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Technical Specifications (In-Cash Procurement)

Supply of LEVI coaxial and triaxial electrical feedthroughs and connectors

Supply Contract: The Supplier is responsible for the supply of Coaxial and Triaxial electrical feedthroughs and connectors for LEVI (Loom Electrical Vacuum Interfaces) system, its delivery to the ITER Site and for ensuring that the product meets the technical requirements defined in this Technical Specification

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1 Subject

Supply Contract: The Supplier is responsible for the supply of Coaxial and Triaxial electrical feedthroughs and connectors for LEVI (Loom Electrical Vacuum Interfaces) system, its delivery to the ITER Site and for ensuring that the product meets the technical requirements defined in this Technical Specification.

1.1 Responsibilities

The responsibilities between the Parties are summarised in Table 1 and is further detailed in the following sections.

Table 1 Summary of the responsibilities between IO and the Supplier

Activity	**IO**	**Supplier**
Design customization	A	R
Prototyping	A	R
Manufacturing in-series products	A	R
Factory Acceptance Testing	A	R
Packing and Delivery to the ITER Site	A	R
IO Site acceptance test	R	
Testing according to Commercial Grade Dedication	R	
Qualification test for nuclear safety demonstration	R	

R = Responsible for organizing, performing the content
A = Review/Comment/Accept/Approve

1.2 Contract Execution

1.2.1 Outline of Contract Implementation

The overall procurement cycle is divided into the following main phases:
- Design customization to meet the technical requirements
- Prototypes and tests
- Manufacture of in-series final products
- Factory acceptance test
- Packing and delivery to the ITER site
- Final acceptance at the ITER site

For the SIC (Safety Important Component) items, CGD (Commercial Grade Dedication) [RD20] will be applied in order to ensure that the items will perform their intended nuclear safety function. The Supplier shall provide some specimen for test and inspection which IO will perform, and also allow IO survey on the manufacturing procedure related to the critical characteristics determining the safety function.

It is worthwhile to note for information that IO will perform the nuclear safety qualification test [RD21] using some of the in-series final products.

1.3 Estimated Duration

The contract will be carried out over an initial firm period of three years.

1.4 Binding contract requirements

The binding contract requirements which the Supplier shall comply with are described with the following two documents:

- Technical specification dedicated to this contract, which is described in this document
- General Management Specification for Service & Supply ("GM3S") given in [AD4]

The GM3S is the reference document for the management of the scope that is to be performed in preparation for, and during the implementation of the Contract, in conjunction with the technical specification and the Contract conditions.
The GM3S presents the main principles and requirements which the Contractor must take into account during the implementation of the scope of work and defines the minimum standards expected for the management of the Occupational health, safety ("OHS"), environment, nuclear safety, quality, contact control and all associated deliverables. In case of conflict, the content of this technical specification supersedes the content of GM3S.

2 Scope of Supply

2.1 General

The Supplier shall provide the IO with the following components (See Figure 1):

- HN type CTMS (Ceramic to Metal Sealing) hermetic electrical coaxial feedthrough used for RF power transmission (item name: **Coax-EFT**)
- Push-pull type HN coaxial connectors with suitable adaptor which will be mounted on the airside flange (item name: **Coax-CON**)
- CTMS hermetic electrical triaxial feedthrough used for RF signal transmission (item name: **Triax-EFT**)
- Push-pull type triaxial connectors with suitable adaptor which will be mounted on both the IVS flange and the airside flange (item name: **Triax-RCON**)
- Triaxial connectors in the interspace suitable for manual permanent connection with EFT (item name: **Triax-MCON**)

The bill of material to be supplied is listed in Appendix 1.

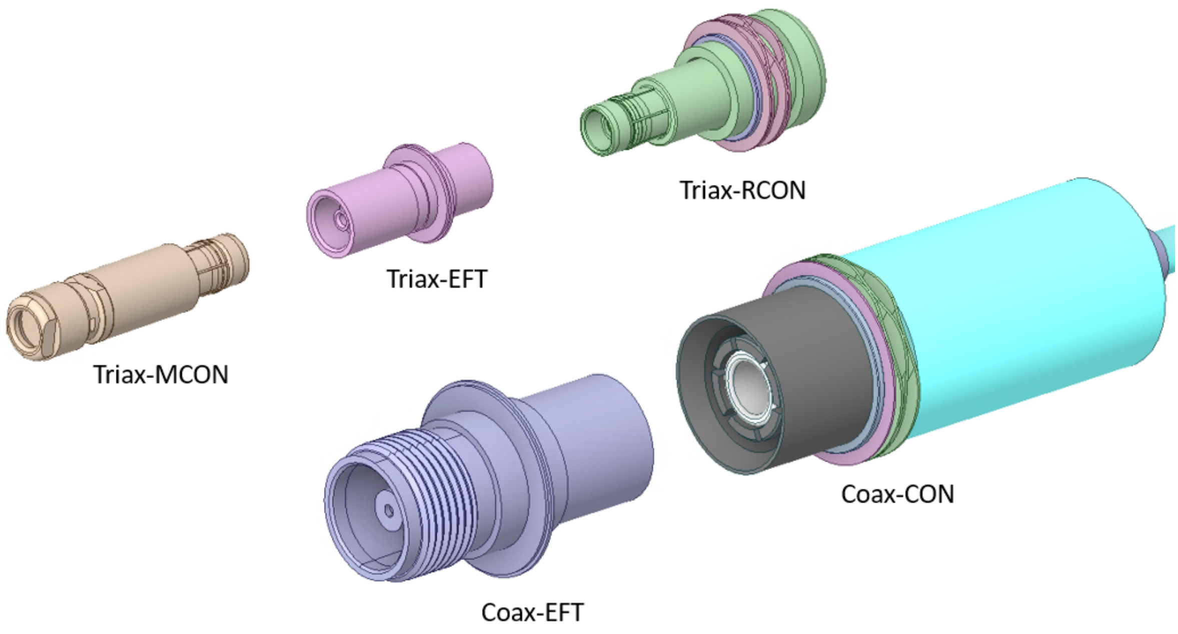


Figure 1 Components under the scope of this contract

2.2 Design customization

The Supplier shall customize the design of its own COTS product in order to satisfy the technical requirements as well as the mechanical interfaces with the structure which the components will be assembled to. The design interface is described in Section 3.1 & 3.2.

2.3 Prototyping

The Supplier has to fabricate the prototypes and carry out the necessary tests in order to justify the customized design and its electrical and mechanical performance.

2.4 Manufacturing of the components

Considering that the hermetic feedthroughs (Coax-EFT & Triax-EFT) are SIC-1, it is mandatory to ensure the rigorous quality control and the traceability required as per the INB Order [AD1] [AD2]. For this particular product, the approach to guarantee the quality will be based on the commercial grade dedication. Note that the connectors (Coax-CON, Triax-MCON & Triax-RCON) are non-SIC and so manufacturing of these components are not required to follow the requirements of the INB order.

Commercial Grade Dedication (CGD) has been developed to provide a process to evaluate items not manufactured in accordance with a nuclear QA program and determine, with reasonable assurance, that the items would perform their intended nuclear safety functions.

All the SIC feedthroughs manufactured for both qualification and final production shall follow the CGD as specified in [RD20].

CGD process will require the Supplier to:

- Provide material certificates (EN 10204 3.1 or 3.2) for all materials used in the manufacturing (ceramic, brazing material and metallic housing)
- Provide 100% measurement reports for key dimensional parameters, for example, diameter of ceramic before brazing and diameter of housing. These parameters will be agreed with IO.
- Allow IO or a representative to audit the manufacturing process to ensure:
    - Consistency of manufacturing drawings
    - Procedure according to recognized standard for the verification of critical dimensions
    - Verification of quality assurance when implementing procedure.
    - Existing procedure for the maintenance and operation of ovens used for brazing
    - Implementation of brazing procedure by operators
    - Temperature profile during brazing and temperature uniformity in the oven (this can be verified using thermocouples attached on each manufactured feedthrough)
    - All thermocouples are calibrated by a certified laboratory
    - Certification is still valid (time frame)
    - All pressure gauges are calibrated by a certified laboratory (in case of vacuum brazing)

- The manufacturer will also provide IO with the following samples (testing of these samples will decide if a batch is acceptable or not):
    - One metallized ceramic piece per batch of manufacturing
    - One extra feedthrough per batch of manufacturing

2.5 Factory Acceptance Test

The supplier shall perform factory acceptance test for all the products according to Section 2.5 before delivery to IO site.

2.6 Packing and Delivery

The supplier shall pack all the products and deliver to IO according to Section 2.6

2.7 Supply of Documentation

The Supplier shall provide IO with the documents and data defined in the Appendix 2 of this Technical Specification (List of Deliverables).

3 Technical Requirements

This section specifies the technical requirements which the supplier shall satisfy for the whole scope of this contract.

3.1 Design Description

The LEF (LEVI Electrical Feedthrough) transmits the electric signal and power to the components installed in the ITER diagnostic port plug.

The LEF is a safety important component (SIC), which, therefore, makes it PIC (Protection Important Component), to provide the nuclear safety confinement for radioactive products or toxic material (Tritium, activated dust, Be). It also forms the primary ultra-high vacuum boundary for the tokamak machine.

An example of the LEF design is illustrated in Figure 2. The LEF is composed of three main sub-assemblies: in-vessel subassembly (IVS), LEF subassembly (LEF SA) and air-side flange subassembly (AFS). The IVS is the vacuum-side connector, while the AFS is the air-side connector. As illustrated in Figure 2, the LEF assembly can accommodate different types of electrical signals, including the RF coaxial signal and the RF triaxial signal. In Figure 2, RF coaxial lines are integrated in the LEF.

With regards to the assembly sequence, first, the IVS is permanently mounted to the port plug. And the LEF SA is inserted from the air side and bolted to the vacuum flange (the black part of the LEF assembly in Figure 2) welded to the closure plate. Finally, the AFS is assembled. During the insertion of the LEF SA and the AFS, the electric connection of each electrical line should be blindly mated with a push-pull type connector. The joint of the blind-mated electric connection is ensured by fixing the LEF body structure and the AFS body structure with bolts.

It is noted that there are guiding pins and dowels at the LEF SA & AFS structural body to first align those sub-assemblies each other for insertion. Then, the final alignment of the connector sockets and the EFT pins shall be made with the guiding and compliance features of the push-pull type connectors.

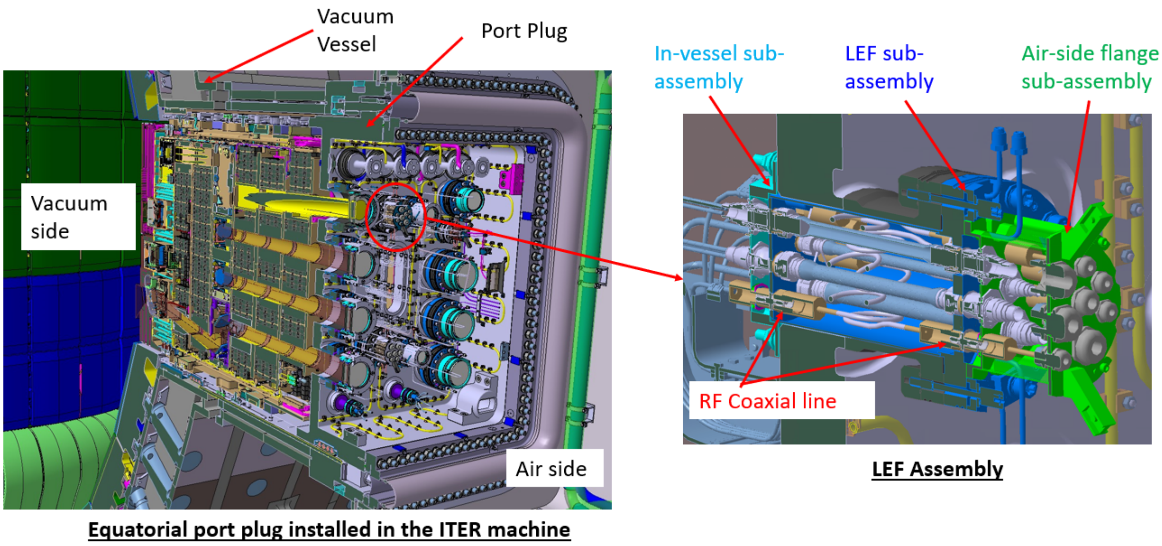


Figure 2 LEF installed in a diagnostic port plug

Figure 3 shows the hermetic feedthroughs and connectors for the coaxial & triaxial lines assembled to the LEF structure.

The hermetic coaxial feedthrough, Coax-EFT is a double-ended HN type connector providing a high vacuum tightness. It has a threaded connection on one side and a push-pull type connection on the other side. The threaded side will be placed in the vacuum monitoring interspace of the LEF, as shown in Figure 3.

The hermetic triaxial feedthrough, Triax-EFT is also a double-ended connector providing a high vacuum tightness. The connection with Triax-RCON on the vacuum or air side should be made with a push-pull type, while the connection with Triax-MCON in the vacuum monitoring interspace can be made with thread lock, one-touch lock, push-twist lock, or other locking mechanism if it ensures a good permanent locking.

Triax-EFT and Coax-EFT are welded to both the vacuum-side and the air-side bulkhead of the LEF SA.

Triax-MCON provides the cable connection between the two Triax-EFTs, while Triax-RCON is mounted to the IVS or the AFS for cable connection.

For the connection between two Coax-EFTs is used a mineral insulated (MI) coaxial cable which is already terminated with a standard HN connector. This connection will be manually done at the factory when the LEF SA is assembled. After that, there is no need to disconnect for maintenance and so the threaded connection is applied here. The connection at the vacuum-side connection is also made with this type of MI cable. It should be noted that these MI cables are not the scope of this contract. On the other hand, the connection at the air side is made with Coax-CON, which is clearly the scope of this contract.

The locking of the push-pull connectors (Triax-RCON, coax-CON) is achieved with the wave spring and the retaining ring to the IVS or the AFS.

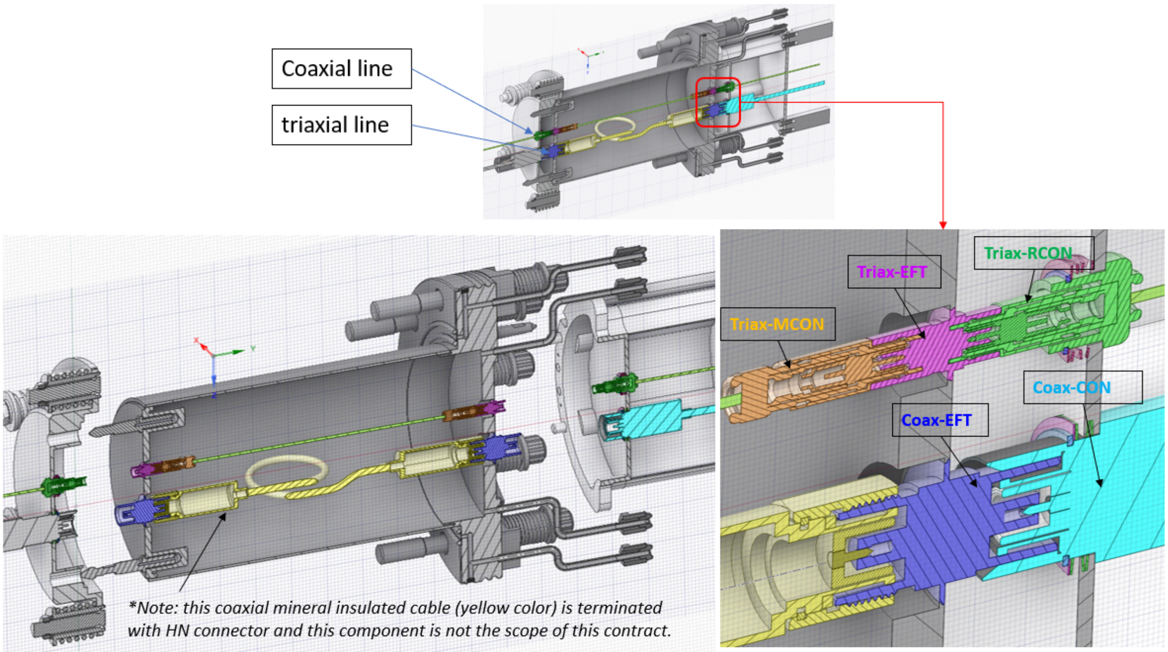


Figure 3 Coaxial and Triaxial feedthroughs and connectors assembled to LEF

The electrical requirements for coaxial and triaxial lines are given in Table 2.

Table 2 Electrical requirements

Components	Use Case	Rated Voltage and current	Contact resistance	Insulation Resistance	Withstand Voltage	Frequency Range	Transfer Impedance	VSWR
Triax-EFT Triax-MCON Triax-RCON	Triaxial line for RF signal transmission	600 V 10 µA	< 1mΩ	> 10 G Ω @ 500 VDC	1800V RMS	10 – 200 MHz	< 0.1 Ω/m @ 10 – 200 MHz	< 1.2 @ 10 – 200 MHz (Reference impedance 50 Ω)
Coax-EFT Coax-CON	Coaxial line for RF power transmission	1kV 6A (Power handling < 2kW)	< 1mΩ	> 1 G Ω @ 500 VDC	3000V RMS	10 – 100 MHz	< 7mΩ + 0.5 nH @ 10 – 100 MHz	< 1.15 @ 10 – 100 MHz (Reference impedance 50 Ω)

3.2 Design Requirements

3.2.1 General

[RQ-1] The contractor shall prepare the component models and drawings implementing the technical requirements specified in this document. The final models and drawings shall be checked and approved/accepted by IO before starting the manufacturing of both prototypes and in-series products.

[RQ-2] The hermetic feedthroughs (Coax-EFT and Triax-EFT) are SIC-1 (Safety Important Component) and PIC (Protection Important Component) implementing a safety function (confinement of radioactive material).

[RQ-3] The connectors (Coax-CON, Triax-MCON, Triax-RCON) are non-PIC.

[RQ-4] The hermetic feedthroughs shall be He leak tight to 2.69 x 10E-10 Pa.m3. s-1 (Helium-equivalent; normal pressure).

[RQ-5] The connector set shall meet all the electrical requirements specified in Table 2.

[RQ-6] Ceramic-to-metal seal (CTMS) technology shall be applied for the vacuum-tight sealing.

[RQ-7] The Maximum operation temperature for the coaxial electrical feedthrough and its connector shall be 350ºC. The components shall retain the required electrical and mechanical integrity and functionality at this temperature.

[RQ-8] The Maximum operation temperature for the triaxial electrical feedthrough and its connector shall be 240ºC. The components shall retain the required electrical and mechanical integrity and functionality at this temperature.

[RQ-9] The mechanical and electrical properties (insulation resistance, loss tangent) of the non-metallic materials shall not be degraded and shall keep the required function under the radiation environment (neutron fluence < $5x10^{17}$ n/cm2 and gamma dose < 10MGy).

[RQ-10] According to the ITER vacuum handbook, the feedthrough is classified as VQC 1A. The connector on the vacuum side and the connector in the vacuum monitoring space are classified as VQC1B and VQC3B, respectively.

[RQ-11] The design of any vacuum component shall avoid trapped volumes in vacuum spaces which could result in virtual leaks.

[RQ-12] The components shall be compatible with exposure to steam resulting from a water leak (90ºC during 30 days) as defined in the System Load Specification [RD11] in order not to compromise 20 years lifetime of ITER.

[RQ-13] The hermetic feedthroughs shall keep the safety leak rate (<0.6 x 10^{-8} Pa.m3/s air equivalent) at the environmental condition (300ºC during 2 hours) which the LEF will undergo during fire [RD11].

[RQ-14] The component shall have Manufacturer's serial number and IO's Part Number Identification (PNI) marked on the externally exposed surface of which will not be hidden after complete assembly. The marking location should be approved by IO. This marking should be clearly readable and undeletable and compatible with vacuum.

3.2.2 Design requirement for Coax-EFT and Coax-CON

[RQ-15] Coax-EFT shall be a double-ended HN coaxial connector for threaded connection on one side and push-pull type connection on the other side (See Figure 1) and the design should follow MIL-STD-348B (Figure 7).

[RQ-16] Coax-EFT shall be compatible with the counterpart coaxial connector (ITEM A & B in Figure 4) which will be connected on the MI cable side.

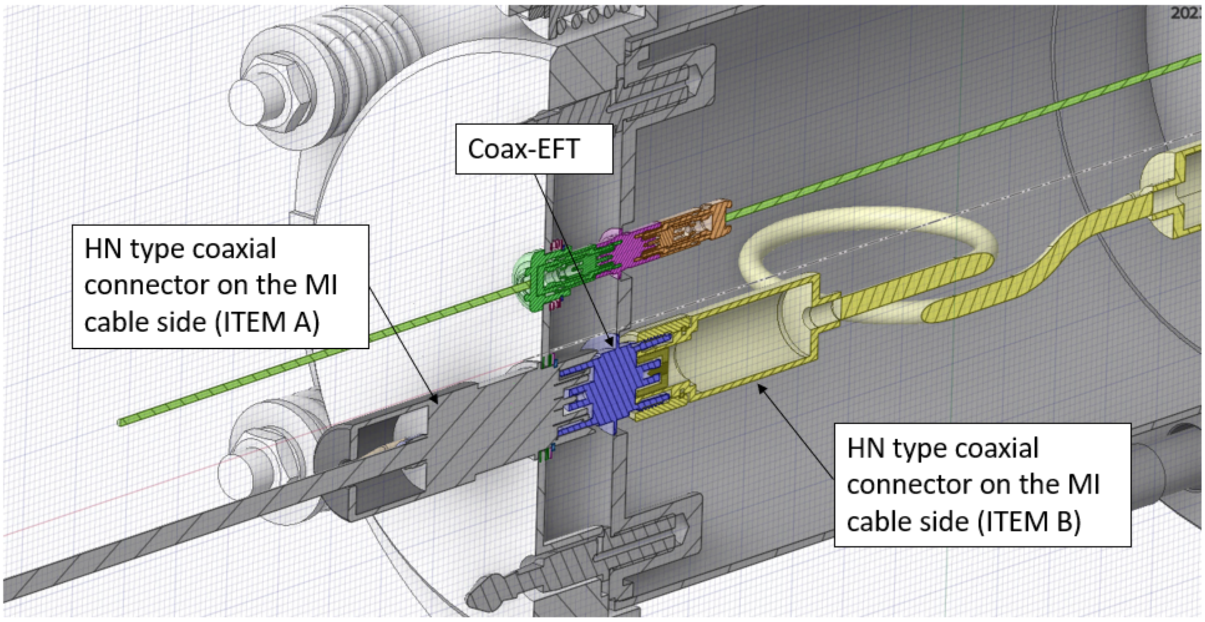


Figure 4 Connection of Coax-EFT with the coaxial connector on the MI cable side

[RQ-17] Coax-Con shall be a push-pull type HN coaxial connector for blind mating and its design shall be compliant with Coax-EFT.

[RQ-18] Coax-Con which will be mounted to the AFS shall have a compliance feature to accommodate misalignment during AFS insertion to the LEF SA. As shown in Figure 5, a wave spring and a retainer ring is used for this flexible fixation. The reference of this wave spring and retainer ring is CMS28-L1 and ES-22 of Smalley. The distance between the retainer ring and the AFS plate is 2 mm which will give 0.5 mm axial compliance range. Depending on the engagement requirement of the RF connectors, this value needs to be adjusted. The supplier can also use another compliance mechanism, if the proposed design is approved by IO.

[RQ-19] Coax-EFT shall have a thin circular flange which will be welded to the bulkhead of the LEF SA body. See Figure 5.

[RQ-20] The circular flange of Coax-EFT shall have the specific welding preparation feature (see Figure 6), which will allow full penetration butt Electro-Beam (EB) weld. It needs to be noted that the other weld technique which will not cause any damage of the CTMS is acceptable as well.

[RQ-21] The welded part of the circular flange of Coax-EFT shall have a sufficient distance with the ceramic-to-metal sealing (CTMS) part so that the heat input during the EB welding will not damage the CTMS and its leak tightness required.

[RQ-22] The external diameter of Coax-EFT, which is the diameter of the circular flange, shall be small or equal to 27 mm. Coax-EFT and Coax-con shall be designed to ensure the connection required for RF transmission under the dimensional constraint given in Figure 5.

[RQ-23] Coax-Con shall be designed to connect the corresponding RF coaxial cable by crimping.

[RQ-24] The temperature range required for these coaxial components is

- Operating temperature: 20ºC ~ 350ºC.
- Environment temperature during no RF signal transmission (during baking): -10ºC ~ 250ºC.
- Environment temperature during RF signal transmission: 20ºC ~ 70ºC.

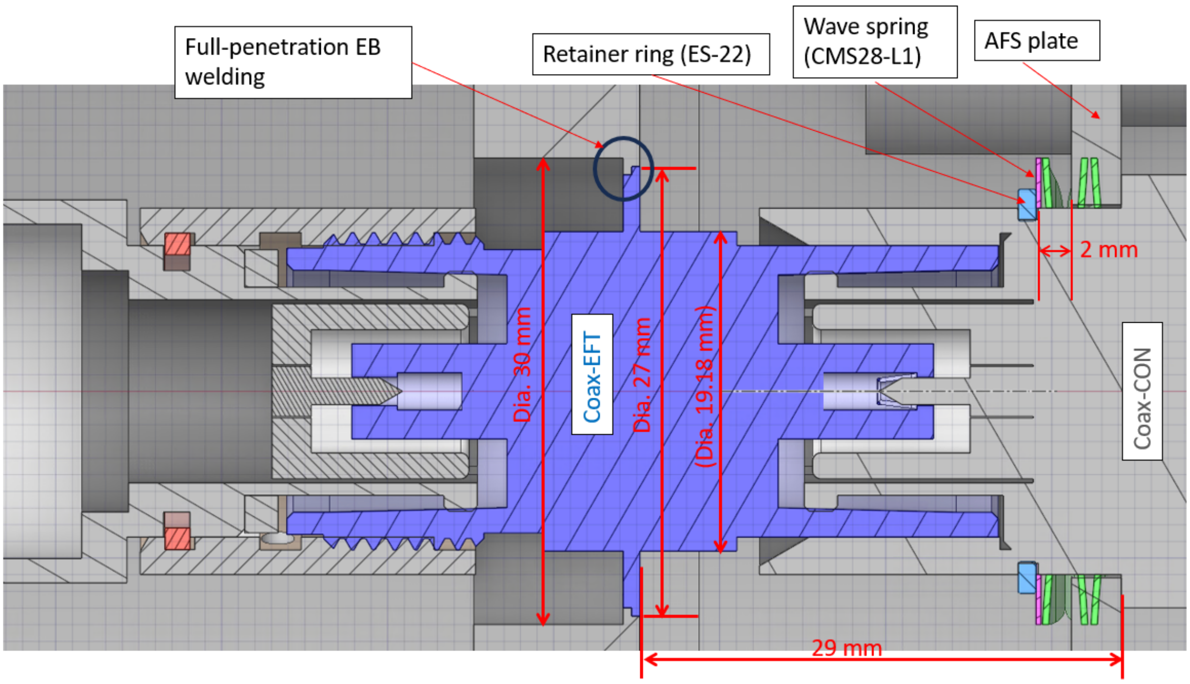


Figure 5 Dimensional constraint for Coax-EFT and Coax-con

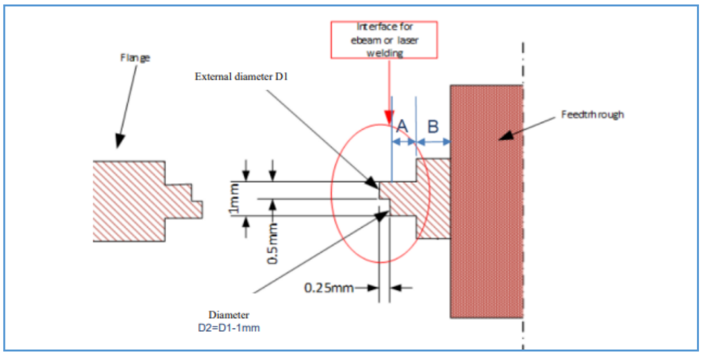
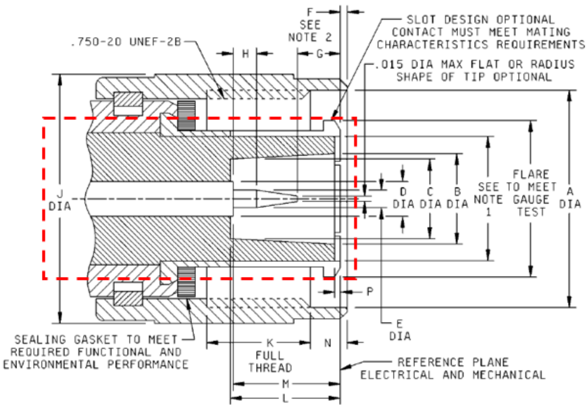


Figure 6 Welding interface design of Coax-EFT & Triax-EFT with LEF SA body

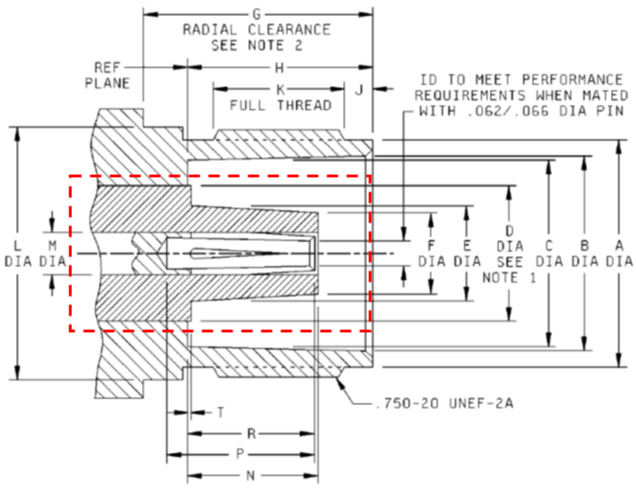


MIL-STD-348B
w/CHANGE 2

Dimension Ltr.	Inches (mm)	
	Minimum	Maximum
A	.760 (19.30)	--------
B	.289 (7.34)	--------
C	.263 (6.68)	--------
D	--------	.132 (3.35)
E	.062 (1.57)	.066 (1.68)
F	--------	.058 (1.47)
G	.138 (3.51)	--------
H	.120 (3.05)	--------
J	--------	.925 (23.50)
K	.403 (10.24)	--------
L	.368 (9.35)	--------
M	.356 (9.04)	.388 (9.86)
N	.100 (2.54)	--------
P	.005 (0.13)	--------

NOTE:
1. ID of outer contact when inserted into a .548 inch (13.92 mm) maximum diameter ring gauge shall be .432 inch (10.97 mm) minimum.
2. With nut biased in forward position.

Male part of the HN connector



MIL-STD-348B
w/CHANGE 2

Dimension Ltr.	Inches (mm)	
	Minimum	Maximum
A	.662 (16.81)	.683 (17.35)
B	.571 (14.50)	.578 (14.68)
C	.548 (13.92)	.553 (14.05)
D	--------	.430 (10.92)
E	--------	.294 (7.47)
F	--------	.268 (6.81)
G	.590 (14.99)	--------
H	.516 (13.11)	.522 (13.26)
J	.077 (1.96)	.087 (2.21)
K	.359 (9.12)	--------
L	--------	.755 (19.18)
M	--------	.132 (3.35)
N	--------	.368 (9.35)
P	.355 (9.02)	--------
R	.328 (8.33)	.358 (9.09)
T	--------	.005 (0.13)

NOTES:
1. Dielectric protrusion beyond reference plane.
2. Clearance for mating connector coupling nut.
3. Dimensions are in inches.
4. Metric equivalents are given for information only.

Female part of the HN connector

Figure 7 Standard HN-type connector design (MIL-STD-348B): the design and dimension in the red rectangular box shall be kept for Coax-EFT and Coax-con. The external features outside the blue box need to be modified to be compliant with the requirements given here.

3.2.3 Design requirement for Triax-EFT, Triax-MCON, Triax-RCON

[RQ-25] Triax-EFT shall be a double-ended triaxial connector for permanent connection on one side and push-pull type connection on the other side (See Figure 1). The connection with Triax-RCON on the vacuum or air side shall be made with a push-pull type for blind mating, while the permanent connection with Triax-MCON in the vacuum monitoring interspace shall be made with thread lock, one-touch lock, push-twist lock, or other locking mechanism which will ensure a good permanent locking.

[RQ-26] The design of Triax-EFT shall be compatible with the counterpart connectors (Triax-MCON and Triax-RCON).

[RQ-27] To mount Triax-RCON to both the AFS and the IVS, Triax-RCON shall have a compliance feature to accommodate misalignment during AFS insertion to the LEF SA or LEF SA insertion to the IVS. As shown in Figure 8, a wave spring and a retainer ring is used for this flexible fixation. The reference of this wave spring and retainer ring is CMS18-L1 and ES-13 of Smalley. The distance between the retainer ring and the AFS plate is 3.6 mm which will give 2.6 mm axial compliance range. Depending on the engagement requirement of the RF connectors, this value needs to be adjusted. The supplier can also use another compliance mechanism, if the proposed design is approved by IO.

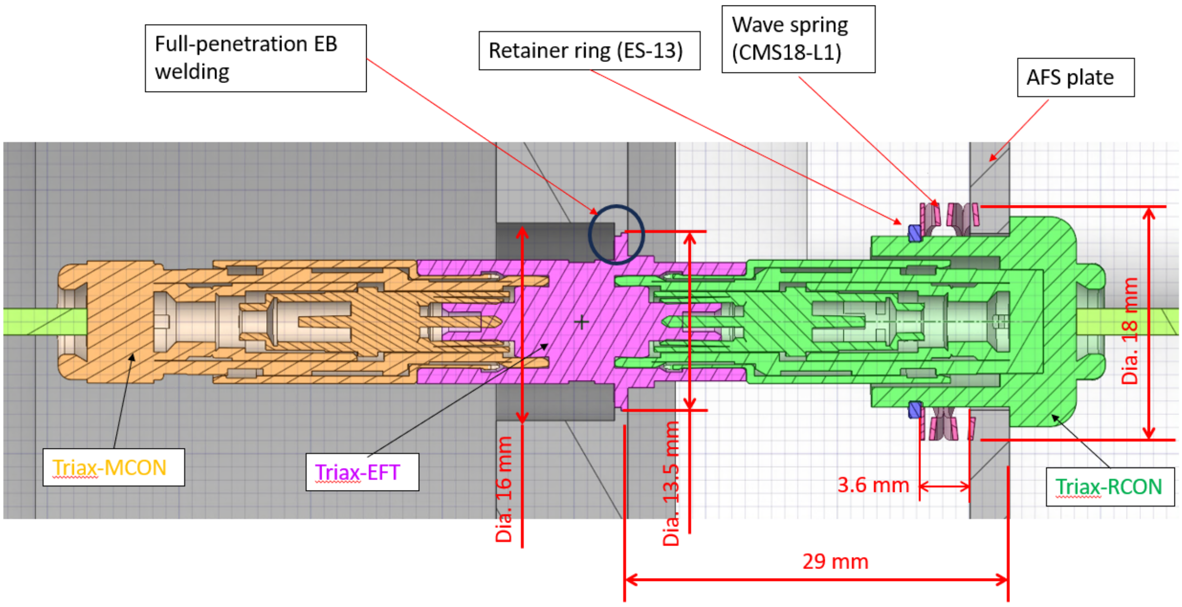


Figure 8 Dimensional constraint for triaxial components (Triax-EFT, Triax-MCON, Triax-RCON)

[RQ-28] Triax-EFT shall have a thin circular flange which will be welded to the bulkhead of the LEF SA body. See Figure 8.

[RQ-29] The circular flange of Triax-EFT shall have the specific welding preparation feature (see Figure 6), which will allow full penetration butt Electro-Beam (EB) weld. It needs to be noted that the other weld technique which will not cause any damage of the CTMS is acceptable as well.

[RQ-30] The welded part of the circular flange of Triax-EFT shall have a sufficient distance with the ceramic-to-metal sealing (CTMS) part so that the heat input during the EB welding will not damage the CTMS and its leak tightness required.

[RQ-31] The diameter of the circular flange of Triax-EFT shall be smaller or equal to 13.5 mm. The maximum external diameter of Triax-EFT shall be small or equal to 18 mm. Triax-EFT and Triax-MCON/Triax-RCON shall be designed to ensure the connection required for RF transmission under the dimensional constraint given in Figure 8.

[RQ-32] Triax-RCON and Triax-MCON shall be designed to connect the corresponding RF triaxial cable by crimping.

[RQ-33] The temperature range required for these triaxial components is

- Operating temperature: 20ºC ~ 70ºC.
- Environment temperature during no RF signal transmission (during baking): -10ºC ~ 250ºC.
- Environment temperature during RF signal transmission: 20ºC ~ 70ºC.

3.3 Material Requirement

This section describes the requirements of the material to be used for the manufacturing of the components.

[RQ-34] The structural body of the feedthroughs and the connectors shall be Austenite Stainless Steel (316 type) with the following impurity controlled: Co < 0.05%, Ta <0.01%, Nb <0.01%. If the Supplier cannot get this type of material, IO may provide the raw material at the expense of the Supplier. If both approaches are not feasible, the Supplier may submit a Deviation Request for IO approval.

[RQ-35] The metallic machined parts shall be used as per Section 5.3, 5.5, 5.6, 5.7 and Table 5.2 in IVH [AD3].

[RQ-36] Materials shall have a relative magnetic permeability ≤ 1.03.

[RQ-37] Materials shall be free of Halogenated materials.

[RQ-38] The stainless steel forming the vacuum boundary should be made of ESR/VAR cross-forging.

[RQ-39] The electric insulation material shall be machinable Alumina (>96%) or Shapal-M or equivalent aluminum nitride product (to be agreed with IO).

[RQ-40] Only materials accepted for the relevant Vacuum Classification shall be used. All material for use in vacuum shall be clearly specified and certified in accordance with EN 10204 3.1 or 3.2 before being used in manufacturing. (Ref. Section 5.1 in IVH [AD3]) The list of materials accepted for ITER is listed in [RD3]. For the materials which are subject to restricted use or not on the accepted list, the contractor can submit Material Acceptance Request and they can be used only with IO's approval. (Ref. Section 5.2 in IVH [AD3])

[RQ-41] The outgassing rates of materials shall be consistent with the values in Table 5.1 in IVH [AD3].

[RQ-42] All other non-metallic materials shall be classified self-extinguishing in accordance with agreed standards and IEC publication 332.

[RQ-43] Halogenated materials, sulphur and phosphorus, and processes involving the use of these materials, shall be avoided. These materials lead to potential for oxidation catalyst poisoning and to metallic corrosion due to acid formation.

[RQ-44] Certification in accordance with EN 10204 shall be provided. Other materials, or materials without the EN 10204 certification, shall be supplied with a supplier's certificate of conformity.

3.4 Licensing Requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 ("Installation Nucléaire de Base").

For Protection Important Components and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.
In such case the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 [AD1] applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors. [AD6]
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, the Supplier shall ensure that a specific management system has to be implemented by any Supplier and Subcontractor working on Protection Important Activities, following the requirements of the Order 7th February 2012 on the basis of activities defined and executed by the Supplier and Subcontractor. This system could be included in the Manufacturing and Inspection Plan or the Quality Plan.

For the feedthroughs (Coax-EFT and Triax-EFT) which are the SIC (or PIC) components in this contract, the CGD process explained in Section 2.4 will be applied in order to mitigate the difficulties (cost, market availability) due to the rigorous and strict requirements related to the INB order.

[RQ-45] The Supplier shall fulfil the requirements of the CGD process [RD20], of which the key content is summarized in Section 2.4.

3.5 System Classification

The main ITER classifications for the System are listed in Appendix 1.

3.6 Manufacturing Requirements

This section defines the requirements on manufacturing.

[RQ-46] Permanent joining process, including the ceramic-to-metal sealing (CTMS), shall be compliant with the requirements specified in Section 7 in in IVH [AD3].

[RQ-47] The cutting fluid shall be selected as per Section 6.1 in IVH [AD3].

[RQ-48] For a machined part, the surfaces shall be thoroughly examined before CTMS to check the soundness of the metal. The part shall be sound and free of scale, strings, tears, nicks or other injurious defects.

[RQ-49] Key dimensions (for example, diameter of ceramic before brazing and diameter of housing) which will affect the brazing integrity shall be measured on all feedthroughs manufactured.

[RQ-50] 100% of ceramic insulator shall be visually inspected, with no visible cracks nor defects present on the ceramic insulator before the brazing operation.

[RQ-51] Brazing operation shall be carried out by suitable qualified operators and the brazing parameters (temperature and vacuum in case of vacuum brazing) shall be consistent during the manufacturing process.

[RQ-52] Brazing parameters shall be recorded with adequate and calibrated instrumentation (thermocouples and pressure gauges). Copies of calibration certificates shall be provided to IO.

[RQ-53] Metallic components shall be supplied with the maximum average surface roughness listed in Table 8-1 in IVH [AD3].

[RQ-54] To minimize the risk of trapped volume which can subsequently cause leaks or enhanced outgassing, parts and sub-components shall be degreased using solvents or alkaline detergents, rinsed with demineralized water, and dried prior to joining in accordance with Section 24 of IVH [AD3]. The use of halogenated solvents is forbidden at any stage for systems of class VQC 1 and 3. Accepted fluids are listed in [RD4].

[RQ-55] All components shall be subjected to a rigorous cleaning procedure, consistent with the Vacuum Classification of that particular component. A guide to cleaning and handling of components for use on ITER vacuum systems can be found in [RD5].

[RQ-56] Abrasive techniques to clean or to attempt to improve the appearance of the surfaces of vacuum components must be kept to an absolute minimum and are preferably avoided.

[RQ-57] Pickling and passivation must always be followed immediately by an appropriate cleaning process relevant to the VQC of the component. A guide to the pickling/passivation of steels and copper can be found in [RD6].

[RQ-58] After final cleaning, the handling of vacuum equipment shall be strictly controlled to preserve cleanliness as per Section 24.5 in IVH [AD3]. The mandatory requirements relating to cleanliness during assembly of vacuum equipment are detailed in [RD7].

[RQ-59] Surfaces which are to be exposed to vacuum shall only be marked or identified if necessary and shall be marked by scribing with a clean sharp point, laser scribing or electromagnetic dot peen method.

[RQ-60] Data and ratings for each component shall be recorded and maintained as part of the permanent records. Modifications or revisions shall be recorded by the Supplier and provided to IO as part of Manufacturing Dossier. They shall include the following:

- Manufacturer's name and year of manufacture,
- Individual identification number,
- Technical specification:

[RQ-61] One metallized sample of ceramic per each batch of ceramics shall be provided to IO before the brazing operation of the batch. This samples will be used to perform a micrographic examination to guarantee that the metallization process is done to the required standards.

[RQ-62] All brazing operations shall be compliant with the class B imperfection limits as per ISO-18273.

[RQ-63] One feedthrough per brazing batch of manufacturing shall be delivered to IO in order to perform:

- a micro-computed tomography to demonstrate compliance to ISO-18273 (nondestructive examination)
- a macro section following the standard EN12797

These tests are under IO responsibility and will represent a Hold Point for each manufactured batch before delivery.

3.7 CE Markings

[RQ-64] CE Markings shall be implemented in accordance with European directives requirements.

The list of European directives concerning CE marking is available on the following web site http://www.conformance.co.uk/directives/index.php. Other useful information can be found in the "Guide of implementation of directives based on the New Approach and the Global Approach": http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guide/guidepublic_en.pdf.

3.8 Reliability and Maintainability Requirements

[RQ-65] The supplier shall provide the reliability data for their COTS product corresponding to the components.

[RQ-66] The Supplier shall inform IO of any risk regarding components' obsolescence and make all necessary recommendation to fix that risk.

4 Delivery

The Supplier shall deliver to the IO site the in-series final products as listed in Appendix 1 as per the delivery schedule in Appendix 2.

4.1 Requirements for Labelling, Cleaning, Packaging, Handling, Shipment and Storage

4.1.1 Scope of application

The following generic requirements apply both for the shipment of components from the manufacture/assembly site to the ITER Site or to any intermediate site.
Suitable precautions shall be taken to avoid damage to the component. The component shall be subject to control and inspection, as defined below.

4.1.2 Labelling and Traceability

[RQ-67] All components shall be clearly marked in a permanent undeletable way and in a visible place as per [RQ-14] & [RQ-59].

[RQ-68] All labelling, color coding and signage shall be standardized to reduce the likelihood of error. The IO guideline is given in [RD12].

[RQ-69] All labelling shall follow the IO official numbering system according to the document "ITER Numbering System for Components and Parts" [RD13]. A detailed 'IO component identification standard' together with printed label templates and RFID tagging standards will be provided by IO.

4.1.3 Cleaning

During cleaning, particular attention shall be given to the removal of weld spatter, debris and other foreign matter. Final cleaning shall ensure effective cleaning without damage to the surface finish, material properties or metallurgical structure of the materials. The Supplier shall submit to the IO the proposed cleaning procedure for approval/acceptance.
The demonstration of meeting the above cleaning requirements represents a Hold Point (HP).

4.1.4 Packaging and Handling

[RQ-70] The supplier shall design and supply appropriate packaging, adequate to prevent damage during shipping lifting and handling operations.

[RQ-71] The direct contact with any material such as Carbon steel which may cause corrosion of the component shall be avoided during handling and packaging.

[RQ-72] Where appropriate, accelerometers or other sensors shall be fitted to ensure that limits have not been exceeded. When accelerometers are used, they shall be fixed onto each box.

[RQ-73] Shock absorbing material shall be used.

[RQ-74] Components shall be packed with adequate protection from thermal or mechanical stresses which may adversely affect the operation of the component. All packing shall be sealed and marked externally with the component VQC. Handling instructions shall also be clearly marked on the outside of the packaging. All such marking shall be in English and French.

[RQ-75] All vacuum components shall be shipped dry internally and externally, irrespective of final acceptance testing at the supplier's site.

[RQ-76] The use of adhesive tape for the protection and packaging of vacuum components shall be restricted to prevent the risk of contamination from the tape. In particular, tape used on austenitic stainless steel shall meet leachable chloride and fluoride limits of 15 ppm and 10 ppm, respectively. Where used, tape shall be fully removable leaving no residue, using isopropyl alcohol or acetone as the solvent to remove all traces of the adhesive.

[RQ-77] To prevent damage and possible contamination during transit, the packaging of components shall be done as soon as possible after acceptance testing and final cleaning at the supplier's premises. Cleaning and packaging operations may be witnessed by ITER.

[RQ-78] Where practical, vacuum components shall be entirely enclosed in heat sealed polyethylene for shipping. The polyethylene enclosure shall be purged and backfilled with dry air (<4000 ppm H2O). Where this is not practical, alternative conditions shall be accepted by IO.

[RQ-79] Prior to delivery to ITER site, the components shall be stored in clean and dry conditions, protected from normal hazards.

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
- Release Note [AD9];
- Packing List;
- Material Safety Sheet;

- 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 IO and its Supplier. The signature by the IO of the Delivery Report prior to shipment represents a Hold Point (HP).

The Manufacturing Dossier is part of the List of Deliverables in Appendix 2.
The Manufacturing Dossier should include at least the following documents:

- As-Built Drawings, Documents, and Data (with signatures)
- Contractor Release Note
- Quality Plan
- Material certification
- Manufacturing documentation: record of brazing parameters, calibration certificate of brazing instrumentations (pressure gauge, thermocouple), and any other records required to be compliant with CGD process [RD20]
- Records of approved Non-Conformances (NCR) and Deviation Requests (DR)
- Control Reports (Visual Examination, Non-Destructive Tests, Leak Tests, Certificates of Cleanliness, Geometric measurements, etc.)
- FAT report

4.1.5 Shipment, Transportation and Delivery to the ITER Site

The components shall exclusively be delivered to the ITER Site under the responsibility of the Supplier.
Before the shipment, a Release Note shall be prepared in accordance with the "Contractor Release Note" [AD9] and approved by the IO.
Upon receipt of the package, the IO 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 reading of the accelerometers or other sensors;
- The integrity of the components.

In the case of anomalies the IO shall make any additional relevant remark on the inspection.
The IO will inspect the accelerometers or other sensors mounted on the boxes. If these accelerometers record shocks above 5g, a thorough inspection of the components shall be performed. A decision on acceptance of the delivery of the components will be made by the IO.
If the components are in an acceptable condition, the IO will sign the Delivery Report. The signature of the Delivery Reports is an IO Hold Point.
The original of the Delivery Report shall be kept by the IO and a copy of it shall be kept by the Supplier.

5 Testing

[RQ-80] The Supplier and Subcontractors shall supply procedures regarding all testing operations for IO approval.

5.1 Prototype Testing

[RQ-81] The following electrical tests shall be carried out to demonstrate that the paired assembly of EFT and connector satisfies the electrical characteristics specified in Table 2.

- Characteristic impedance test
- VSWR (Voltage Standing Wave Ratio) test
- Withstand voltage/dielectric strength test
- Insulation resistance test
- Continuity test
- Rated current test only for coaxial components
- Transfer impedance test
- EMC/shielding effectiveness test: shielding effectiveness shall be equal or greater than 90dB from 10 kHz to 200MHz
- Insertion loss test: the insertion loss (not due to the impedance mismatch) shall be equal or lower than 0.05 dB from DC to 200MHz

[RQ-82] Connection of feedthrough and connector shall be tested for 100 cycles while keeping the electrical properties. To validate the compliance, the continuity test and the insertion loss test shall be carried out.

[RQ-83] The thermal cycling test shall be performed. It consists of a minimum of 10 baking cycles from room temperature to 350ºC for the coaxial components and 240ºC for the triaxial components. The component shall be kept with the uninform maximum temperature for at least 10 minutes before cooling to room temperature. The maximum temperature at the last thermal cycle shall be kept for at least 24 hours. The heating rate shall be less than 10°C /min (±1°C/min).

[RQ-84] After the thermal cycling, the following electrical tests shall be performed to demonstrate that there is no electrical performance degradation due to thermal cycling:

- Dielectric strength test
- Insulation resistance test
- Continuity test
- Characteristic impedance test
- VSWR test

[RQ-85] He leak test shall be performed after the thermal cycling test. The leak rate shall be smaller than $1x10^{-10}$ $Pa.m^3/s$ air equivalent. The He leak test must be done according to Section 25 in IVH [AD3].

[RQ-86] A welding test shall be conducted to demonstrate that Coax-EFT and Triax-EFT can be welded into the 1mm-thick plate without damage of CTMS sealing. After the welding test, the test specimen shall be examined for signs of physical damage and pass the He leak test and the electric tests (electric continuity, insulation resistance and dielectric strength).

5.2 *Factory Acceptance Tests (FAT)*

[RQ-87] Before delivery to IO, the Supplier shall perform the following factory acceptance test through random sampling (10% of each product lot) and provide the test report showing the test is successfully passed. If a failure occurs, the complete lot shall be checked.

[RQ-88] The Supplier shall perform the following electrical tests:

- Dielectric strength test
- Insulation resistance test
- Electrical continuity test
- Characteristic impedance test
- VSWR test

[RQ-89] The supplier shall check the key dimensions which are agreed with IO before FAT.

[RQ-90] The CTMS brazing part shall be visually inspected following ISO 18279.

[RQ-91] Cold He leak test shall be performed for Coax-EFT and Triax-EFT. The leak tightness shall be less than $1x10^{-10}$ $Pa.m^3/s$ air equivalent.

[RQ-92] Full records of the tests carried out shall be compiled in order to maintain traceability of the leak test history of a particular item as per Section 25.9 in IVH [AD3]. The records shall become part of the final document package for the component concerned.

5.3 *Site Acceptance*

Upon receipt of the package, the IO or the delegated entity will 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 reading of the accelerometers or other sensors;
- The integrity of the components.
- The existence and correctness of the components' markings and labelling

The site acceptance tests may also consist of electrical tests (dielectric strength test, insulation resistance, and electrical continuity) and mechanical tests (He leak test and connection/disconnection test).

The execution of the above Site Acceptance Tests is outside the scope of this contract.

The Supplier shall bear the risk of loss or damages to the components during the execution of this Contract up to Final Acceptance at the ITER site. Any risk of loss or damage shall be transferred from the Supplier to the IO upon Final Acceptance.

The components shall be handed over to the IO when they have been delivered in accordance with this Technical Specification and all related documentation have been accepted by the IO, and a Certificate of Final Acceptance at the ITER site has been issued (Final Acceptance). The Certificate of Final Acceptance shall be signed by both the IO and the Supplier, after the definitive acceptance of each component and its related documentation.

Ownership of the components shall be transferred from the Supplier to the IO upon Final Acceptance at the ITER Site. The transfer of ownership to the IO shall not relieve the Supplier of its obligations under this Contract in case of non-conformities of the components for the duration of the warranty period.

The Supplier shall provide a standard commercial warranty covering repair or replacement of the components up to 2 years after the Final Acceptance of the components.

6 Contract Management

The Supplier shall prepare a Project Execution Plan (PEP) to describe how the Supplier intends to execute their works. It shall identify the Scope of work, the organisational structure proposed, key processes which will be carried out, and roles and responsibilities within the Contract, Detailed Work Schedule (DWS), and any other information necessary to manage the contract.

6.1 Data Management

The data generated during the execution of the present Contract shall be handled electronically and entered into the ITER IDM (documents) and SMDD (2D drawings). The structure of this database shall be defined by the IO. The Supplier shall use this database to store information related to the Contract. All data entered in the database will be kept strictly confidential by the IO and, under no circumstances, shall be communicated or made accessible to other Suppliers or the DAs. Data consistency checks shall be implemented to facilitate IO oversight. Relevant data shall be made available by the Supplier to the IO through IDM each time a control point is requested, or a deviation request, a non-conformance report, or any other document which is part of the Contract deliverables is issued by the Supplier, in accordance with the document "Procedure on Procurement Documentation Exchange between IO, DA, and contractors" [RD19]. This requirement does not apply for other documents and data files which are, for example, managed through specialized CAD software (e.g. CATIA) and so undergo other requirements specified in separate documents.

6.2 Monitoring and Access Rights

The Supplier shall submit periodic reports to the IO, with a frequency depending on the progress of the works. Progress meetings shall be conducted at the IO or Supplier premises, as required by the IO.

The Supplier shall ensure that access rights are granted to IO personnel at all locations where ITER work is being performed.
In case of concerns regarding the quality of production, the IO reserves the right to perform unscheduled inspections in accordance with Par. 3.10 of the ITER Procurement Quality Requirements [AD6]. Planned and documented audits will be performed by the IO, and regulatory body representatives in France, to verify compliance with the technical and quality requirements of the Contract.
Moreover the IO reserves the right to take photographs of the ITER equipment during the contract life.

7 Quality Assurance

Quality Requirements shall be in accordance with the “ITER Procurement Quality Requirements” [AD6]. The ITER Quality Assurance Program shall be applied to all the work under this Contract. The ITER QA Program is based on IAEA Safety Standard GS-R-3 and on conventional QA principles and integrates the requirements of the INB Order dated 7 February 2012 [AD1] on the quality of design, construction and operation in Basic Nuclear Installation. For this purpose, the Supplier and Subcontractors carrying out contracts placed under this Contract shall be in compliance with the QA requirements under the relevant ITER QA classifications, the requirements of the INB Order and shall have an IO approved QA Program or an ISO 9001 accredited quality system, complemented with the above mentioned requirements.

Prior to commencement of any work under this Contract, a “Quality Plan” (QP) [AD7] shall be produced by the Supplier and Subcontractors and submitted to the IO for approval, describing how they will implement the ITER Procurement Quality Requirements.

It should be noted that interventions additional to those required in this Technical Specification may be requested by the IO. The right of the IO listed above shall apply in relation to any Subcontractor and in this case the IO will operate through the Supplier. The overseeing of the quality control operation by the IO shall not release the Supplier from his responsibility in meeting any aspect of this Technical Specification.

All requirements of this Technical Specification and subsequent changes proposed by the Supplier during the course of execution of this Contract are subject to the Deviation Request process described in “Contractors Deviations and Non-conformities Procedure” [AD10].

Documentation developed as the result of this Contract shall be retained by the Supplier for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO prior to its use, in accordance with “Quality Assurance for ITER Safety Codes Procedure” [RD17].

8 Applicable and Reference Documents

8.1 Applicable Documents

This list contains documents that are mandatory.

[AD1] Order dated 7 February 2012 relating to the general technical regulations applicable to INB - FR (7GJHSE v1.3) translated for guidance in Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN (7M2YKF v1.7) and the subsequent ASN decisions linked to this Order
[AD2] Provisions for Implementation of the Generic Safety Requirements by the External Actors/Interveners (SBSTBM v2.2)
[AD3] ITER Vacuum Handbook (2EZ9UM v2.5)
[AD4] General Management Specification for Service and Supply (82MXQK v1.4)
[AD5] Overall Surveillance Plan of the Chain of External Actors for Protection Important Components, Structures and Systems and Protection Important Activities (4EUQFL v7.4)
[AD6] Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners (BG2GYB v3.3)
[AD7] ITER Procurement Quality Requirements (22MFG4 v5.1)
[AD8] Requirements for Producing a Quality Plan (22MFMW v4.0)
[AD9] ITER Requirements Regarding Contractors Release Note (ITER_D_22F52F v5.0)
[AD10] Procedure for Management of Nonconformities (22F53X v9.1)

8.2 Reference Documents

This list contains documents for information:

[RD1] Work Instruction for Producing of the Manufacturing and Inspection Plan (UKQG8M v1.6)
[RD2] Working Instruction for Manufacturing Readiness Review (44SZYP v5.0)
[RD3] Appendix 3 Materials (27Y4QC v1.20)
[RD4] Appendix 4 Accepted Fluids (2ELN8N v1.14)
[RD5] Appendix 13 Cleaning and Cleanliness (2ELUQH v1.2)
[RD6] Appendix 14 Passivation and Pickling (2F457S v1.2)
[RD7] ITER Vacuum Handbook Attachment 2 - Cleanliness Requirements Relating to the Assembly of Vacuum Equipment (MBXPP3 v1.7)
[RD8] Appendix 12 Leak Testing (2EYZ5F v1.4)
[RD9] Technical Specification for Overload Current for Multi-Pins Feedthrough (74MJCM v2.2) (Note: to be updated for approval)
[RD10] Sub-System Requirement Document sSRD-55.NE.LE: Loom Electrical Vacuum Interface (LEVI) (XZZF6N v2.4)
[RD11] System-Loads-Specification-of-the-LEVI (WNGBZT v3.5)
[RD12] ITER Site Signage & Graphics Standards (4ALJEU v2.5)
[RD13] ITER Numbering System for Components and Parts (28QDBS v5.0)
[RD14] System-Loads-Specification-of-the-LEVI (WNGBZT v3.5)
[RD15] IO/DA Documentation Exchange and Storage (35BVQR v5.0)

[RD16] MDB Manual IDM folder (https://user.iter.org/?uid=T6VPEP)
[RD17] Working Instruction for the Qualification of ITER safety codes (258LKL v3.1)
[RD18] Quality Classification Determination (24VQES v5.2)
[RD19] IO/DA Documentation Exchange and Storage (35BVQR v5.0)
[RD20] Technical Evaluation for Commercial Grade Dedication of brazed feedthroughs (9HPGAX v1.0) https://user.iter.org/?uid=9HPGAX&version=v1.0
[RD21] IN-55.NE.LEVI - Qualification plan on LEVI electrical feedthrough (649F6U v1.1)

List of Appendices

- Appendix 1: List of supply components for prototyping, qualification prototypes and in-series products
- Appendix 2: List of documents and data to be provided by the Supplier (List of Deliverables)
- Appendix 3: Propagation of Defined Requirements

Acronyms

AF	Air Flange
ASN	French Nuclear Safety Authority (from French “Autorité de Sûreté Nucléaire”)
CAD	Computer Aided Design
COTS	Commercial Off-The-Shelf
DSM	Diagnostic Shield Module
DWS	Detailed Work Schedule
EFT	Electrical Feedthrough
FAT	Factory Acceptance Test
FE	Front-End
HC	High Current
HP	Hold Point
GM3S	General Management Specification for Service & Supply
GTMS	Glass to Metal Seal
IAEA	International Atomic Energy Agency
IDM	ITER Document Management
IO	ITER Organization
IVH	ITER Vacuum Handbook
IVS	In-Vessel Support
LEF	LEVI Electrical Feedthrough
LEVI	Loom Electrical Vacuum Interfaces
LF	Low Frequency
LV	Low Voltage
MDB	ITER Manufacturing Database
MIP	Manufacturing and Inspection Plan
MRR	Manufacturing Readiness Review
MQP	Management and Quality Program
NEXT	Near-end Cross Talk
NP	Notification Point
OHS	Occupational health and Safety
PEP	Project Execution Plan
PIA	Protection Important Activity
PIC	Protection Important Component
PNI	Part Number Indentification
QA	Quality Assurance
QP	Quality Plan
RF	Radio Frequency
RH	Remote Handling
RMS	Root Mean Square
RO	Responsible Officer
RT	Room Temperature (20 ^{o}C)
SA	Sub-Assembly
SIC	Safety Important Class
TC	Thermocouple
VDC	Voltage Direct Current
VQC	Vacuum Quality Class

Appendix 1 : List of supply components for prototyping, qualification prototypes and in-series products

No.	Item ID	PNI	Component Description	Quality Class	Safety Class	Vacuum Class	Quantity			
							Prototypes	Prototypes for qualification	Batch #1	Batch #2
1	Coax-EFT	I00AL4FAH	Hermetic HN Coaxial feedthrough	QC1	SIC-1	VQC-1A	5	10	15	95
2	Coax-CON	I00ALC8J4	Push-pull type HN coaxial connector including retainer ring and wave spring	QC1	SIC-1	Non-VQC	5	10	15	95
3	Triax-EFT	I0098JQSP	Hermetic Triaxial feedthrough	QC1	SR	VQC-1A	5	10	0	60
4	Triax-MCON	I00AL3AZT	Triaxial connector in the interspace for permanent manual connection	QC1	SR	VQC-3B	5	10	0	60
5	Triax-RCON	I00AMCVP9	Push-pull type triaxial connector including retainer ring and wave spring	QC1	SR	VQC-1B	5	10	0	60

Appendix 2 : List of documents and data to be provided by the Supplier (List of Deliverables)

The documents which the Supplier shall provide as deliverables are listed in the table below. T0 means the Kick-off meeting date.

Table 3 List of deliverables and the due dates

D #	Description	Due Dates
D01	P#01/#02/#03/#04/#05 in Table 4	T0 + 1 months
D02	P#08 in Table 4	T0 + 3 months
D03	P#9/10 in Table 4 and supply of prototypes	T0 + 6 months
D04	P#11in Table 4	T0 + 6 months
D05	P#12/#13/#14/#16 in Table 4 and supply of qualification prototypes, including metalized 5 ceramic samples	T0 + 10 months
D06	P#14/#15/#16 in Table 4 for 1st batch of in-series product, including metalized 5 ceramic samples	T0 + 12 months
D07	P#14/#15/#16 in Table 4 for 2nd batch of in-series product, including metalized 5 ceramic samples	T0 + 36 months

The following table summarizes the different documents that shall be provided by the Supplier.

Table 4 Documents to be delivered

Documents to be delivered	Content	Need date
P#01 Quality Plan	As per Section 7	KOM
P#02 Project Execution Plan	As per Section 6.	KOM
P#03 Contract risk register	plan for managing risks associated with implementing the Contract	KOM
P#04 Detailed Work Schedule (DWS), including documentation schedule	The schedule should be in the form of a fully resourced program based on the Work Breakdown Structure (e.g. Primavera, MS Project), identifying all significant milestones, documentations, deliverables, activities, and their interdependencies, durations and anticipated start and finish dates and the project critical path(s). The detailed schedule proposed at the official Kick-off Meeting by the Contractor, once agreed, will be used as baseline.	KOM
P#05 Verification control plan	The verification control plan shall consist of a compliance matrix listing all requirement (RQ)	KOM

	listed in this specification.	
P#06 Monthly Progress Report	Report of technical progress and issues to be presented at monthly progress meeting. The progress (%) update as per DWS must to be provided as well. (IO will provide a template for progress update)	Monthly
P#07 Meeting minutes	Meeting minutes for Kick-Off meeting and monthly progress meeting, including ad-hoc meetings.	For each meeting
P#08 Design specification data sheet	The datasheet shall include electrical & mechanical specifications, dimensional specification, material composition and drawings of each component. The drawing shall show the design, including all joints, methods of joining, materials and tolerances, etc. After the completion of prototype activity, the datasheet shall be updated based on the prototyping results if necessary.	Before prototype fabrication & update before final manufacturing
P#09 Prototype test plan	Specification of procedures for each type of test for prototypes (Section 5.1)	Prototyping
P#10 Prototype test results report	Report on prototype test results	Prototyping
P#11 Clean work plan	The Clean Work Plan shall specify how cleanliness will be maintained throughout the manufacturing process. It shall state when specific cleaning procedures will be applied and all of the controls which will be in place to maintain cleanliness including handling. (Section 4.1.3)	Before Final manufacturing
P#12 Material certificates	Per material	Before Final manufacturing
P#13 FAT plan	Test procedures for factory acceptance as per Section5.2.	Before FAT
P#14 FAT results report	Report for the FAT results and acceptance certificate per each batch	After FAT
P#15 Transportation Quality Plan	As per Section 10.3 in [AD4]	Before delivery
P#16 Manufacturing dossier and delivery report	As per Section 4 per each batch	Before delivery

Appendix 3 : Propagation of Defined Requirements

SRD ID	Defined Requirements	Propagated Requirements for the supply
55NELEs943	IN-55.NE.LEVI SSCs shall withstand the different loading conditions, in the different foreseen events described in the corresponding Sub-system Load Specifications [ADc81], according to the component safety function, Codes & Standards and design rules [ADc44].	[RD6][RQ-7][RQ-8][RQ-9][RQ-12][RQ-13] To be noted that IO is responsible for the final qualification test to demonstrate these requirements (See Section 1).
55NELEs256	The electrical feedthroughs shall be fire resistant to the extend defined below. Insulated materials and insulation systems shall be self-extinguishing, All other non-metallic materials shall be classified self-extinguishing in accordance with agreed standards and IEC publication 332.	[RQ-42]
55NELEs423	SSCs of IN-55.NE.LEVI in areas served by the detritiation systems or Tokamak Exhaust Processing System (TEPS) shall be free of Halogenated materials. Exceptions shall require a formal project approval (The procedure for formal project approval shall include approval of the Nuclear Safety and Tritium Plant Responsible Officers).	[RQ-37][RQ-43][RQ-54]
55NELEs870	IN-55.NE.LEVI shall be designed and operated to contribute in guaranteeing that the collective annual worker dose, averaged over the operational lifetime of ITER, does not exceed an annual target of 0.5 person.Sv.	[RQ-34]
55NELEs611	Prior to delivery to ITER site, the PIC SSCs shall be stored in clean and dry conditions, protected from normal hazards.	[RQ-79]
55NELEs319	IN-55.NE.LEVI located in fire sectors shall be designed to ensure there is no spread of contamination to rooms and other zones that cannot maintain confinement, see ITER Fire Safety Approach [ADc62].	[RQ-13]
55NELEs1021	Penetration through internal or external confinement barriers, fire barriers or radiological zones shall maintain performance of the confinement barrier	[RQ-2][RQ-7][RQ-8][RQ-12]