification supersedes the content of [1].

2 Purpose

The purpose of this Contract is for the procurement of austenitic stainless steel (SS316L(N)-IG) raw materials in their different forms (forgings, plates and bars) for the manufacture of in-vessel components for the Equatorial Port Plugs (EPP) # 2, 8 &17 and Upper Port Plugs (UPP) #4, 5 and 6. Exhaustive technical and delivery requirements of these parts are given in the Appendixes A1, A2 and A3 of this Technical Specification.
This purpose is to be executed under a Framework Contract format, with task orders identified for deliverables per Port Plug as well as the detailed scope of work and place of execution.

3 Acronyms & Definitions

3.1 Acronyms

The following acronyms are the main one relevant to this document.

Abbreviation	Description
CRO	Contract Responsible Officer
DR	Deviation Request
DSM	Diagnostics Shielding Module
EPP	Equatorial Port Plug
GM3S	General Management Specification for Service and Supply
HP	Hold Point
IDM	ITER Document Management System
IO	ITER Organization
NPE	Nuclear Pressure Equipment
PE	Pressure Equipment
PIA	Protection Important Activity
PIC	Protection Important Component
PMI	Positive Material Identification
PP	Port Plug
PPS	Product Procurement Specification
PRO	Procurement Responsible Officer
QC	Quality Class
RPrs	Preliminary Safety Report
RO	Responsible Officer
TO	Task Order
UPP	Upper Port Plug

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VV	Vacuum Vessel

3.2 Definitions

Client: ITER Organization, referred to as IO in the rest of this document.

Contractor: shall mean an economic operator who have signed the Contract in which this document is referenced. In this document as well as in the mandatory Appendixes and Annexures referred here, the names Contractor and Supplier are used interchangeably.

In-Vessel Components: This term is used in this specification for indicating all the components, sub-assemblies and provision for services (electrical, gas and cooling water) that constitute the Integrated Diagnostic Port Plug Assembly, other than Interspace and Port Cell Support structures and their associated components *(that are called as Ex-vessel components)*

Integrated Diagnostic Port Plug Assembly: This assembly mainly consists of Diagnostic Shield Modules (DSM) with provision for shielding (Shielding blocks, Shielding Trays and Stainless Steel backfilling and associated attachments) housing associated diagnostic tenant systems and Service Systems (electrical, cooling water and gas) connections with provisions for required layouts. This DSM is contained in the Customised Port Plug Structure and attached to the Diagnostic First Walls.

Machine: The term "Machine" is used to describe the ITER Tokamak Machine where the final installation of these deliverables will be done.

Assembly: The term "Assembly" is used to describe the assembly activities of the components (mainly mechanical) of the deliverables planned by the Contractor. These activities are not in the scope of this contract.

IDM ID: This is the IDM document number referred.

4 Applicable Documents & Codes and standards

4.1 Applicable Documents

This is the responsibility of the Contractor to identify and request for any documents that would not have been transmitted by IO, including the below list of reference documents.

This Technical Specification takes precedence over the referenced documents. In case of conflicting information, this is the responsibility of the Contractor to seek clarification from IO.

Upon notification of any revision of the applicable document transmitted officially to the Contractor, the Contractor shall advise within 4 weeks of any impact on the execution of the contract. Without any response after this period, no impact will be considered.

Ref	Title	IDM Doc ID	Version
1	General Management Specification for Service and Supply (GM3S)	82MXQK	1.4
2	Order related 7 February 2012 relating to the general technical regulations applicable to INB-EN, https://user.iter.org/default.aspx?uid=7M2YKE	7M2YKF	1.7
3	Codes and Standards for ITER Mechanical Components	25EW4K	4.0
4	ITER Vacuum Handbook	2EZ9UM	2.5

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5	ITER Requirements Regarding Contractors Release Note	22F52F	5.0
6	ITER Procurement Quality Requirements	22MFG4	5.1
7	IO QA Deviation Request Template	2LRNQP	4.0
8	Suppliers Deviation Request Template	2LRNQP	4.0
9	Procurement Requirements for Producing a Quality Plan,	22MFMW	4.0
10	ITER Configuration Management Plan	27LHHE	3.3
11	Procedure for implementation of a Manufacturing and Inspection Plan	22MDZD	3.7
12	Manufacturing Inspection Plan Template for Manufacturing Database (MDB)	VGDUSJ	2.3
13	Working Instruction for the Delivery Readiness Review (DRR)	X3NEGB	2.0
14	ITER Quality Assurance Program,	22K4QX	8.5
15	Procedure for management of Deviation Request,	2LZJHB.	8.1
16	ITER Policy on Safety, Security and Environment Protection Management	43UJN7	3.1
17	Procedure for management of Nonconformities, https://user.iter.org/default.aspx?uid=22F53X	22F53X	9.1
18	Guideline for identification (Symptoms) of Counterfeit, Fraudulent and Suspect Items (CFSI)	XKUKAX	1.3
19	Quality Classification Determination	24VQES	5.2
20	NCR Database - Introduction & How to for Suppliers and Contractors	SM2JWP	3.7
21	ITER_D_2X4E9A - Root Cause Analysis Leaflet	2X4E9A	1.1
22	Chemical composition and impurity requirements for materials	REYV5V	2.3
23	ITER Numbering System for Components and Parts (ITER_D_28QDBS)"https://user.iter.org/?uid=28QDBS &version=v2.0	28QDBS	5.0
24	ITER_D_VYJ7U2, Procedure for Labelling on Physical Items	VYJ7U2	1.4

4.2 Applicable Codes and Standards

Material procurement shall follow the Applicable Code for manufacturing operations RCC-MR 2007 for class 2 box structures. Section 2 of the Code, devoted to material procurement activities constitutes the main reference. Additionally, first paragraph of RCC-MR 2007 Section 1 Subsection C describing how the Section 2 should be applied to all parts or components designed under the scope of Subsection C: Class 2 components (RC 2000) shall be followed. This paragraph also establishes in which situations a product qualification (according to RM 0140) is required.

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Applicable Code and Standards for each product form in the scope of this Technical Specification are defined in the corresponding technical appendixes A1, A2 and A3.

Besides, EN European and ISO Standards referenced in Product Procurement Specifications as well as those specifying certification requirements also mentioned in this technical appendix shall be considered as complementary applicable documents. These complementary Standards shall be considered in their last revision at the time of the sign of the contract.

In addition, provisions included in the ITER Vacuum Handbook (2EZ9UM v2.3) [4] in general and particularly in section 5 shall be considered as well.

5 Scope of Work

The ITER Project is an international effort aimed at demonstrating the scientific and technological feasibility of nuclear fusion energy. The nuclear fusion reactions occur within the volume of the ITER Vacuum Vessel (VV), which is filled during operation with a hot gas (plasma). A key aspect of the research program of ITER is the diagnosis of the plasma and the first-wall, e.g. the plasma temperature, density, radiative properties, first-wall resilience, etc. For this purpose, a large number of different types of diagnostic equipment peer into the ITER vacuum vessel from many different vantage points.

The diagnostic Port Plugs (PP), see Figure 1, are components which serve as common platforms for a variety of diagnostics systems. Diagnostic equipment and shielding are integrated together into three cassettes known as “Diagnostic Shielding Modules” (DSM) which, in turn, are attached to the PP structure that is part of the ITER VV confinement barrier.

The back of the PP structure is formed by the closure flange (1) that connects the PP to the ITER VV ports and the closure plate (2), the region where most of the penetrations transmitting diagnostic signals from the inside to the outside of the VV are located.

PPs structures are boxes inserted into the regular penetrations (port extensions upper and equatorial) of the ITER VV. The DSMs fill the internal space of PP structures housing diagnostics, shielding and common services.

SUPPLY

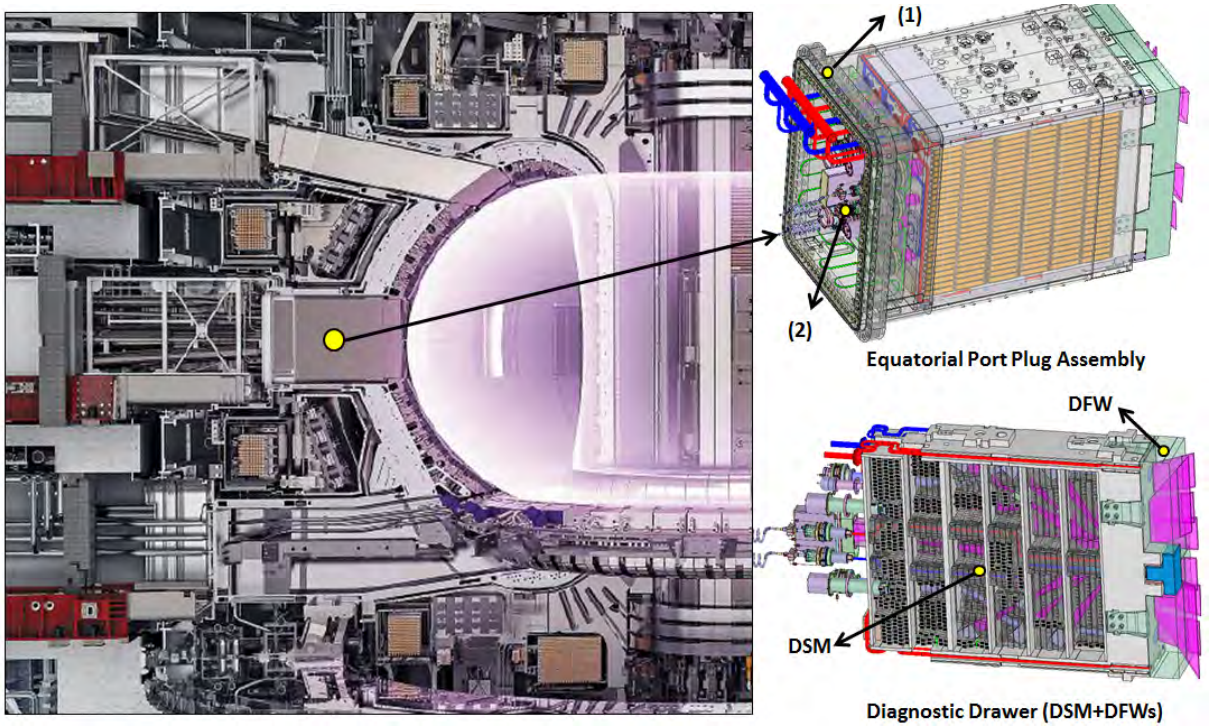


Fig. 1. Diagnostic EPP in the ITER tokamak.

Thie Technical specification covers the general requirements for the procurement of materials and related activities to be performed for the supply of base material for the manufacturing of in-vessel parts of the PPs.

Product Procurement Specifications (PPSs) including all requirements that are applicable to different material products that take part on the manufacturing of PP in-vessel parts are introduced in this TS as Appendixes: A1, A2 and A3. Additional requirements regarding the necessity of product qualification are also stated.

5.1 Scope of Supply

5.1.1Description

The scope of supply of this FWC contract includes the procurement of base materials for the manufacturing of in-vessel parts of the ITER Equatorial (3 PPs) and Upper (3 PPs) Diagnostic Port Plugs depicted in the figures below:

Forgings for Equatorial DSM frames (Figure 2): Frame forging (grey – front part width ≈ 450mm, wings thickness ≈200mm) and forged or rolled plates (red) typically 40mm to 80mm thick. The Supply to be formalized in the corresponding Task Orders comprises 9 sets of main forging and plates for 3 Equatorial Port Plugs.

SUPPLY

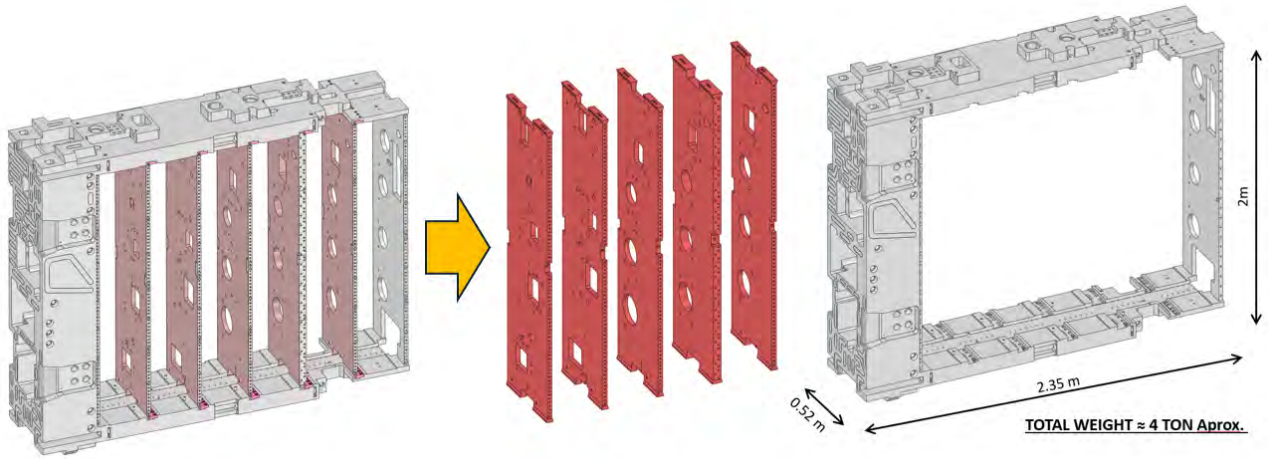
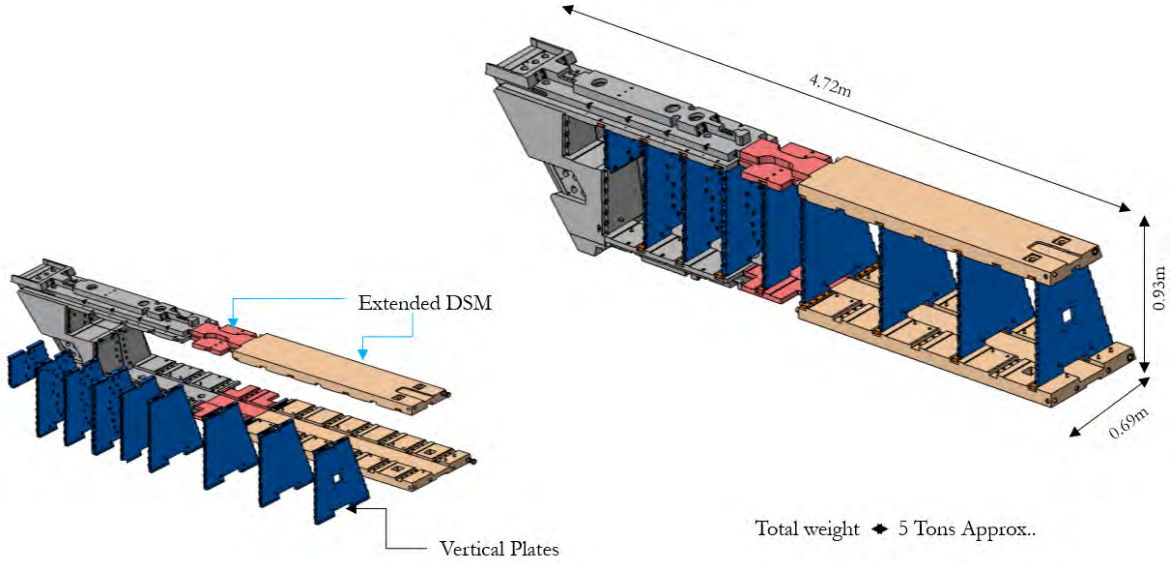


Fig. 2. Diagnostic EPP DSM Frame.

Forgings for Upper DSM frames (Figure 3): Frame forgings, made of 2 split parts (grey – combined front part width ≈ 450mm, wings thickness ≈200mm), extended DSM forgings (brown, orange: thickness ≈200mm) and forged or rolled plates typically 40mm thick (blue). The Supply to be formalized in the corresponding Task Orders comprises 3 sets of main forgings and plates for 3 Upper Port Plugs. Dimensions represented in Figure 3 are final quantities (after final machining).



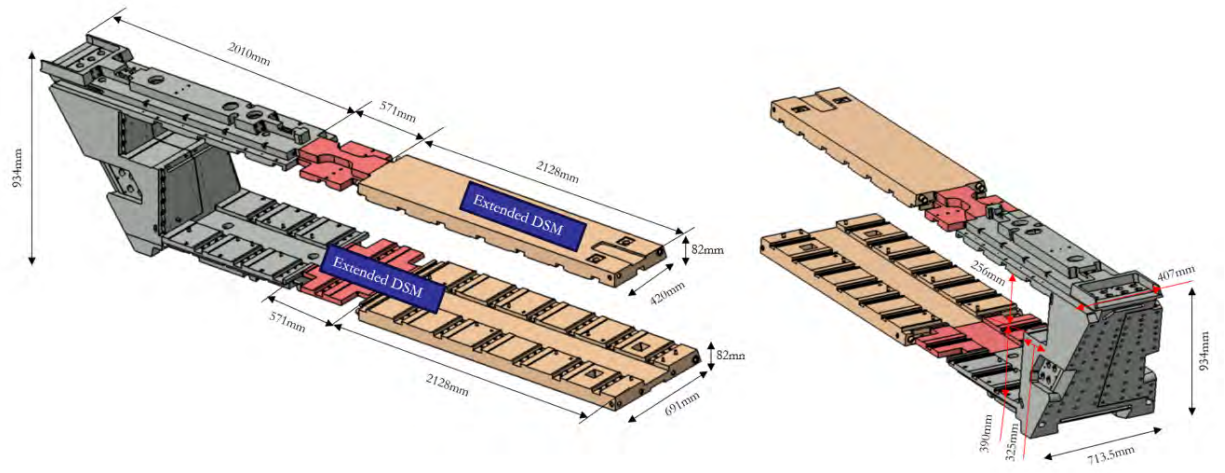


Fig. 3. Diagnostic UPP DSM Frame.

Backfilling blocks for Diagnostic PP DSMs (Figure 4): Small forged blocks for Equatorial DSMs (in green in the picture) which final shapes, sizes and number is to be specified in the different task orders. The figure shows approximately the number and disposition of blocks typically in an Equatorial DSM.

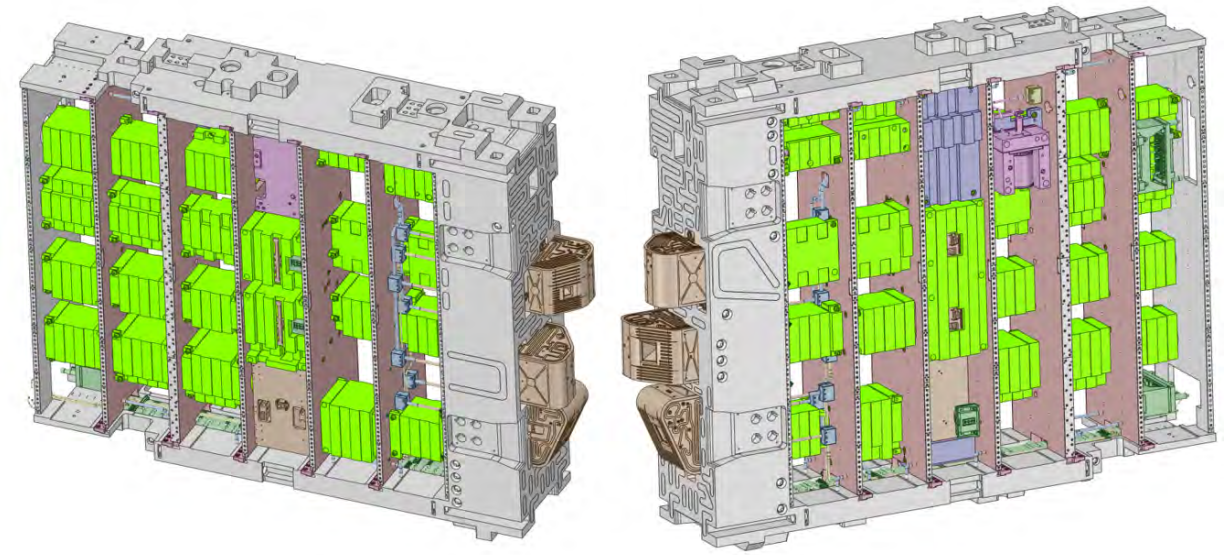


Fig. 4. Example of diagnostic backfilling blocks (represented in green).

5.1.2Material requirements

The Supplier shall procure material in accordance with PPSs and shall provide certificates which comply with the requirements of the procurement specifications and the purchase order.

Any deviations from PPSs shall require the Client's written agreement.

The Supplier or his subcontractor shall note and list clearly all exceptions to any requirements which shall be reported through the deviation request (DR).

The Supplier shall comply with all requirements presented in this specification. Release of any drawings, specifications and tests by the Client shall not constitute a way for relieving the Supplier from these responsibilities.

SUPPLY

5.1.2.1 Supply of 316L(N)-IG austenitic stainless-steel plates

316L(N)-IG austenitic stainless-steel plates for the PPs in-vessel parts shall be delivered according to the "**Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless-steel plates for the PP in-vessel components**" included in Appendix A1 of this Technical Specification.

5.1.2.2 Supply of 316L(N)-IG austenitic stainless-steel forgings

316L(N)-IG austenitic stainless forgings for the PPs in-vessel parts shall be delivered according to the "**Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless-steel forgings for the PP in-vessel components**" included in Appendix A2 of this Technical Specification.

5.1.2.3 Supply 316L(N)-IG austenitic stainless steel rolled or forged bars and semi-finished products

316L(N)-IG austenitic stainless rolled or forged bars and semi-finished PPs in-vessel parts shall be procured according to the "**Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless steel rolled or forged bars and semi-finished products for the PP in-vessel components**" included in Appendix A3 of Technical Specification.

5.1.3 Quality Control Provisions

The quality assurance system behind the material procurement in RCC-MR regardless of the procurement route is based on the fact that the material Manufacturer must certify the conformity of the part or product with the order. The declaration of conformity shall also include the certification documents as it is stated in EN 10204:2004.

The confirmation of compliance shall be stated in or appended to the certificate, depending on the type of certificate issued.

In case the Supplier has carried out a specific assessment for materials and has a proper quality-assurance system, certified by a competent body established within the European Community (EU), it is assumed that they can certify conformity with the requirements of this technical specification (PPSs). Then, the specific assessment of the quality system covers all relevant processes and material properties referred in the material specifications. In this case inspection certificate 3.1 in accordance with EN 10204:2004 and an inspection report is enough.

When the Supplier does not have a quality assurance system as described above, inspection certificate type 3.2 in accordance with EN 10204:2004 shall be provided by the material Manufacturer before agreement with IO. In this case there shall be a justification from a Third Party following the material testing and ensuring that the conformity of the material meets the requirements of applicable EN Standards and PPSs.

EN 10204:2004 specifies the different types of inspection documents supplied to the purchaser, in accordance with the requirements of the order, for the delivery of all metallic products, whatever their method of production.

5.1.4Radiation Protection Requirements

Following BNI Order dated 7 February 2012 and the RPrS, PPSs must include requirements for minimization of contact dose during operation and reduction of waste.

ITER nuclear and safety analyses identifies that the following elements (impurities) should be controlled in materials for VV and in-vessel components: Cobalt, Niobium and Tantalum.

These requirements [22] are based on ALARA approach and they are already included in PPSs covered by this Technical Specification.

SUPPLY

5.1.5Material Traceability

A material traceability system shall be established to ensure that only correct and accepted products and parts are used or installed during manufacturing activities. This system shall be implemented so that traceability shall be guaranteed from the reception stage to the delivery including all intermediate steps during the manufacturing route.

This system shall be implemented through dedicated procedures which shall be subjected to the Client's approval.

All materials shall be marked according to the requirements of section 8 of this technical appendix. The following information shall be consigned as described in PPSs:

- Heat number.
- Piece number (or serial number).
- Manufacturer name or symbol.
- Plate/Forging/Bar number or unique identification number related to quality history.
- Grade of material.

If marking/stamping anomalies comprising incoming material identification or traceability occur and they cannot be properly traced back through further investigations, material concerned shall be considered as non-conforming material until appropriate test/verifications have been made and documented.

The material may be re-marked upon establishing a positive identification (section 9 of this Technical Appendix).

5.1.6 Material Marking

The marking of materials shall meet the requirements in RF 2000 of RCC-MR 2007.

The methods used for marking shall not result in contamination of the material, significant strain hardening, or sharp discontinuities.

Items shall be marked in areas which are subjected to minimum loading and shall not be marked in areas where stress concentrations are expected (particularly in areas where there are discontinuities in shape) or in weld heat affected zones.

Marking must not adversely affect the interpretation of the results of non-destructive examination.

The method used shall suit the quality of marking requested (temporary, final marking, on components whose access will be restricted in the future).

5.1.7 Permanent Marking

All parts, sub-assemblies and welds shall be identified and marked using low stress marking methods such as low stress stamping or vibro-etching.

The use of electric arc marking pencils is forbidden.

Surfaces which are expected to be exposed to vacuum shall only be marked or identified if necessary and shall be marked by scribing with a clean sharp point or by a laser scribing method. Chemical etching shall not be used unless accepted by the Client's RO.

Dyes, marker pens, paints, etc. shall not be used on surfaces which will be exposed to vacuum. Furthermore, their use shall be avoided on other surfaces to eliminate the potential for cross-contamination during subsequent cleaning operations.

The use of such substances may block porosity in material and result in leaks which are initially undetectable but may open up after some time.

5.1.8 Temporary Marking

Ink stamps, indelible ink, paint, label and adhesive tape may be used for temporary marking during manufacture. The parts shall be marked only in this way provided that the marking may be removed afterwards. The use of these methods shall be as restricted as possible.

The inks, paint, etc. used shall not contain any contamination in order to prevent corrosion or contamination.

In case of use adhesive tapes, residue after removal shall be completely removed from material surfaces prior to any manufacturing, inspection or work operation which make them inaccessible or before to any operation which may increase the temperature of the component.

5.1.9 Positive Material Identification (PMI)

Positive Material PMI testing constitutes a chemical composition evaluation of the material, meeting the requirements of the Product Procurement Specification, to confirm that the material which will be placed into service is consistent with the selected or specified grade.

PMI testing if needed, shall be performed at a point in time that ensures proper material is used in the fabrication of an identifiable assembly.

Usually, this is during delivery material acceptance at Supplier's factory, fabrication or immediately prior to fabrication.

Testing performed by material Supplier of raw material or loose components is not considered to be PMI testing.

PMI testing can be witnessed by an inspector with a notification by the Supplier.

PMI testing shall not substitute required material test reports and certificates.

PMI shall be performed by qualified personnel with operator's records being available to the Client for review and approval.

The methods to be used (X-ray fluorescence analysis or optical emission spectrograph for lighter elements) are suitable to identify the material by quantitative measurement of the major alloying elements in the product procurement specification. As an alternative, a chemical analysis of samples cut out of pieces (in the pre- machined condition) requiring PMI may be used to check the alloying elements of the material.

Applicable Standards covering methods for PMI are:

- EN 10315:2006 Routine method for analysis of high alloy steel by X-ray Fluorescence Spectrometry (XRF) by using a nearby technique.
- ASTM E1476-04(2010) Standard Guide for Metals Identification, Grade Verification, and Sorting.

If sample removal is used, a written procedure for identification and traceability of the samples to original material shall be required.

For acceptance, it shall be demonstrated that materials contain the amounts of alloying element stated in product procurement specifications. In cases that the measured elements are outside of the ranges of elements in the product procurement specification, a deviation report will be sent to the Client for review and approval.

Pieces positively tested shall be verified by marking with no harmful effect on metal at ambient or elevated temperatures by method defined by Supplier.

SUPPLY

5.1.10 Storage and Handling

Material shall be stored on clean surfaces or surfaces covered with materials like wood, plastic avoiding any contact with non-Stainless-Steel surfaces.

Storage requirements shall follow RF 6630 of RCC-MR 2007.

If Material is unpacked, it shall be protected by means that Supplier will specify in compliance with RCC-MR 2007 to avoid any accumulation of dust or unwanted sprinkling.

The seating or sealing surfaces, edges to be welded, etc… shall be protected against damage using suitable covers.

All material shall be placed properly to avoid any physical damage. Prevention of contamination must be ensured.

The Supplier shall issue a procedure that shall be subjected to the Client's approval.

5.1.11 Cleanliness Preservation

Requirements in RCC-MR 2007 - RF 6620 relative to protection and preservation of cleanliness shall be respected as long as they are compatible with ITER Vacuum Handbook (2EZ9UM v2.5) [4] section 24,28, 29, 31 and appendix 13. Otherwise, requirement in later reference shall prevail.

After final cleaning, the handling of vacuum equipment shall be strictly controlled to preserve cleanliness.

Cleaning shall be performed in the workshop.

Further fabrication, conditioning, transportation, etc., shall also include dispositions to preserve and/or restitute the required degree of cleanliness according to aforementioned requirements.

5.1.12 Packing

Packing conditions and materials will be defined in a packing procedure that shall meet the requirements of RCC-MR RF 6420 and the ITER Vacuum Handbook (2EZ9UM v2.5) [4] section 29. This procedure shall be subjected to the Client's approval.

All components shall be visually inspected immediately before starting final packing for transport.

All machined interfaces shall be protected against damage using compatible covers.

All components shall be wedged, cushioned and blocked to prevent movement and any physical damage to the component or wrapping material during transport.

DSMs parts shall be packed suitable for road and sea transportation.

DSMs parts shall be isolated from the ambient atmosphere by an envelope (watertight, ensuring protection of the DSM component against ingress from sea water and air humidity) to protect them from deterioration during the road and/or sea transportation.

All components and the main subcomponents shall be clearly marked in a permanent way and in a visible place with the Client's official numbering system according to the document "ITER Numbering System for Components and Parts (ITER_D_28QDBS)" [23].

The Components' labelling shall follow the procedure ITER_D_VYJ7U2, Procedure for Labelling on Physical Items [24].

A detailed 'component identification standard' together with printed label templates and RFID tagging standards will be provided by the Client.

The equipment shall be permanently marked on at least two sides of each box/package with good quality non-fading indelible ink/paint in characters approx. 150mm high (depending upon size of the packages):

SUPPLY

- The ITER Organization and the Supplier's name marked on the outside of the packing.
- The customers Purchase Order Number.
- Origin of manufacture (country).
- Overall size of the individual pieces of equipment.
- The gross weight including the packing.
- Centre of gravity in three planes.
- The lift points with the SWL.
- Wherever necessary the packages will be marked on all four sides with special shipping marks such as "TOP", "BOTTOM", "DO NOT OVER TURN", "HANDLE WITH CARE", "FRAGILE","KEEP DRY" etc. as well as special symbol indicating the top (see Fig.).
- Marking/symbols for storage and handling shall also be indicated on packages.

If the packing is a purpose made container, it must be marked with a unique identity number, and Purchase Order Number, if different from that of the component.

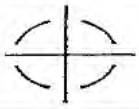
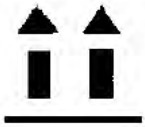
No.	Name of Mark	Stenciled Marked and Letters	Remarks
1	Center of gravity		At the center of gravity
2	Sling		Where sling wire is to be applied
3	Top		When package cannot be placed upside down
4	Keep Dry	 KEEP DRY	For boxes that need protection from water and moisture
5	Handle with care	 HANDLE WITH CARE	For fragile cargo
6	Heavy weight this end	 HEAVY WEIGHT THIS END	When center of gravity is on one side
7	Danger	 DANGER	For boxes containing dangerous and toxic materials

Fig.5. Auxiliary Shipping Marks.

SUPPLY

5.1.12.1 Packing inspection

The Supplier shall demonstrate the soundness of the packing after installation on the transport through an inspection.

The Inspection shall be extended to a visual, dimensional quantity check of equipment and materials, etc. based on the approved detail packing and shipping procedure.

Packing inspection will be performed by the Supplier, himself in accordance with the requirements described in this appendix and drawn up by the purchaser in a procedure approved by the Client.

The Supplier shall also check the conditions during transportation and quality of the contents, etc. in each package on his own responsibility so that the requirements of this Technical Specification are properly met.

When the inspection is finished, the Supplier shall prepare a report including photographic records showing shipping marks, exterior and interior views of packages and how the equipment or machines are fixed on the transportation frame, etc., per one package.

If the Client pointed out any defect of packing the Supplier shall modify or fix at once it at his own responsibility and expenses. The Supplier shall inform to the Client about the results of the modification.

In case any damages or unexpected expenses occur due to delay of shipment owing to the said modification, the Supplier shall be responsible for these damages of expenses.

5.1.12.2 Documents attached to the package

A packing list shall be issued and signed for each despatch. Packing lists shall be numbered sequentially for each despatch.

Each package will be accompanied with two (2) copies of the packing list each and other specifications describing the contents:

- One copy of the above packing list shall be sheathed in a watertight envelope and fastened on the inside of the packing.
- The other also in a watertight envelope shall be fixed to outside the package in such a manner not to be separated or lost during shipment.

Each shipment shall be accompanied by a delivery report shall be prepared by the Supplier, stating as a minimum:

- The packing date.
- The full address of the place of delivery and the name of the person responsible to receive the package, as well as of the Supplier’s name and full address.
- Bill of materials.
- Security measures.
- Contractor’s Release Note.
- Packing list.
- Material Safety Data Sheet (MSDS).
- The declaration of integrity of the package.
- The declaration of integrity of the components.
- Any additional relevant information on the status of the components.

The delivery report shall be signed by a representative of the Client and its Supplier. The signature by the Client of the delivery report prior to shipment represents a Hold Point (HP).

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5.1.13 Shipping and Transportation

Displacements induced on DSMs parts due to transportation actions shall be limited so that neither permanent deformations nor any relative displacement between assembled pieces are developed.

During transportation a stiff frame ensuring small deflections under any transport load conditions shall be used.

The transport frame shall be equipped with multiple lifting lugs in order to avoid direct handling of the DSM components.

DSMs parts shall be robustly clamped on the transportation frame. While packing the component/assembly, shock absorbing material shall be used.

The Supplier shall ensure that the packed components are safely and securely attached to the road transporter and that the road transport organisation establishes a safe route. This responsibility includes arranging for the street/road furniture to be strengthened, removed or replaced. Additionally, this responsibility shall include the temporary removal and replacement of any overhead infrastructure (like cables).

The Supplier shall ensure that the road transport organisation will liaise with the local authorities responsible for the route, including the law enforcement agencies to ensure the safe and timely movement of the load.

The off-loading of the packed components from the road transport at the port of exit and onto the ship if applicable shall be responsibility of the Supplier.

The safe and secure installation on the ship is the ultimate responsibility of the ships master and the ship owner.

The Supplier shall ensure that the transport organisation, port of exit authorities and the shipping company are insured for damage and/or loss of the components.

Copies of customs declarations, export/import licenses, goods dispatch/receipt notes shall be kept for incorporating into the overall documentation.

5.1.14 Delivery

Upon receipt of the package, the Client shall open the package and make a visual inspection of its content to check:

- The integrity of the package, including identifying visible damage
- The number and type of components contained in the shipment
- The enclosed documentation
- The integrity of the components.

In the case of anomalies, the Client shall make any additional relevant remark on the inspection.

If the components are in an acceptable condition, the Client will sign the Delivery Report. The signature of the Delivery Reports is a Client’s Hold Point. The original of the Delivery Report shall be kept by the Client and a copy of it shall be kept by the Supplier.

5.1.15 Unpacking

The Supplier shall provide detailed procedure subjected to the Client's approval for unpacking describing how the DSM components must be removed from the packing safely and without damage.

5.1.16Final Acceptance

The Contractor shall provide commercial warranty as per IO Supply Contract General Conditions covering repair or replacement of the components up to one year after the Provisional Acceptance of the item.

The Final Acceptance shall be granted upon expiry of the warranty period and when all defects or damages have been rectified.

The Final Acceptance Certificate shall be signed by both the Client and the Contractor

6 Location for Scope of Work Execution

The Contractor shall perform the work at their own location and deliver the manufactured parts to the Client's delivery place to be defined in the particular Task Orders".

7 Deliverables and Schedule Milestones

The maximum expected duration from the contract signature to the supply of the scope of work is 36 months plus option for 12 months.

7.1.1 List of deliverable documentation

The Supplier shall provide IO with the documents and data required in the application of this Technical Specification, the GM3S Ref [1] and any other requirement derived from the application of the contract.

You can find here below a minimum list of documentation, but not limited to, that are required within the expected timing:

Category	Document Type	Further Description	Expected Timing (T0+x) *
Other Manufacturing Output	Material Certificate	Material Certificates of individual items delivered	To be defined in corresponding Task Orders

(*) T0 = Commencement Date of the contract; X in months.

8 Quality Assurance requirements

The Quality class under this contract is QC-1, [1] GM3S section 8 applies in line with the defined Quality Class.

9 Safety requirements

The scope under this contract does not cover for PIC and/or PIA and/or PE/NPE components, [1] GM3S section 5.3 applies.

SUPPLY

10 Special Management requirements

Requirement [1] GM3S section 6 applies in full.

11 Appendix 1: Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless-steel plates for the PP in-vessel components

11.1 Scope

This Specification covers 316L(N)-IG austenitic stainless-steel hot rolled plates between 5 mm and 100mm thick for the ITER port plug components (GPPs).

Generally, 316L(N)-IG steel is grade 316L steel with narrower alloying element ranges and controlled impurities. The closest analogy is X2CrNiMo17-12-2 controlled nitrogen content austenitic stainless steel described in the RCC-MR Code, Edition 2007.

This Specification is based on the product procurement specification RM 3331 in RCC-MR 2007 for plates, plus additional requirements arising from the features of the ITER vacuum vessel and port components. The plates are considered for equipment Class 2 (in accordance with RCC-MR classification).

The amount of stainless-steel plates to be procured shall include appropriate contingency to face unexpected difficulties, to remake rejected parts and to repair parts with insufficient quality.

The supply covers the following items:

- Manufacture of the total quantity of stainless-steel plates grade 316L(N)-IG.
- 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.

11.2 Referenced documents

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

11.3 Design and Construction Code:

- RCC-MR, Edition 2007
- RCC-MR, 2007, Section 2 – Materials, Chapter RM 3331
- Applicable requirements of RM 0100 of RCC-MR, Edition 2007 must be respected.

11.3.1EN and ASTM Standards:

- **NF-EN 10088-2: 2005** Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes.
- **NF-EN 10028-1+A1: 2009** Flat products made of steels for pressure purposes, Part 1: General requirements.
- **NF-EN 10002-1: 2001** Tensile testing at ambient temperature.
- **NF-EN 10002-5: 1992** Tensile testing at elevated temperature.
- **NF-EN 10307: 2002** Ultrasonic testing of austenitic and austenitic-ferritic stainless steels. Flat products of thickness equal to or greater than 6 mm.
- **NF-EN 10204: 2004** Metallic products: Type of inspection documents.

- **NF-EN 10029: 2011** Hot rolled steel plates 3 mm thick or above -Tolerances on dimensions, shape and mass.
- **NF-EN ISO 643: 2013** Steels - Micrographic determination of the apparent grain size.
- **NF-EN ISO 4288:1998** Geometrical product specifications (GPS). Surface texture: Profile method. Rules and procedures for the assessment of surface texture.
- **ASTM E45-13** Standard test methods for determining the inclusion content of steel.
- **ASTM A342-14** Standard Test Methods for Permeability of Feebly Magnetic Materials.

EN, ISO and ASTM standards mentioned in this PPS may be considered in their last revision at the time of the sign of the contract provided that equivalency is demonstrated.

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 Client's approval.

The use of EN but non-NF Standards is also allowed demonstrating equivalence with the corresponding NF version of the Standard.

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

11.4 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 (Electro-Slag Remelting ESR). The refining processes are argon-oxygen decarburization (AOD), vacuum oxygen de-carbonised (VOD).

Supplier shall propose refining method, which shall be agreed with the Client.

11.5 Chemical requirements and physico-chemical characteristics

11.5.1 Required values

The chemical composition determined by ladle and product analyses, shall comply with the requirements given in Table 1.

Table 1. Chemical composition

Element	Alloying elements and impurities content, wt. %.	
	Minimum	**Maximum**
C		0.030
Mn	1.60	2.00
Si		0.50
P		0.025
S		0.010
Cr	17.00	18.00
Ni	12.00	12.50
Mo	2.30	2.70
N	0.060	0.080
B		0.002
Cu		0.30

Co		0.03
Nb		0.01
Ti		0.10
Ta		0.01

11.5.2 Chemical analysis

The Steelmaker shall supply a ladle analysis certified by the Mill Manager or his duly accredited representative. In addition, they shall provide a product analysis taken from each rolled plate. This latter analysis may be performed on metal discards taken from mechanical test specimens.

Chemical analyses and crosschecks shall be performed in a laboratory of the steel manufacturer's choice, according to the laboratory's usual method. These analyses shall be performed in compliance with the requirements of RMC 1000 of RCC-MR 2007.

11.5.3 Ferrite content and magnetic permeability

The ferrite content evaluated using the Schaeffler diagram, modified by Pryce and Andrews (Figure RMC 1341.2, Section 3, RCC-MR 2007) and measured on a solution annealed product must be less or equal than 0.5 %.

The ferrite content shall be measured at the surface of each heat-treated rolling sheet or strip, at one quarter width at the top and bottom, close to mechanical test specimens. Method of testing is RMC 1340 of RCC-MR 2007 or by a method agreed between the Client and the Supplier.

The relative magnetic permeability of the finished plates shall be measured at room temperature after solution annealing. The value measured shall be lower than or equal to 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 A342-14. Specimen for testing shall be cut as described in the previous paragraph. Measurements of permeability made with other physical methods (e.g. permascope, magnetoscope, etc.) are accepted provided information about type and trademark of apparatus uses and information about calibration.

11.5.4 Structure

A micrographic examination with photographs must be made parallel to the rolling direction of each heat-treated plate rolling sheet or strip. The structure must be homogeneous.

11.5.4.1 Grain size

The grain size number determined in accordance with NF-EN ISO 643:2013 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.

The determination is performed on test samples taken from the immediate vicinity of the mechanical test specimens.

11.5.4.2 Non-metallic inclusions

Amount and definition shall meet standard ASTM E45-13.

Test shall be done from one edge of each heat-treated plate rolling sheet or strip.

Macroinclusions (exogenous inclusions from entrapped slag or refractories): they are strictly forbidden and are cause of rejection.

Microinclusions (indigenous inclusions detectable by microscopical test methods):
The rate of shall be checked using the Method D (or equivalent) to be within the following inclusion limits:

- Inclusion Type A ≤ 1.0
- Inclusion Type B ≤ 1.0
- Inclusion Type C ≤ 1.0
- Inclusion Type D ≤ 1.5

11.6 Manufacture

11.6.1 Manufacturing programme

Prior to the commencement of manufacturing operations, the material Supplier shall draw up a manufacturing programme. This programme shall include:

- Identification of melting process.
- Ingot weight and type.
- Identification of main hot-working operations.
- In case of continuing casting, the discard parameters, weight of blooms, etc.
- Top and bottom end discard percentages.
- Position of plate in the ingot, in particular the final rolling direction in relation to the ingot axis.
- Indication of the main rolling direction.
- Conditions for intermediate heat treatments and for final solution heat treatment (in particular, temperature, holding time and cooling method).
- Position of acceptance test samples on the plate.
- Dimensional drawing with position of test specimens in these samples.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

For plates less than 80 mm thick, points 2nd, 3rd and 5th of afore mentioned manufacturing programme are not required.

The program shall be agreed with the Client.

11.6.2 Delivery condition

The plates shall be delivered in a solution heat treated, pickled and passivated condition, equivalent to 1D finish according NF-EN 10088-2:2005.

11.6.2.1 Solution heat treatment

Solution heat treatment shall consist of maintaining a temperature of between 1050°C and 1150°C followed by water cooling and possible air cooling for smaller thicknesses. The thermal cycles shall be recorded and the records kept shall be presented in the test report.

11.6.2.2 Pickling- passivation - surface conditions

The pickling-passivation treatment shall be performed in compliance with the requirements of RF 6000. No trace of oil or grease must remain on the surface of the metal in the as-delivered condition.

The surface condition of the plates evaluated in accordance with RMC 7200 of RCC-MR 2007 must on average be at least that defined by scale N9 of LCA-CEA plate No.3, that is, a roughness of about 6.3 μm. If in doubt, this comparative examination shall be supplemented by a measurement using a roughness meter. The result of this measurement should be ≤ 9 μm.

Method of testing shall be proposed by Supplier and agreed with the Client. Roughness measurement in accordance with NF-EN ISO 4288:1998 can be used.

11.7 Mechanical properties

11.7.1 Required values

Mechanical strength requirements shall comply with values given in Table 2.

Table 2. Mechanical properties.

Tensile properties			
Test temperature (°C)	**Tensile Strength, (Rm) min (MPa)**	**Yield Strength ($Rp_{0.2\%}$) min (MPa)**	**Elongation A, (5d) min (%)**
Room	525-700	220	45
250	415	135	-

Note: Yield strength at 1% offset (**$R_{p1.0\%,}$**) shall be given for information purposes as the tensile strength (R_m) for tension testing at high temperature.

11.7.2 Sampling

Test samples shall be taken after the plate has been subjected to solution heat treatment. They shall be appropriately marked and show the final rolling direction.

The size of test samples shall be such that they can provide enough test specimens for all test and retests. Test samples shall be taken halfway between the edge and the axis of the plate centreline. Specimens shall not be taken closer to the edge of the sample than a distance equal to the thickness of the plate. The longitudinal axis of the test specimens shall be parallel to the rolling skins and perpendicular to the final rolling direction.

The longitudinal axis for tension test specimens is located as follows:

- For plates 30 mm thick or less, at mid-thickness.
- For plates thicker than 30 mm, at quarter thickness
- For plates less than 10 mm thick, the thickness of the test specimen shall be equal to the thickness of the plate (specimen with rectangular cross-section).

The tests shall be performed on specimens taken from samples subjected to no heat treatment after sampling.

The number of tests to be performed is given in Table 3.

11.7.2.1 Test procedure

11.7.2.1.1 Tension testing at room temperature

Test specimen:

Test specimens shall have a circular section. Their normal diameter shall be 10 mm and their dimensions as specified in Appendix D of NF-EN 10002-1:2001. For plates less than 20 mm thick, the cylindrical test specimen may be replaced by a specimen with a rectangular section. For details see RMC 1211 of RCC-MR 2007.

Test method:

The tension test shall be performed in compliance with NF-EN 10002-1:2001.

The following values shall be recorded:

- Yield strength at 0.2% offset, in MPa.
- Yield strength at 1% offset, in MPa.
- Ultimate tensile strength, in Mpa.
- Percentage elongation after fracture.
- Percentage reduction of the area after fracture.

Table 3. Number of and content of test – sampling

				Top end			Bottom end			Number of specimens	
Name of test	**Test temperature (°C)**	**Weight of plate**	**Thickness t**	**Full thick-ness**	**Mid-thick-ness**	**Quarter thick-ness**	**Full thick-ness**	**Mid-thick-ness**	**Quarter thick-ness**	**Per heat**	**Per sheet**
Solution heat treated (SHT)											
Tensile	**Room**	≤ 3000 kg	< 10 mm	1							1
			10 mm ≤ t ≤ 30 mm		1						1
			> 30 mm			1					1
	Room	> 3000 kg	< 10 mm	1			1				2
			10 mm ≤ t ≤ 30 mm		1			1			2
			> 30 mm			1			1		2
	200	Regardless of weight	< 10 mm	1						1	
			10 mm ≤ t ≤ 30 mm		1					1	
			> 30 mm			1				1	

SHT – solution heat treated

Results:

The results obtained shall meet the requirements given in Table 2 (the percentage of area reduction and yield strength at 1% offset shall be given for information). If this is not the case and the test specimen has a physical defect (which does not affect the usefulness of the product) or if unsatisfactory test results are due to incorrect mounting of the specimen or a testing machine malfunction, the test shall be repeated using another specimen. If the results of the second test are satisfactory, the rolled sheet shall be accepted; if not, the following paragraph shall apply.

When unsatisfactory results cannot be attributed to any of the above mentioned causes, two retests may be performed for each unsatisfactory result obtained. The second set of test specimens shall be compared to the defective ones. If the results of the retest are satisfactory, the rolled sheet shall be accepted; if not, it shall be rejected, see chapter “Retreatment”.

11.7.2.1.2 Tension testing at high temperature

Test specimen:

The nominal diameter shall be 10 mm. The dimensions are as specified in NF-EN 10002-5:1992. For plates less than 20 mm thick, the cylindrical test specimen may be replaced by a specimen with a rectangular section. For details see RMC 1212 of RCC-MR 2007.

Test methods:

The tension test shall be performed in compliance with NF-EN 10002-5:1992. The rate of stressing shall not exceed 80MPa per minute up to the yield strength. For details see RMC 1212 of RCC-MR 2007.

Results:

Yield strength at 0.2% offset obtained shall meet the requirements given in Table 2. If this not the case, the paragraph" Results" of chapter "Tension test at room temperature" shall be applied.

11.7.3 Retreatment

Rolled plates rejected on the basis of unsatisfactory results for one or more mechanical tests may be retreated (solution heat treatment as per 5.2.1) Retreatment conditions shall be described in the test report.

In the case of rejection, test specimens shall be taken in the same condition as specified in chapter 11.6.2. Tests performed shall be the same as those described in chapter 11.6.2.

Not more than one retreatment shall be allowed.

11.8 Surface examination - surface defects

Plates shall be visually examined. 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 in accordance with RMC 7100 of RCC-MR 2007. 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 RMC 4000 of RCC-MR 2007. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook requirements.

Criteria:

Indications with one dimension exceeding 1 mm shall be considered as a recordable condition.

The following are acceptable:

- Linear indications of 8 mm or less for plates 40 mm thick or less, and of 10 mm or less for plates more than 40 mm thick.
- As the operating conditions of the plates could lead to a risk of lamellar tear, the only acceptable indications are those with a cumulative length over the most densely covered meter as follows:
    - Less than 30 mm for plates up to 40 mm thick.
    - Less than 40 mm for plates over 40 mm thick.

Two separate indications are considered as one if the distance between them is less than twice the length of the smaller of the two. The length of the indication is then equal to the sum of the length of the two indications plus the distance between them.

If these criteria are not respected, no repair welds shall be authorized and the part is rejected.

However, if there are special and highly localized indications (which can be checked by shear wave ultrasonic examination) this zone can be eliminated by grinding and the plate accepted if its dimensions remain within the acceptable tolerances.

Note: if during use, cleavage or lamination appears, the plate shall be discarded.

11.9 Volumetric examination

All plates shall be examined. An ultrasonic examination shall be performed in compliance with RMC 2400 of RCC-MR 2007, which states the condition for application of standard EN 10307.

The examination shall only be carried out for parts at least 30mm thick, in accordance with the scanning plan and the criteria given in standard NF-EN 10307:2002, quality class S2 for plate body and quality class E3 for plate edges.

11.10 Removal of unacceptable areas

11.10.1 Removal by grinding

The Supplier may remove surface defects by grinding, providing that:

- The remaining thickness is within the tolerances specified by the drawing or the purchase order.
- The cavity blends smoothly with the surrounding surface.

After removal, the surface is subject to liquid penetrant examination in accordance with RMC 4000 of RCC-MR 2007. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook.

The following criteria shall be applied for the liquid penetrant examination.

An indication greater than 1 mm shall be considered recordable conditions.

The following are unacceptable:

- Linear indications.
- Rounded indications with one dimension greater than 2 mm.

11.10.2 Repair welding

As general rule, the Rolling Mill shall not be authorised to perform welding repairs.

11.11 Dimensional check - tolerances

Dimensional checks shall be performed following procedures and requirements of ordering information of the Technical Specification.

The dimensions of the plates shall comply with requirements of the purchase order. The tolerances for thickness, length, width, flatness, edge camber and out-of squareness shall comply with NF-EN 10029:2011.

The following are requirements for tolerances:

- Thickness tolerance - Class C as in NF-EN 10029:2011.
- Flatness tolerances - Class S as in NF-EN 10029:2011.
- Edge camber shall be limited to 0.2% of the actual length of plate and out-of-squareness limited to 1% of actual width (G), as specified in NF-EN 10029:2011.

11.12 Marking

The Supplier shall specify the identification and marking method used, in compliance with RC 1300 of RCC-MR 2007.

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.

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.

11.13 Cleanliness-packaging-transportation

Requirements are specified in the purchase order, taking particular account the requirements of RF 6000 of RCC-MR 2007.

11.14 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.

11.15 Documentation and test report

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

The Inspection Certificate is accepted only provided the Material Manufacturer has an appropriate quality-assurance system, certified by a competent body established within the European Community and having undergone a specific acceptance for materials.

Inspection certificate type 3.2 in accordance with NF-EN 10204:2004 can be provided by Supplier after agreement with the Client, providing justification that the Accepted Notified Body or another Authorised Third Party Organisation followed the testing as specified in accordance with NF-EN 10204:2004.

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

- Ladle and product analyses.
- Melting process method.
- Records of micrographic examination, inclusions and grain size.
- Ferrite content and permeability.
- Results of mechanical property tests.
- Non-destructive examination.
- Dimensional check and roughness.
- Record of heat treatment.

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.
- Name of the Inspection Agency, where applicable.
- Test and retest results together with required values.
- Packaging data.

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.

11.16 Quality system requirements

The Supplier shall implement an adequate and currently operational quality control system capable of ensuring that:

- Contract requirements will be met.
- Evidence of such compliance will be maintained.

The quality control system implemented by the Supplier shall:

- Be based on recognized quality standards.
- Encompass all activities performed in connection with the contract.
- Be described in a manual to be submitted to the Client at the start of the work.

The Supplier shall ensure that each subcontractor implements an effective quality control system. Failing this, the Supplier shall undertake all necessary actions to establish and maintain quality control in the subcontractors' premises.

The quality organisation shall comply with the requirements defined in the contract.

11.17 Access of Inspectors

Representatives of the Client and of 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 Client and TPI and make available to them such information and documents as are necessary to determine the progress and status of the work.

12 Appendix 2: Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless-steel forgings for the PP in-vessel components

12.1 Scope

This Specification covers 316L(N)-IG austenitic stainless-steel forgings and drop forgings with unit weight of not more than 10 tonnes as-delivered condition for the ITER port plug structures in-vessel components.

Generally, 316L(N)-IG steel is grade 316L steel with narrower alloying element ranges and controlled impurities. The closest analogy is X2CrNiMo17-12-2 controlled nitrogen content austenitic stainless steel described in the RCC-MR Code, Edition 2007.

This Specification is based on the product procurement specification RM 3321in RCC-MR 2007 for forgings, plus additional requirements arising from the features of the ITER vacuum vessel and ports components. The forgings are considered for equipment Class 2 (in accordance with RCC-MR classification).

The amount of stainless-steel forged material to be procured shall include appropriate contingency to face unexpected difficulties, to remake rejected parts and to repair parts with insufficient quality.

The supply covers the following items:

- Manufacture of the total quantity of stainless-steel forged material grade 316L(N)-IG.
- 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.

12.2 Referenced documents

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

12.2.1 Design and Construction Code:

- RCC-MR, Edition 2007
- RCC-MR, 2007, Section 2 – Materials, Chapter RM 3331
- Applicable requirements of RM 0100 of RCC-MR, Edition 2007 must be respected.

12.2.2EN and ASTM Standards:

- **NF-EN 10222-1: 1998** Steels forgings for pressure purposes, Part 1: General requirements for open die forgings.
- **NF-EN 10002-1: 2001** Tensile testing at ambient temperature.
- **NF-EN 10002-5: 1992** Tensile testing at elevated temperature.
- **NF-EN 10228-4: 1999** Non-destructive testing of steel forgings, Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless-steel forgings.
- **NF-EN 10204: 2004** Metallic products: Type of inspection documents.
- **NF-EN ISO 643: 2013** Steels - Micrographic determination of the apparent grain size.

- **ASTM E45-13** Standard test methods for determining the inclusion content of steel.
- **ASTM A342-14** Standard Test Methods for Permeability of Feebly Magnetic Materials.

EN, ISO and ASTM standards mentioned in this PPS may be considered in their last revision at the time of the sign of the contract provided that equivalency is demonstrated.

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 Client's approval.

The use of EN but non-NF Standards is also allowed demonstrating equivalence with the corresponding NF version of the Standard.

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

12.3 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 (Electro-Slag Remelting ESR). The refining processes are argon-oxygen decarburization (AOD), vacuum oxygen de-carbonised (VOD).

Supplier shall propose refining method, which shall be agreed with the Client.

12.4 Chemical requirements and physico-chemical characteristics

12.4.1 Required values

The chemical composition determined by ladle and product analyses, shall comply with the requirements given in Table 1.

Table 1. Chemical composition

Element	Alloying elements and impurities content, wt. %.	
	Minimum	**Maximum**
C		0.030
Mn	1.60	2.00
Si		0.50
P		0.025
S		0.010
Cr	17.00	18.00
Ni	12.00	12.50
Mo	2.30	2.70
N	0.060	0.080
B		0.0020
Cu		0.30
Co		0.03
Nb		0.01
Ti		0.10
Ta		0.01

12.4.2 Chemical analysis

The Steelmaker shall supply a ladle analysis certified by the Mill Manager or his duly accredited representative. A product analysis is made per part for parts listed in RM 0141 of RCC-MR 2007. A product analysis is made per heat.

This analysis may be performed on metal discards taken from mechanical test specimens. Chemical analyses and crosschecks shall be performed in a laboratory of Steelmaker choice, according to that laboratory's usual method. These analyses shall be performed in compliance with the requirements of RMC 1000 of RCC-MR 2007.

12.4.3 Ferrite content and magnetic permeability

The ferrite content evaluated using the Schaeffler diagram, modified by Pryce and Andrews (Figure RMC 1341.2, Section 3, RCC-MR 2007) and measured on a solution annealed product must be less or equal than 0.5 %.

The ferrite content shall be measured per lot in the mechanical test specimen sampling zone. Method of testing is RMC 1340 of RCC-MR, Edition 2007 or by method agreed between the Client and the Supplier.

The relative magnetic permeability of the finished plates shall be measured at room temperature after solution annealing. The value measured shall be equal or 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 A342-14 (see note). Specimen for testing shall be cut as described in the previous paragraph. Measurements of permeability made with other physical methods (e.g. permascope, magnetoscope, etc.) are accepted provided information about type and trade mark of apparatus uses and information about calibration.

12.4.4 Structure

A micrographic examination, with photographs, shall be performed parallel to the main direction of extension. The structure must be homogeneous.

12.4.4.1 Grain size

The grain size number as determined in accordance with NF-EN ISO 643:2013 shall be greater than 2. The grain size homogeneity shall be ±1 around the true average value. The grain size is determined on a test sample taken close to the mechanical test specimens.

12.4.4.2 Non-metallic inclusions

Amount and definition shall meet standard ASTM E45-13.

Macroinclusions (exogenous inclusions from entrapped slag or refractories): they are strictly forbidden and are cause of rejection.

Microinclusions (indigenous inclusions detectable by microscopical test methods). The rate of shall be checked using the Method D (or equivalent) to be within the following inclusion limits:

- Inclusion Type A ≤ 1.0
- Inclusion Type B ≤ 1.0
- Inclusion Type C ≤ 1.0
- Inclusion Type D ≤ 1.5

Test shall be done from one edge of forging.

12.5 Manufacture

12.5.1 Manufacturing programme

Before the beginning of manufacturing operations, the Foundry shall draw up a manufacturing programme. This programme shall include the following:

- Identification of melting process.
- Drawing of parts as-forged or drop-forget, profiles for heat treatment, non-destructive examination and delivery.
- Conditions for intermediate heat treatments and for final heat treatment.
- Position of acceptance test samples on the part.
- Dimensional drawing with position of test specimens on samples.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

The produced parts shall be multi-directionally cross-forged. The program shall be agreed with the Client. The overall ratio of reduction as determined in RM 0380 of RCC-MR 2007shall be greater than 3.

12.5.2 Delivery condition

Forged parts shall be delivered in the solution heat treated condition then machined to the as-delivered profile.

12.5.2.1 Solution heat treatment

Solution heat treatment shall consist of holding at a temperature between 1050°C and 1150°C followed by water cooling. The thermal cycles shall be recorded and the records kept shall be presented in the test report.

12.5.2.2 Machining - surface conditions

The parts shall be machined to its as-delivered profile. The surface condition determined in accordance with RMC 7200 of RCC-MR 2007 shall meet the following requirement: roughness Ra shall not exceed 6.3 microns measured by roughness meter.

12.6 Mechanical properties

12.6.1 Required values

Mechanical strength requirements shall comply with values given in Table 2.

Table 2. Mechanical properties.

Tensile properties			
Test temperature (°C)	**Tensile Strength, (Rm) min (MPa)**	**Yield Strength ($Rp_{0.2\%}$) min (MPa)**	**Elongation A, (5d) min (%)**
Room	525-700	220	45
250	415	135	-

Note: Yield strength at 1% offset (**$R_{p1.0\%,}$**) shall be given for information purposes as the tensile strength (R_m) for tension testing at high temperature.

12.6.2 Sampling

12.6.2.1 General

Test samples shall be cut:

- Either from the part itself.
- Or from a prolongation or excess material integrally attached to the part, after the part has undergone solution heat treatment; it shall be appropriately marked.

The size of the test samples shall be such that they can provide enough test specimens for all test and retests. Insofar as the shape of the parts so allows, test specimens shall be cut out in such a way that their axis is oriented perpendicular to the main forging direction and the distance between the axis and the nearest treated surface (skin) is:

- 20 mm if thickness is > 40 mm.
- Mid-thickness if the thickness is ≤ 40 mm.

The distance between the test-pertinent area of the test specimen and the other treated surfaces shall not be less than:

- 40 mm if the thickness is > 40 mm,
- The thickness if this is ≤ 40 mm.

If the shape of the parts does not permit this, values as close as possible to those given above shall be obtained.

12.6.2.2 Drop-forget parts

Mechanical test samples shall be cut out from one or more parts in a lot or, when this is impossible (for instance, very small parts) and subject to the approval of the Contractor, from a test bar of the same heat of steel simultaneously treated in the same heat treatment charge. This test bar shall first have been subjected to forging operations considered to be representative of those undergone by the parts.

The position of test specimen in the parts or the test bar shall be given in the mechanical test report in accordance with previous chapter “General”.

12.6.3 Testing

Tests shall be performed on test specimens which were not subjected to heat treatment after sampling.

12.6.3.1 Definition a lot

- General case:

A lot shall comprise parts of similar shape, cross-section and diameter, as defined below:

$$Ø_{max}/\ Ø_{min} \leq 1.1\ ;\ e_{max}/\ e_{min} \leq 1.1\ ;\ S_{max}/\ S_{min} \leq 1.25$$

- Special case:

The dimensions given above do not apply to hollow, circular parts 80 mm thick or less and weighting 500 kg or less.

In all cases the parts of the lot shall be from the same heat of steel. They shall undergo the same processing cycle and shall be from the same furnace charge or shall been subjected to the same heat treatment run. A lot shall be limited to 5000 kg. However, each part with an as-delivered

unit weight of more than 1000 kg shall constitute a lot. In addition, each part listed in RM 0141 of RCC-MR 2007 shall constitute a lot.

12.6.3.2 Number and content of tests

One series of tests shall be performed per lot for parts weighting 500 kg or less and two series of tests shall be performed for parts weighting more than 500 kg. A test series shall comprise:

- Tension testing at room temperature.
- Tension testing at high temperature.

12.6.3.3 Test procedure

12.6.3.3.1 Tension testing at room temperature

- **Test specimen:**

  Test specimens shall have a circular section. Their normal diameter shall be 10 mm and their dimensions as specified in Appendix D of NF-EN 10002-1:2001. For details see RMC 1211 of RCC-MR 2007.

- **Test method:**

  The tension test shall be performed in compliance with NF-EN 10002-1:2001.

  The following values shall be recorded:

  - Yield strength at 0.2% offset, in MPa.
  - Yield strength at 1% offset, in MPa.
  - Ultimate tensile strength, in MPa.
  - Percentage elongation after fracture.
  - Percentage reduction of area after fracture.

- **Results**

  Results obtained shall meet the requirements given in Table 2 (percentage of reduction of area and yield strength at 1% offset shall be given for information purposes). If this is not the case and the test specimen has a physical defect (which does not affect the usefulness of the product) or if unsatisfactory test results are due to incorrect mounting of the specimen or a testing machine malfunction, the test shall be repeated using another specimen. If the results of the second test are satisfactory, the part and /or the lot shall be accepted; if not, the following paragraph shall apply.

  When unsatisfactory results cannot be attributed to any of the above-mentioned causes, two retests may be performed for each unsatisfactory result obtained. The second set of test specimen shall be taken from an area close to the one were defective samples originated from. If the results of the retest are satisfactory, the lot shall be accepted; if not, it shall be rejected, see chapter “Retreatment”.

12.6.3.3.2 Tension testing at high temperature

- **Test specimen:**

  The nominal diameter shall be 10 mm. The dimensions are as specified in NF-EN 10002-5:1992. For details see RMC 1212 of RCC-MR 2007.

- **Test methods:**

The tension test shall be performed in compliance with NF-EN 10002-5:1992. The rate of stressing shall not exceed 80MPa per minute up to yield strength. For details see RMC 1212 of RCC-MR 2007.

- **Results**

  Yield strength at 0.2% offset obtained shall meet the requirements given in Table 2. If this not a case, the paragraph" Results" of chapter "Tension test at room temperature" shall be followed.

12.6.4 Retreatment

Lots rejected on the basis of unsatisfactory results for one or more mechanical tests may be retreated (solution heat treatment). Retreatment conditions shall be described in the test report.

In such cases, test specimens shall be taken in the same conditions as specified in chapter 12.6.2. Test performed shall be the same as those described in chapter 12.6.3.

No more than one retreatment shall be allowed.

12.7 Surface examination - surface defects

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

The part shall be sound and free of scale, strings, tears, nicks or other injurious defects.

A visual examination shall be performed on all parts, and this shall be followed by a liquid penetrant examination in accordance with RMC 4000 of RCC-MR 2007. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook.

The following recordable conditions and examination criteria shall be applied for liquid penetrant examination.

Except in the particular case described below, any defects with one dimension of 1 mm or more shall be considered a recordable condition.

The following indications shall be unacceptable:

- Linear indications.
- Rounded indications with one dimension greater than 3 m.
- 3 or more indications aligned less than 3 mm apart edge to edge.
- 5 or more grouped indications within a rectangular area of 100 cm^2, whose greater dimension shall not exceed 20 cm, taken in the most unfavorable location relative to the indication being evaluated.

In the particular case of parts to be deep machined (removal of over 30% of the wall thickness), the condition regarding grouped indications shall be applied taking into account defects with one dimension greater than 0.5 mm.

When the examination described above indicate the presence of unacceptable defects on the part, the instruction of chapter "Removal of unacceptable areas" shall apply.

12.8 Volumetric examination

An ultrasonic volumetric examination shall be performed for all forgings.

12.8.1 Degree ant time of examination

This examination shall be performed when the profile of the part permits satisfactory test performance. It shall be performed in the following order of preference:

- After final machining,
- After heat treatment for mechanical properties, whether subsequent machining is performed or not.

Parts or portions of parts which cannot be examined after heat treatment due to the geometry of the part shall be examined at the latest intermediate stage possible.

In the case of small, formed parts, the examination may be performed on semi-finished products.

12.8.2 Procedures

Ultrasonic examination procedures are specified in RMC 2310 and RMC 2320 of RCC-MR 2007 and conditions specified in standard NF-EN 10228-4:1999 shall apply.

Probe characteristics shall normally be as follows:

- Straight beam examination: frequency 2 MHz.
- Angle beam examination: frequency 1 MHz, refraction angle depends on the part geometry.

A lower frequency may be used for thick parts if the structure so requires.

12.8.3 Scanning plane and degree of examination

The entire volume of the part shall be subject to ultrasonic examination. 100% scanning coverage defined in §12.4 of standard NF-EN 10228-4:1999 shall be performed. Part type is 1, 2, 3 or 4.

12.8.4 Evaluation of indications

Indications shall be evaluated in accordance with the requirements of RMC 2310 and RMC 2320 of RCC-MR 2007.

12.8.5 Recordable conditions and examination criteria

- **Straight beam examination:**

  The ranges considered and the acceptance criteria which depends on the thickness of the part examined, shall be those defined by the standard NF-EN 10228-4:1999 for normal probe. The quality class 2 shall be adopted.

  For thickness above or equal 75 mm, concerning the loss of back echo, the recordable attenuation range is $R \leq 0.12$ with no acceptability limit.

- **Angle beam examination:**

  Any indications with echo amplitude $\geq$ 50% of the reference echo shall be recorded.

  Any indication whose echo amplitude is greater than the reference echo amplitude shall be unacceptable.

12.9 Removal of unacceptable areas

The Forging Mill may eliminate surface defects by grinding, provided the dimensional tolerances of the part in the as-delivered condition are respected.

After grinding, a liquid penetrant examination shall be performed in accordance with RMC 4000 of RCC-MR 2007. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook requirements.

Examination criteria shall be those defined in chapter “Surface examination - surface defects”.

No repairs by welding by the Forging Mill shall be permissible.

12.10 Dimensional check - tolerances

The dimensions shall be checked in accordance with the requirements of procurement drawings and ordering information of the Technical Specification.

The main dimensions shall be recorded.

The values shall be within the tolerances given on the drawing.

In case of drop forgings, this examination shall be performed by representative sampling.

12.11 Marking

The Supplier shall specify the identification and marking method used, in compliance with RC 1300 of RCC-MR 2007.

Marking shall include:

- Manufacturer name or symbol.
- Forging number or unique identification number related to quality history.
- Grade of material.
- Heat number.

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 purchase order.

12.12 Cleanliness-packaging-transportation

Requirements are specified in the purchase order, taking particular account the requirements of RF 6000 of RCC-MR 2007.

12.13 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.

12.14 Documentation and test report

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

The Inspection Certificate is accepted only provided the Material Manufacturer has an appropriate quality-assurance system, certified by a competent body established within the European Community and having undergone a specific acceptance for materials.

Inspection certificate type 3.2 in accordance with NF-EN 10204:2004 can be provided by Supplier after agreement with the Client, providing justification that the Accepted Notified Body or another Authorised Third Party Organisation followed the testing as specified in accordance with NF-EN 10204:2004.

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

- Ladle and product analyses.
- Melting process method.
- Records of micrographic examination, inclusions and grain size.
- Ferrite content and permeability.
- Results of mechanical property tests.
- Non-destructive examination.
- Dimensional check.
- Record of heat treatment.

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.
- Name of the Inspection Agency, where applicable.
- Test and retest results together with required values.
- Packaging data.

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.

12.15 Quality system requirements

The Supplier shall implement an adequate and currently operational quality control system capable of ensuring that:

- Contract requirements will be met.
- Evidence of such compliance will be maintained.

The quality control system implemented by the Supplier shall:

- Be based on recognized quality standards.
- Encompass all activities performed in connection with the contract.
- Be described in a manual to be submitted to the Client at the start of the work.

The Supplier shall ensure that each subcontractor implements an effective quality control system. Failing this, the Supplier shall undertake all necessary actions to establish and maintain quality control in the subcontractors' premises.

The quality organisation shall comply with the requirements defined in the contract.

12.16 Access of Inspectors

Representatives of the Client and of 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 Client and TPI and make available to them such information and documents as are necessary to determine the progress and status of the work.

13 Appendix 3: Product Procurement Specification for the supply of 316L(N)-IG austenitic stainless steel rolled or forged bars and semi-finished products for the PP in-vessel components

13.1 Scope

This Specification covers 316L(N)-IG austenitic stainless-steel forgings and drop forgings with unit weight of not more than 10 tonnes as-delivered condition for the ITER Port Plug In-vessel components.

Generally, 316L(N)-IG steel is grade 316L steel with narrower alloying element ranges and controlled impurities. The closest analogy is X2CrNiMo17-12-2 controlled nitrogen content austenitic stainless steel described in the RCC-MR Code, Edition 2007.

This Specification is based on the product procurement specification RM 3324 in RCC-MR 2007 for bars, plus additional requirements arising from the features of the ITER vacuum vessel and port components. The rolled or forged bars and semi-finished products are considered for equipment Class 2 (in accordance with RCC-MR classification).

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

The supply covers the following items:

- Manufacture of the total quantity of stainless-steel bars and semi-finished products grade 316L(N)-IG.
- 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.

13.2 Referenced documents

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

13.2.1 Design and Construction Code:

- RCC-MR, Edition 2007.
- RCC-MR, 2007, Section 2 – Materials, Chapter RM 3324.
- Applicable requirements of RM 0100 of RCC-MR, Edition 2007 must be respected.

13.2.2 EN and ASTM Standards:

- **NF-EN 10272: 2008** Stainless steel bars for pressure purposes.
- **NF-EN 10002-1: 2001** Tensile testing at ambient temperature.
- **NF-EN 10002-5: 1992** Tensile testing at elevated temperature.

- **NF-EN 10228-4: 1999** Non-destructive testing of steel forgings, Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless-steel forgings.
- **NF-EN 10204: 2004** Metallic products: Type of inspection documents.
- **NF-EN ISO 643: 2013** Steels - Micrographic determination of the apparent grain size.
- **ASTM E 45-13** Standard test methods for determining the inclusion content of steel.
- **ASTM A342-14** Standard Test Methods for Permeability of Feebly Magnetic Materials.

EN, ISO and ASTM standards mentioned in this PPS may be considered in their last revision at the time of the sign of the contract provided that equivalency is demonstrated.

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 Client's approval.

The use of EN but non-NF Standards is also allowed demonstrating equivalence with the corresponding NF version of the Standard.

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

13.3 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).

Supplier shall propose refining method, which shall be agreed with the Client.

13.4 Chemical requirements and physico-chemical characteristics

13.4.1 Required values

The chemical composition determined by ladle and product analyses, shall comply with the requirements given in Table 1.

Table 1. Chemical composition

Element	Alloying elements and impurities content, wt. %.	
	Minimum	**Maximum**
C		0.030
Mn	1.60	2.00
Si		0.50
P		0.025
S		0.010
Cr	17.00	18.00
Ni	12.00	12.50
Mo	2.30	2.70
N	0.060	0.080
B		0.0020
Cu		0.30
Co		0.03

Nb		0.01
Ti		0.10
Ta		0.01

13.4.2 Chemical analysis

The Steelmaker shall supply a ladle analysis certified by the Mill Manager or his duly accredited representative. A product analysis is made per heat.

This analysis may be performed on metal discards taken from mechanical test specimens. Chemical analyses and crosschecks shall be performed in a laboratory of Steelmaker choice, according to that laboratory's usual method. These analyses shall be performed in compliance with the requirements of RMC 1000 of RCC-MR 2007.

13.4.3 Ferrite content and magnetic permeability

The ferrite content evaluated using the Schaeffler diagram, modified by Pryce and Andrews (Figure RMC 1341.2, Section 3, RCC-MR 2007) and measured on a solution annealed product must be equal or less than 0.5 %.

The ferrite content shall be measured on the surface of one bar per lot. Method of testing is RMC 1340 of RCC-MR 2007 or by a method agreed between the Client and the Supplier.

The relative magnetic permeability of the finished plates shall be measured at room temperature after solution annealing. The value measured shall be equal or lower than 1.03 (see note[1]) (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 A342-14 (see note). Specimen for testing shall be cut as described in the previous paragraph. Measurements of permeability made with other physical methods (e.g. permascope, magnetoscope, etc.) are accepted provided information about type and trademark of apparatus uses and information about calibration.

13.4.4 Structure

A micrographic examination, with photographs, shall be performed parallel to the main direction of extension. The structure must be homogeneous.

13.4.4.1 Grain size

The grain size number as determined in accordance with NF-EN ISO 643:2013 shall be greater than 2. The grain size homogeneity shall be ±1 around the true average value. The grain size is determined on a test sample taken close to the mechanical test specimens.

13.4.4.2 Non-metallic inclusions

Amount and definition shall meet standard ASTM E45-13.

Microinclusions (indigenous inclusions detectable by microscopical test methods): method D is applicable. Severity level number shall be at most 2. The tolerance for acceptance may be a half-class above the set limit to the extent of 2% of the fields counted.

Macroinclusions (exogenous inclusions from entrapped slag or refractories): they are strictly forbidden and are cause of rejection.

Test shall be done from one edge of bars.

13.5 Manufacture

The overall ratio of reduction calculated in accordance with RM 0380 of RCC-MR 2007, should not, as general rule, be greater than 3.

13.5.1 Manufacturing programme

Before the beginning of manufacturing operations, the Foundry shall draw up a manufacturing programme. This programme shall include the following:

- Identification of melting process.
- As-treated and as-delivered bar diameters.
- Conditions for intermediate heat treatments and for final heat treatment.
- Dimensional drawing with position of test specimens on samples.

The various heat treatments, sampling and non-destructive examination operations shall be presented in chronological order.

The produced parts shall be multi-directionally cross-forged. The program shall be agreed with the Client. The overall ratio of reduction as determined in RM 0380 of RCC-MR 2007shall be greater than 3.

The program shall be agreed with the Client.

13.5.2 Delivery condition

Bars shall be delivered in the solution heat treated condition.

13.5.2.1 Solution heat treatment

Solution heat treatment shall consist of holding at a temperature between 1050°C and 1150°C followed by water cooling. The thermal cycles shall be recorded, and the records kept shall be presented in the test report.

13.5.2.2 Machining - surface conditions

The bars shall be machined to its as-delivered profile. The surface condition determined in accordance with RMC 7200 of RCC-MR 2007 shall meet the following requirement: roughness Ra shall not exceed 6.3 microns.

13.6 Mechanical properties

13.6.1 Required values

Mechanical strength requirements shall comply with values given in Table 2.

Table 2. Mechanical properties.

Tensile properties			
Test temperature (°C)	**Tensile Strength, (Rm) min (MPa)**	**Yield Strength ($Rp_{0.2\%}$) min (MPa)**	**Elongation A, (5d) min (%)**
Room	525-700	220	45
250	415	135	-

Note: Yield strength at 1% offset ($\mathbf{R_{p1.0\%,}}$) shall be given for information purposes as the tensile strength (R_m) for tension testing at high temperature.

13.6.2 Sampling

Test samples shall be cut after the bar or semi-finished product has undergone solution heat treatment; they shall be appropriately marked.

The size of the test samples shall be such that they can provide enough test specimens for all tests and retests.

Sampling procedures are defined in §9.5.2 of the standard NF-EN 10272:2008 (figure 1 and 2).

13.6.3 Retreatment testing in solution heat treated condition

Tests shall be performed on test specimens which were not subjected to heat treatment after sampling.

13.6.3.1 Definition a lot

A lot shall comprise parts of similar shape, cross-section and diameter, as defined below:

$$Ø_{max}/ Ø_{min} \leq 1.1 ; e_{max}/ e_{min} \leq 1.1 ; S_{max}/ S_{min} \leq 1.25$$

These parts are produced from the same heat, have been subjected to the same manufacturing cycle and form part of the same furnace charge or the same heat treatment cycle. A lot shall be restricted to 3000 kg.

13.6.3.2 Number and content of tests

One series of tests shall be performed per lot for parts weighting 500 kg or less and two series of tests shall be performed for parts weighting more than 500 kg. A test series shall comprise:

- Tension testing at room temperature.
- Tension testing at high temperature.

13.6.3.3 Test procedure

13.6.3.3.1 Tension testing at room temperature

- **Test specimen:**

  Test specimens shall have a circular section. Their normal diameter shall be 10 mm and their dimensions as specified in Appendix D of NF-EN 10002-1:2001. For details see RMC 1211 of RCC-MR 2007.

- **Test method:**

  The tension test shall be performed in compliance with NF-EN 10002-1:2001.

  The following values shall be recorded:

  - Yield strength at 0.2% offset, in MPa.
  - Yield strength at 1% offset, in MPa.
  - Ultimate tensile strength, in MPa.
  - Percentage elongation after fracture.
  - Percentage reduction of area after fracture.

- **Results:**

  Results obtained shall meet the requirements given in Table 2 (percentage of reduction of area and yield strength at 1% offset shall be given for information purposes).

  If this is not the case and the test specimen has a physical defect (which does not affect the usefulness of the product) or if unsatisfactory test results are due to incorrect mounting of the specimen or a testing machine malfunction, the test shall be repeated

using another specimen. If the results of the second test are satisfactory, the piece and/or lot shall be accepted; if not, the following paragraph shall apply.

When unsatisfactory results cannot be attributed to any of the above-mentioned causes, two retests may be performed for each unsatisfactory result obtained. The second set of test specimen shall be taken close to those which were defective. If the results of the retest are satisfactory, the piece and/or lot shall be accepted; if not, it shall be rejected, see chapter “Retreatment”.

13.6.3.3.2 Tension testing at high temperature

- **Test specimen:**

  The nominal diameter shall be 10 mm. The dimensions are as specified in NF-EN 10002-5:1992. For details see RMC 1212 of RCC-MR 2007.

- **Test methods:**

  The tension test shall be performed in compliance with NF-EN 10002-5:1992. The rate of stressing shall not exceed 80MPa per minute up to yield strength. For details see RMC 1212 of RCC-MR 2007.

- **Results:**

  Yield strength at 0.2% offset obtained shall meet the requirements given in Table 2. If this not a case, the paragraph ”Results” of chapter “Tension test at room temperature” shall be followed.

13.6.4 Retreatment

Lots rejected on the basis of unsatisfactory results for one or more mechanical tests may be retreated (solution heat treatment). Retreatment conditions shall be described in the test report.

In such cases, test specimens shall be taken in the same conditions as specified in chapter 13.6.2. Test performed shall be the same as those described in chapter 13.6.3.

No more than one retreatment shall be allowed.

13.7 Surface examination - surface defects

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

The bars shall be sound and free of scale, strings, tears, nicks or other injurious defects.

A visual examination shall be performed on all parts, and this shall be followed by a liquid penetrant examination in accordance with RMC 4000 of RCC-MR 2007. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook.

The following recordable conditions and examination criteria shall be applied:

- Any defects with one dimension of 1 mm or more.
- All defects which the following indications shall be unacceptable:
  - Linear indications.
  - Rounded indications with one dimension greater than 3 mm.
  - 3 or more indications aligned less than 3 mm apart edge to edge.

- 5 or more grouped indications within a rectangular area of 100 cm^2, whose greater dimension shall not exceed 20 cm, taken in the most unfavorable location relative to the indication being evaluated.

When the examination described above indicate the presence of unacceptable defects on the part, the instruction of chapter “Removal of unacceptable areas” shall apply.

13.8 Volumetric examination

Research of internal defects shall be carried out by ultrasonic examination.

13.8.1 Degree ant time of examination

This examination shall be performed after heat treatment and machining to delivery dimension.

13.8.2 Procedures

Ultrasonic examination procedures are specified in RMC 2310 and standard NF-EN 10228-4:1999 shall apply. Probe characteristics shall normally be 2 MHz.

13.8.3 Scanning plane and degree of examination

The entire volume of the part shall be subject to ultrasonic examination.

100% scanning coverage defined in §12.4 of EN 10228-4:1999 shall be performed.

Part type is 1.

13.8.4 Evaluation of indications

Indications shall be evaluated in accordance with the requirements of RMC 2310.

13.8.5 Recordable conditions and examination criteria

The ranges considered and the acceptance criteria which depend on thickness of the part examined, shall be those defined by the standard NF-EN 10228-4:1999 for normal probe. The quality class 2 shall be adopted.

For thickness above or equal to 75 mm, concerning the loss of back echo, the recommended attenuation range is R< 0.12 with no acceptability limit.

13.9 Removal of unacceptable areas

The Forging Mill may eliminate surface defects by grinding, provided the dimensional tolerances of the part in the as-delivered condition are respected.

After grinding, a liquid penetrant examination shall be performed in accordance with RMC 4000. Penetrant used shall be compatible with requirements of the ITER Vacuum Handbook.

Examination criteria shall be those defined in chapter “Surface examination – surface defects”.

No repairs by welding by the Forging Mill shall be permissible.

13.10 Dimensional check

Dimensional checks shall be performed following procedures and requirements of ordering information of the Technical Specification.

The main dimensions shall be recorded.

13.11 Marking

The Supplier shall specify the identification and marking method used, in compliance with RC 1300 of RCC-MR 2007.

Marking shall include:

- Manufacturer name or symbol.
- Bar number or unique identification number related to quality history.
- Grade of material.
- Heat number.

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.

13.12 Cleanliness-packaging-transportation

Requirements are specified in the purchase order, taking particular account the requirements of RF 6000 of RCC-MR 2007.

13.13 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.

13.14 Documentation and test report

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

The Inspection Certificate is accepted only provided the Material Manufacturer has an appropriate quality-assurance system, certified by a competent body established within the European Community and having undergone a specific acceptance for materials.

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- Non-destructive examination.

- Dimensional check.
- Record of heat treatment.

These reports shall include:

- Material designation and marking.
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- Identification of the Supplier.
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- Test and retest results together with required values.
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13.15 Quality system requirements

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- Contract requirements will be met.
- Evidence of such compliance will be maintained.

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- Be based on recognized quality standards.
- Encompass all activities performed in connection with the contract.
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The Supplier shall ensure that each subcontractor implements an effective quality control system. Failing this, the Supplier shall undertake all necessary actions to establish and maintain quality control in the subcontractors' premises.

The quality organisation shall comply with the requirements defined in the contract.

13.16 Access of Inspectors

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The Supplier shall hold at the disposal of the Client and TPI and make available to them such information and documents as are necessary to determine the progress and status of the work.