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Technical Specifications (In-Cash Procurement)

Technical Specification for the Supply and Qualification of Vacuum Extension bellows

This document is the Technical Specification for the Supply and Qualification of Vacuum Extension bellows

Contents

List of Abbreviations

For a complete list of ITER abbreviations see: ITER Abbreviations [1].

Acronym	Expansion
ASN	Autorité de Sûreté Nucléaire (French Nuclear Safety Authority)
ALARA	As Low As Reasonably Achievable
DET	Data Export Task
DN	Nominal Diameter (Pipe)
DRR	Delivery Readiness Review
FDR	Final Design Review
INB	Instillation Nucléaire de Base – Licensed Nuclear Installation
IO	The ITER Organization.
IVH	ITER Vacuum Handbook.
MRR	Manufacturing Readiness Review
ORE	Occupational Radiation Exposure
PIA	Protection Important Activity
PIC	Protection Important Component
QAP	Quality Assurance Programme
QP	Quality Plan
SIC	Safety Important Class
VCR	Swagelok Metal Gasket Face Seal Fitting
VQC	Vacuum Quality Class.

1 Purpose

The document is the Technical Specification for Qualification and Supply of DMS Vacuum Extension Bellows.

The ITER Organization (hereinafter called "IO") requires the supply vacuum extension bellows to be used on Disruption Mitigation System (DMS) of ITER.

This Technical Specification shall define the technical requirements for the Supplier to qualify, manufacture, supply and deliver the DMS Vacuum Extension Bellows to the IO for that purpose. The DMS Vacuum Extension Bellows qualification needs to be demonstrated by the supplier and the IO approval qualifies it as PIC components.

The qualified DMS Vacuum Extension Bellows shall be given a supplier part number.

2 Definitions

Table 1 definitions

TERM	DEFINITION
Customer	ITER International Organisation, Domestic Agencies or Subcontractors working for either.
Certificate of Conformity	Certificate issued by the Supplier stating that the product concerned meets the requirements as specified in the Supplier's catalogue or this technical specification or both.
Deviations	A non-compliance with a defined requirement or non-compliance with a requirement set by the IO integrated management system that could affect the provisions of the Environment Code [2].
Double Seal	A seal that has two sealing boundaries with an interspace between these boundaries.
Interspace	The volume between two static barriers in a confinement system
Non-conformance	Any condition that does not comply with a specified IO requirement.
Nuclear Operator	ITER International Organisation
Protective Important Activity	An activity which can impact a Protection Important Component. The list of the main PIA is contained in Annex 2 of [3], [4].

TERM	DEFINITION
Protective Important Component	A component important for protecting the interests of public security as defined in the INB Order [5] and the Environmental Code [2].
Qualification	The process used to ascertain that an item meets the requirements for use.
Safety Important Class	Classification corresponding to the graduated approach of a PIC as defined in [6]
Special Process	Any process which is not used in the manufacturer of a Supplier's proprietary items which must be developed or qualified or both to meet the requirements of these technical specifications.
Subcontractor	Any entity that performs work for the Supplier.
Supplier	Any entity that provides goods or services to the ITER Organisation.

3 Regulatory requirements

ITER is a licensed nuclear facility as defined in the Decree of Authorisation of Creation of ITER-INB-174 [7] and consequently IO, the Nuclear Operator, shall comply with the French Order of 7th February 2012 [5] establishing the general rules for licensed nuclear installations (INB-Order).

Certain components, structures and systems of ITER are classified as important for the interests of public safety as defined under Article L 593-1 of the French Environmental Code and are further classified according to the area or service (i.e. their function).

The Safety Function of the DMS Vacuum extension bellows is to provide confinement as an extension of the vacuum vessel up to the first isolation valve. Therefore the quality assurance requirements of Section 15 shall be applied as well as compliance with the INB Order of 7th of February 2012 [5].

This quality system shall be included in the Manufacturing and Inspection Plan or the Quality Plan. This management system shall include the list of PIA on the basis of reference [8] and the evaluation of Non Conformance Reports whether major or minor in accordance with ITER Requirements Regarding Contractors Deviations and Non Conformities [9], [10]

4 Previous experience

The supplier shall have a background history in either Tokamak or other High Energy Physics with neutronic and gamma radiation and magnetic field environments. Vacuum

bellows with a nuclear confinement function and include examples. These case studies shall be supplied as examples in the tender.

5 System Classifications

The following are the classification the DMS Vacuum Extension bellows shall be compliant with:

- Safety Classification (for confinement function) [6]: SIC-1,
- Vacuum Classification: [11] VQC 1A, for vacuum facing internal convolutions in a double array with interspace
- Vacuum Classification: [11] VQC 3A, for atmospheric facing external convolutions in a double array with interspace
- Quality Classification: [12] QC-1,
- Seismic Classification: [13] SC-1 (SF).

See 7.1.1 Figure 2

Vacuum Quality Classes are defined [11] and this bellows shall provide leak tightness to the VQC 1A criteria.

Table 2 Bellows Safety Function

Vacuum Quality Class [11]	Safety Function of bellows	Notes
VQC 1A	To provide confinement as it forms part of the First Static Barrier (Inner Convolution(s) Boundary) in the First Confinement System and, though the use of a (Outer Convolution(s) Boundary) the Second Static Barrier to the First Confinement System.	Leak testing of the interspace between the two seal elements and of the interspace within the double bellows allows verification of the integrity of the static barriers.

6 Scope

6.1 ITER DMS Vacuum Extension Bellows Deliverables

The DMS system requires 27 Vacuum extension bellows plus 6 spares and assemblies for qualification activities.

A bellows design shall be produced that meets the requirements of this technical specification document for the load case combinations defined in the DMS vacuum extension bellows load specification[34] [D1]This design and design justification shall be submitted to the IO for

review and approval. Two iterations shall be anticipated for this deliverable in order to deal with review comment resolution

A qualification proposal compliant with ITER requirements [21]. shall be proposed by the supplier. [D2] Once approved these qualification activities shall be implemented [D3]and a qualification report shall be produced for review and approval. [D4]. Two iterations shall be anticipated for each of these documentary deliverables in order to deal with review/comment resolution.

The bellows used for test and qualification purposes shall be considered property of the IO and be delivered to the IO after qualification activities are complete.[D5]

Once Final Design Review Approval has occurred the MRR shall be implemented by the supplier. [D6].[20] The successful completion of the MRR shall allow the manufacturing and delivery phases to occur. [D7, D8]

6.2 Deliverables table

Table 3 - Summary of Deliverables and Time Schedule

No.	Deliverable name	Due Date
D-1	Quality Plan (QP)	T0* + 4 weeks (completed)
D-2	Bellows design and design justification	T0 + 10 week (completed)
D-3	Qualification proposal (Inc number of bellows to be produced)	T0 + 10 weeks (completed)
D-4	Qualification implementation	T0 + 35 weeks (completed)
D-5	Qualification report	T0 + 45 weeks (completed)
D-6	Delivery bellows used in qualification activities	T0 + 50 weeks (completed)
D-7	MRR[20]	FDR closure + 12 weeks (completed)
D-8	Manufacture	FDR closure + 20 weeks (completed)
D-9	DRR[21] and Delivery to IO site	FDR closure + 40 weeks (completed)

*T0 is kick off meeting date

6.3 Engineering Services

Services needed to cover future design changes and engineering of bellows shall be managed by this method below

6.3.1 Methodology to manage the contract for supply in the case of a design change request by the ITER Organization

There is likely to be some future need for DMS Vacuum extension bellows design over the life of the ITER project. These changes may range from small modifications based on DMS Vacuum extension bellows use experience by ITER to the design of a new DMS Vacuum extension bellows.

The supplier shall in their offer supply the fixed hourly manpower rates of the engineering work rates used for these works. In the offer the supplier shall propose a price revision formula.

To manage such an additional service IO shall issue a for the service following this process.

1. The ITER Organization shall issue and send to the Supplier a Supply Request for any additional engineering service it may require from the Supplier.
2. The Supply Request shall include the following information.
    - Scope of work
    - Technical specification
    - Required completion date
    - Deliverables
    - Deadline date for the Supply Offer submission
    - Any other information required.
3. By the deadline date described in the Supply Request, the Supplier shall submit the financial and technical Supply Offer to the ITER Organization.
4. The Supply Offer shall include the following information:
    - Compliance with the Supply Request
    - Required total manpower hours and its breakdown
    -
5. After the review of the Supply Offer, the ITER Organization may issue and send to the Supplier a Supply Order for the service it requires from the Supplier. The Supply Orders shall be prepared and sent by two original copies.
6. The Supply Order shall include the following information.
    - Scope of work
    - Quantity
    - Unit price in EURO
    - Total amount of order in EURO
    - Required delivery timing
    - Payment plan
    - Point of contact in each Party during the implementation of the Task
    - Order
    - Deliverables
    - Any other conditions required

7 Technical Requirements

7.1 Safety Function of the Bellows Interspace and the Seal interspace

7.1.1 Bellows interspace safety function

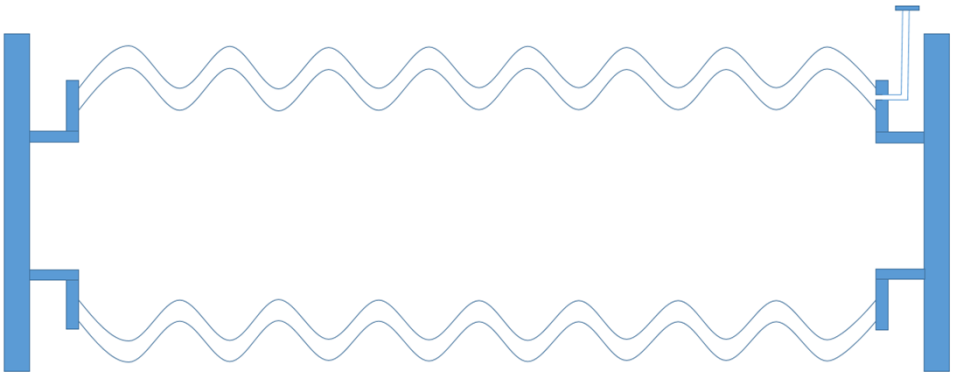

Figure 1 VQC Boundaries of bellows interspace

The bellows interspace system has two sealing elements:

- Convolution(s) 1 – Provides the VQC 1A boundary and forms part of the First Static Barrier in the *First Confinement System*.
- Convolution(s) 2 – Provides the VQC 3A boundary and forms part of the Second Static Barrier to the *First Confinement System*.

The monitor able interspace shall utilise a VCR connection as per the IVH. .

This interspace shall be pumpable with free connectivity between any volumes so that there are no virtual leaks preventing the effective monitoring of the seal leak rates. The nominal pressure in the interspace is 50 kPa, but during any leak testing this pressure will be in the order of 10 Pa.

7.1.2 Seal interspace safety function

The vacuum seal system has two sealing elements:

- Torus 1 – Provides the VQC 1A boundary and forms part of the First Static Barrier in the *First Confinement System*.
- Torus 2 – Provides the VQC 3A boundary and forms part of the Second Static Barrier to the *First Confinement System*.

The space between these two seals is provided with a port in the flange to allow testing of the condition of the First Confinement System, see Figure 2 below.

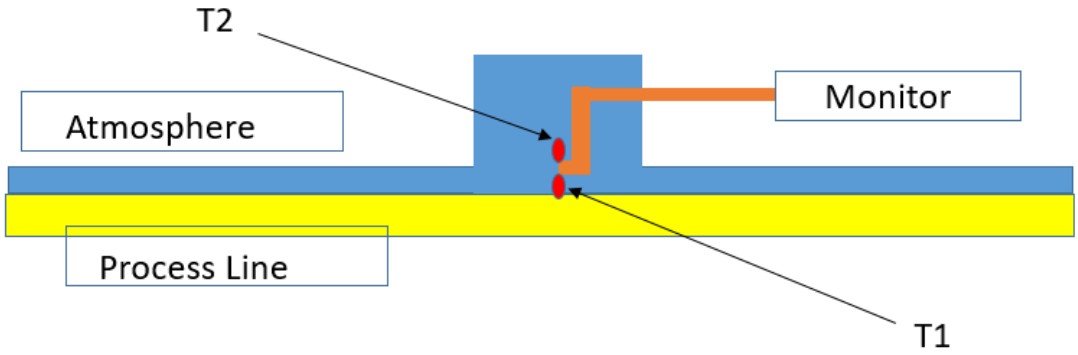

Figure 2 VQC Boundaries

This interspace shall be pumpable with free connectivity between any volumes so that there are no virtual leaks preventing the effective monitoring of the seal leak rates. The nominal pressure in the interspace is 50 kPa, but during any leak testing this pressure will be in the order of 10 Pa.

7.2 DMS Vacuum extension bellows Construction Materials

All materials used in construction of the system shall be fully traceable to their respective sources. Wherever possible all materials used in the bellows shall be made from low activation materials. If a technical constraint forces the use of other materials then the expected composition and the technical requirement for this material shall be given.

IO requires that full disclosure of the materials and their compositions used in the construction is given and that all material test certification is provided in the QA documentation. An EN 10204 Type 3.1 Certificate [14] or IO approved equivalent is required. If an alternative to the Type 3.1 certificate is proposed then this shall be stated in the Supplier's offer for acceptance by IO. Niobium Tantalum and Cobalt content of stainless steel materials shall be demonstrated by certification or calibrated test.

Due to the possible irradiation levels that will be encountered during the end use special care must be taken to ensure no long lived residual activity is induced in the components. Specific limits of impurities and certain materials are restricted in their use. These are given in [15] and the values in VACEXBL-8.1.2 8 shall be applied for use of austenitic stainless steels for these Bellows.

In the case of an overriding technical constraint then the Supplier shall report the reason and actual values for the construction materials to allow IO to make an assessment via a Deviation Request [9] to this specification.

Table 4 Radiological Element Limits for Austenitic Stainless Steel

Element Name – Symbol [16]	Maximum percentage by mass
Cobalt [Co]	0.05%
Niobium [Nb]	0.01%
Tantalum [Ta]	0.01%

7.3 Radiation

The supplier produced qualification report shall reference demonstration that the proposed bellows not degrade and retain their confinement function in the radiation environment of the ITER machine..

7.4 Cleaning to Vacuum Standards

These bellows are UHV components. The cleaning process shall comply with the requirements of IVH [11] Section 24 and IVH Appendix 13 [17]. The Supplier shall commit to an IVH compatible cleaning procedure as part of the offer. The cleaning procedure shall be submitted as an MRR deliverable

During cleaning, particular attention shall be given to the removal of debris and other foreign matter. Final cleaning shall ensure effective cleaning without damage to the surface finish and material properties. Cleaned components shall be bagged to prevent contamination. The component part number shall be clearly marked on the bag and the outer packaging. This shall comply with 8.4 below.

If the supplier has a suitable alternative packaging method for the bellows then this shall be described in their offer.

7.5 Resistance to corrosion

In the postulated event of a water leak into a vacuum systems the bellows may be exposed to water or water vapour for an extended period. This resistance to corrosion shall be demonstrated the via the Qualification Report.

7.6 Baking

The bellows shall be installed in systems that may be baked up to 240°C (+/-10) and may be subject to a fire scenario temperature of 300C for 2 hours. The supplier shall demonstrate that the DMS Vacuum Extension bellows:

1. Does not suffer any significant degradation in performance when compared to the room temperature leak rate.

7.7 Drawings

The supplier shall produce a full set of drawings for the component and assemblies within the scope of this Technical Specification.

8 Listed Technical requirements

Where the following terms appear in bold type, they have the following meanings:

SHALL: mandatory requirement or rigid constraint

SHOULD: optional requirement or flexible constraint

MAY: not a requirement or constraint, included as a suggestion/recommendation to the system designer

8.1.1 Dimensions

Table 5 Dimensional related requirements

#	Requirement	Comment
VACEXBL-8.1.1 1	The bellows **SHALL** have an axial length of less than or equal to720mm in the normal operating position, including both flanges	
VACEXBL-8.1.1 2	The total length of bellows (including tooling and flanges) in the operating position **SHOULD** be minimised	
VACEXBL-8.1.1 3	The bellows **SHALL** fit within an outer cylinder of less than 150mm diameter.and be compatible with the supplied 3D environmental model	
VACEXBL-8.1.1 4	When the vessel is at its nominal temperature, the bellows **SHALL** have an minimum internal clearance of 50mm that corresponds with the flightline as defined in the IO supplied 3D model.	This assumes a maximum vertical offset of +/-3mm and a maximum lateral offset of +/-7.5mm
VACEXBL-8.1.1 5	In the installation position, the bellows and **SHALL** respect the keep-out zones required for two lead screws as shown in the supplied 3D environmental models	

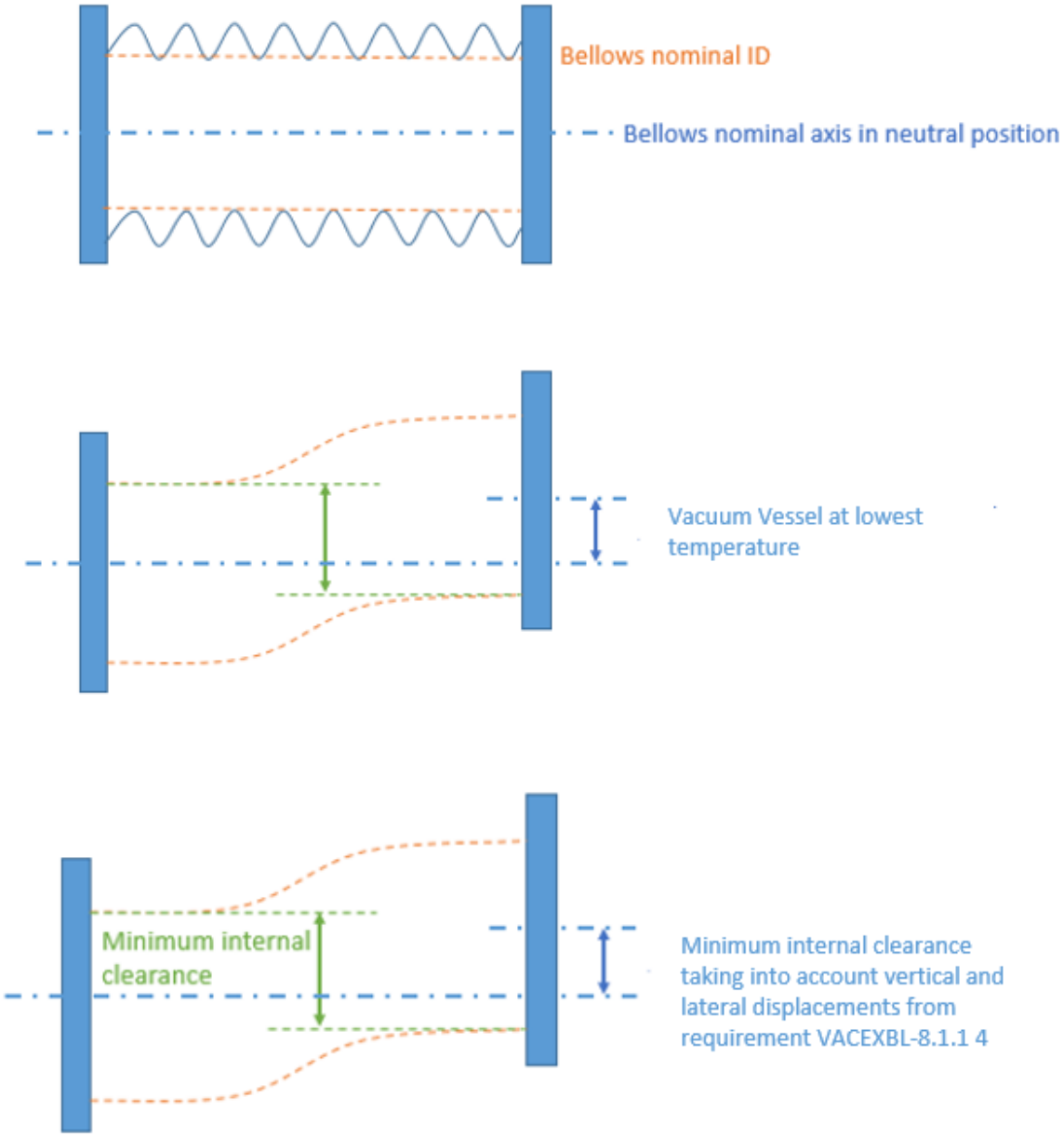

Figure 3 - Sketches showing minimum internal clearance and displacements

8.1.2 Construction (incl flanges)

Table 6 Dimensional related requirements

#	Requirement	Comment
VACEXBL-8.1.2 1	The bellows **SHALL** have two DN65 ALARA ORE style flange on both sides	Flanges with weld stubs seals and blanks shall be free-issued by ITER Organization (IO). 3D dimensioned model is also supplied.
VACEXBL-8.1.2 2	The bellows **SHALL** be of two single layers with a	Greater bellows lifetime is

	monitor able interspace or two multiply layers with a monitor able interspace	preferred
VACEXBL-8.1.2 3	The bellows **SHALL NOT** be of edge-welded construction	
VACEXBL-8.1.2 4	The bellows **SHALL** have an interspace which is connected to a ¼" male VCR fitting	
VACEXBL-8.1.2 5	The interspace **MAY** be connected to the interspace on either flange, so that it can be monitored using the existing ¼" VCR connection on the flange.	
VACEXBL-8.1.2 6	Design, qualification, production and inspection of welded joints **SHALL** comply with the requirements of the ITER Vacuum Handbook (ITER_D_2EZ9UM v2.5) according to Vacuum Quality Class (VQC) 1A.	
VACEXBL-8.1.2 7	The bellows material **SHALL** be 300 series stainless steel proposed by supplier and accepted by IO	
VACEXBL-8.1.2 8	The material **SHALL** comply with the following limits on material composition: Element: Co / Ta / Nb Max wt%: 0.05 / 0.01 / 0.01	

8.1.3 Loads

Table 7 load combination related requirements

#	Requirement	Comment
VACEXBL-8.1.3 1	The bellows **SHALL** be designed to withstand all cyclic loads expected during ITER lifetime [34] without failure.	

8.1.4 Tooling

Table 8 tooling related requirements

#	Requirement	Comment
VACEXBL-8.1.4 1	The bellows **SHALL** be designed and manufactured with features that are compatible with the use of temporary tooling. This design **SHALL** be proposed by the supplier and accepted by the IO.	Example image is shown below

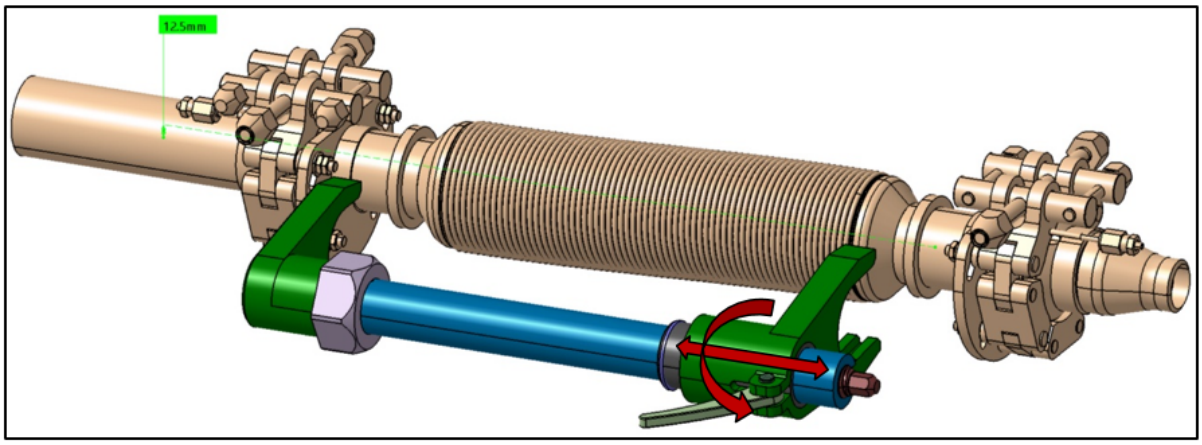

Figure 4 Example image of tooling and tooling interface features

8.1.5 Codes, Standards and Classifications

Table 9 1 Codes, Standards and Classification related requirements

#	Requirement	Comment
VACEXBL-8.1.5 1	The bellows **SHALL** comply in general with the requirements of the ITER Vacuum Handbook (ITER_D_2EZ9UM v2.5) according to Vacuum Quality Class (VQC) 1A.	
VACEXBL-8.1.5 2	The bellows SHALL be designed, manufactured and tested in accordance with the EN14917 and EJMA Section 4-11 for vibration.	EN14917 does not provide a method for verification of vibration load cases

8.1.6 General

Table 10 General requirements

#	Requirement	Comment
VACEXBL-8.1.6 1	The bellows design **SHOULD** be identical for all equatorial and upper port locations, considering the different lifetime cyclic displacement loads at either location	

8.1.7 Overall configuration

Table 10 General requirements

#	Requirement	Comment
VACEXBL-8.1.7 1	The design SHALL be compliant with available space reservations the CAD model supplied	Bellows and tooling access configuration shall be compatible with maintenance access

8.1.8 Calculation requirements

#	Requirement	Comment
VACEXBL-8.1.8 1	All analyses, regardless of the type, shall follow the Procedure for Analyses and Calculations [36]. All analysis models, macros, etc. shall be stored on the IO Analysis Model Database in accordance with the Instructions for the Storage of Analysis Models [37]. Mechanical and structural analyses shall be performed in accordance to the Instructions for Structural Analyses [38]. The contractor shall be responsible for implementation and coordination of all analysis activities required. This includes ensuring that Suitably Qualified and Experienced Personnel (SQEP) resources complete tasks within the proposed timescales. The ITER Organization shall be responsible for technical input for all identified scope. This includes loads and boundary conditions input data. The chosen analysis methodology shall be approved by the ITER Organization prior to commencement of the work. The applicable codes are the ones described in the specific sections. The Contractor shall perform the structural analysis following these codes, unless a different code is agreed in writing by IO. Hand calculations shall be performed using Excel spreadsheets. If an in-house software in used, it has to be qualified following the Software Qualification Policy [39]. For that, the developed software has to demonstrate that performs the calculations correctly for some test cases in the intended purpose. If FE calculations are performed, they shall be done using ANSYS. The use of different software may be proposed by the contractor so long as it is accompanied by a comprehensive validation file, but this may lead to the tender being rejected by IO. The use of any alternative software will in any case require authorization in writing by IO, prior to the commencement of any analysis task. The Contractor shall submit a draft version of each deliverable which could consist of analysis reports or/and models. The IO Technical Responsible Officer will review the draft version of the deliverables and respond within a specified period after receipt, providing a commented version of the deliverables. The Contractor shall perform all the necessary modifications or iterations to the deliverables and submit a revised version by the due dates specified in the Task Order.	

VACEXBL-8.1.8 2	IO shall be able to reproduce all reported results. To that end, the requirements in [40] shall be followed, with the following being provided with every report: • All calculation and finite element models used for generating the reported data. • The models shall come with all the boundary conditions (BCs), loads, and element and material properties applied, making the model ready to run. Alternatively, pre-processing subroutines or macros that apply these BCs, etc. shall be supplied, along with clear instructions for which macros need to be run in order to reproduce the reported results. In other words, the number of manual operations required to rerun the analyses shall be reduced to the strict minimum. Any manual operation that is required to rerun the analyses shall be described either in the analysis report or in a document attached to the model. • All pre- and post-processing subroutines, macros, batch scripts, spreadsheets, etc. used in the preparation of the work. • If macros and subroutines are used, they shall be well commented. All text shall be written in English, including names (parameters, models, files…), comments (scripts, source code…), etc. Macros and subroutines shall be documented to a sufficient extent that a user proficient in the relevant programming language can easily understand the purpose of each macro, and how different macros link to each other. • FE models shall be attached to geometry, unless otherwise agreed in writing by IO. If macros are used for the generation of the model, these form part of the deliverables. • The MQP Instructions for structural analyses [38] specifies the template for the analysis report[41], as well as for checklists for Reviewers [44] , Technical Checkers [45] and Independent Peer Reviewers[46] . As specified in [38], reports and checklists shall follow these templates. For every analysis report, completed Reviewer and Technical Checker checklists form part of the deliverables.	
VACEXBL-8.1.8 3	The official language of the ITER project is English. Therefore, all input and output documentation relevant for this Contract shall be in English. For all deliverables submitted in electronic format, the Contractor shall ensure that the release of the	

	software used to produce the deliverable shall be the same as that adopted by the ITER Organization. All documentation and correspondence shall be through Microsoft Office software or Adobe PDF. If Adobe PDF is used, the corresponding version in Microsoft office format shall also be delivered. A separate Structural Integrity Report has to be issued summarizing the assessments performed. The requirements for Structural Integrity Reports are given in appendix C of [36]. The Guideline for Structural Integrity Report [42] and the Template for Structural Integrity Reports [43] provides guidelines and recommendations for preparing the SIR following the requirements in [36]	

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9 Expected Quantities

9.1 ITER Style ALARA ORE DMS Vacuum extension bellows Quantities

The estimated quantities needed for machine assembly and operation is given in Table 11below for information.

Table 11 Estimated Bellows Quantities

Flange and Bellows Size	Estimated Quantity
ALARA ORE flanges with DN65 NPS Sch20 interfaces	27 + 6 Spares + Those required for qualification purposes

9.2 Batch size

For each DMS Vacuum extension bellows based on the quantities in Table 11 the supplier shall propose a manufacturing batch size in their response.

9.3 Handling, storage, packing & shipping

Handling storage packing and shipping shall conform fully to IVH Section 29 and [19]. All external packaging shall be marked or labelled in English and be of an agreed proper construction that is moisture proof to prevent damage or deterioration of the items being shipped or in controlled storage for up to five years. The package shall be marked with PNI

described in section 8.6 below. The packaging shall allow the removal of the bellows without hindrance or damage. Instructions for removal shall be printed on the outside of the package or attached to the package for ready reference.

9.4 Delivery conditions to IO site or other entity

For delivery to IO site the delivery and reception process for PIC items shall apply. [19] in particular section 7.1.1.1 and Section 8.2.3. The suppler shall understand and agree to these specific conditions relating to the required delivery report, preservation requirements and packing list. The working instructions for the delivery readiness review shall be followed [21]. To allow proper control of these items the supplier shall be provided with an IDM account (s) on request to allow the uploading of the required documentation.

For delivery to another customer such as a DA or other entity the specific requirements for a PIC item for that entity shall be established at the time of order and shall be met.[19]. The IO shall be responsible for payment.

9.5 Traceability – Item Numbering & Record Keeping

The use of these bellows is as a Protection Important Component in the ITER Machine. The bellows and any manufacturing processes used are considered PIC and PIA respectively. Full traceability in terms of record keeping is essential. IO will require that all documentation related to the manufacture of a PIC is provided to the IO. The Supplier shall also retain their records for 5 years. If after that time the Supplier wishes to remove these data then IO should be informed in writing and IO reserves the right to extend the record keeping for a further period or take possession of the data.

ITER will advise the PNI for the bellows and the manufacturer shall choose a serial number and apply a maker's mark.

Any marking on the component shall comply with requirement of IVH Section 28. Marking on the bellows shall only be possible on an agreed surface of the components. The use of marker pens is not permitted. The mark should be either stamped or legibly scribed in letters at least 3 mm high. The locations of this mark shall be noted on the supplier's drawing of the bellows. If this is not possible due to the small size of the item or other overriding considerations then the article's packaging shall be clearly identified with any serial number to fully identify the component.

10 Supplier qualification

The supplier shall provide an outline qualification plan [22] in their offer. The qualification type and evidence shall be provided in the form of a qualification matrix.

The supplier shall demonstrate either by testing, calculation or analysis, operating experience, ongoing qualification or a combination of methods the suitability of the bellows and its compliance and qualification with this specification.

The IO Design Floor Response Spectra [23] shall be provided for the seismic testing for Building 11, L4 so that all anticipated vacuum flange connections are encompassed.

Post contract award the IO reserves the right to perform audit tests on any bellows supplied and reject that batch of bellows if found not to meet the requirements.

Any actual leak testing carried out on these bellows the leak testing shall comply with the requirements of the ITER Vacuum Handbook Section 25 [11] and its Appendix 12 [24] unless otherwise agreed by the Vacuum RO.

All flange stresses will be assessed to the requirements of ASME VIII Div 2 [31], and EN 13445-3 [32]. The code RCC-MRx allows the use of EN13445 according to the restrictions in paragraphs REC2230 [33] so the flange can be considered compliant with this code if EN13445 is followed.

11 Manufacturing

The supplier shall carry out an MRR according to [20]

12 Pricing

In the tender return the supplier shall provide prices for the bellows kits in this specification in the quantities given in Table 11.

The supplier shall assume the flanges, seals and blanks shall be free issued. The IO will provide free issue items to the supplier free of charge. The supplier shall be responsible for for receiving, unloading and handling free issue items when items are delivered to the supplier's premises from flanges supplier.

As part of the offer the supplier shall:

1. Propose DMS Vacuum extension bellows solution,
2. Produce the qualification plan for the bellows to demonstrate the bellows is qualified to meet all technical requirements in the specification,
3. Propose how to demonstrate leak tightness following combined dynamic loading and bending moment,
4. Propose how to demonstrate Bellows compliance with this specification through a compliance matrix.

12.1 The Supplier's responsibilities

1. The Supplier is responsible for the supply of bellows meeting all the requirements contained in these specifications to the Customer. Supply shall include design, manufacture, inspection, testing, delivery and documentation of bellows as specified in the Customer order.
2. The Supplier shall manage all aspects of the DMS Vacuum extension bellows procurement which relate to the Suppliers scope of supply apart from flanges, seals and blanks

3. The Supplier shall ensure that they satisfy the technical requirements in this Technical Specifications.
4. The Supplier shall appoint a Responsible Officer who represents the Supplier for all matters related to this work and who shall:
    a. Coordinate the planning and performance of the work including any work assigned to subcontractors.
    b. Maintain schedules and issue monthly progress reports.
    c. Verify that the quality systems are consistently followed during the performance of the contract.
    d. Assess and oversee quality in any subcontractors' premises
5. The Supplier shall ensure that all input information provided to perform the work remains the property of IO and shall not be used for any other activity than the one specified in this Technical Specification.
6. The Supplier shall ensure to maintain an organization and facilities suitable to perform the scope of the works as described in this Technical Specification.
7. The Supplier shall provide to the IO representative or the applicable ITER Domestic Agency or any applicable regulatory authorities' full access to its work premises, to permit the follow up of work progress, if requested by the IO.
8. The Supplier shall submit all documentation, information and deliverables in English.
9. All external packaging shall be marked or labelled in English.
10. All reporting and measurement shall use SI units as the primary units.

12.2 The IO's responsibilities

1. The IO RO (Responsible Officer) shall make available to the Supplier all technical data, specifications or information which the Supplier requires to carry out its obligations pursuant to this Technical Specification.
2. The IO RO shall assess the performance and quality of the work by the Supplier.

13 Quality Assurance (QA) requirements

13.1 Quality management

The supplier shall have an IO approved QA Program or an ISO 9001 accredited quality system, or equivalent one. The Supplier's Quality Assurance Programme (QAP) is subject to approval by the IO in accordance with the ITER QA Programme and shall be applied to all work carried out as a result of any contract arising from this specification.

The ITER QA Programme is based on IAEA Safety Standard SGR-Part 2 [25] and on conventional QA principles and integrates the requirements of the French Order dated 7th February 2012 [2] on the quality of design, construction and operation of Licensed Nuclear Installations. For this purpose, the Supplier shall ensure that any subcontractors

carrying out work placed under the prime contract are in compliance with the QA requirements under the relevant QA classifications.

The general requirements are detailed in ITER Integrated Safety, Quality and Security Policy [26]and ITER Procurement Quality Requirements [27]whilst the specific requirements for the supervision of the supply chain for Protection Important Components, Structures, Systems and Activities is detailed in [3] [-

13.2 Quality plan

Prior to commencement of the work, a Quality Plan [29] must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the qualification and experience of the workers involved

13.3 Manufacturing and inspection

Prior to the commencement of any manufacturing, a Manufacturing and Inspection Plan [29] must be approved by ITER who will mark up any planned interventions. Prior to the delivery of any manufactured items to the IO Site, a Release Note must be signed in accordance with [30].

13.4 Protection Important Components

For the Protection Important Components, structures and systems, a specific management system must be implemented by the Supplier and any subcontractor working on protective important activities, 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. This management system will include the evaluation of Non Conformance Reports whether major or minor [10].

The use of computer software to perform a safety based task or activity such as analysis and/or modelling shall be reviewed and approved by the IO prior to its use, in accordance with [30].

13.5 Deviations and Non-Conformances

A deviation is defined in the Order [5] as a non-compliance with a defined requirement or non-compliance with a requirement set by the licensee's integrated management system that could affect the provisions of the Environment Code. All deviations and non-conformities must strictly follow the procedure detailed in ITER Requirements Regarding Contractors Deviations [9] and Non Conformities [10].

The overriding principle is to ensure timely identification and review of deviations and non-conformances in order to determine the importance and to ensure appropriate corrective

action is taken. The management of deviations and non-conformances and the analysis of trends is also part of the overall IO Project continuous improvement process.

13.6 Additional Surveillance Requirements

ITER Organisation is the Nuclear Operator and has the ultimate responsibility for the application of the INB Order [5] within the IO and in its chain of suppliers. IO must undertake additional surveillance for those components which are classified as Protection Important Components as described in Section 3.

The Supplier shall therefore grant access to the IO and ASN representatives to its facilities and records and those of its subcontractors for the purposes of surveillance of defined requirements during the design, construction, manufacturing, commissioning, assembly, maintenance and surveillance of a PIC. This surveillance shall also include the examination of all protective important activities and follow-up and verification of any corrective actions which are to be implemented.

13.7 Changes in the supply Chain affecting qualification of the bellows

The supplier's supply chain forms an intimate part of the qualification validity. Any changes in this supply chain to a qualified bellows shall be notified in advance to both the IO RO and QARO. The propagation of the French Order of 7th February 2012 [5] requirements shall be made to all those in the supply chain. IO reserves the right to audit subcontractors for PIC components.

13.8 Documentation

All documentation related to the design, construction, manufacturing, commissioning, assembly, maintenance and surveillance of a PIC must be provided to the IO.

14 References

[1] ITER Abbreviations (ITER_D_2MU6W5).

[2] Environmental Code. Ordinance 2000/914 dated 18 September 2000. As amended. Available: http://www.legifrance.gouv.fr.

[3] Surveillance Plan for PBS 18 - Fueling and Wall Conditioning System (QE6BSS).

[4] Surveillance plan for PBS 18 - Annex 2 - List of Protection Important Activities (SJZJQB)

[5] Order dated 7 February 2012 relating to the general technical regulations applicable to INB (ITER_D_7M2YKFv1.7).

[6] Safety Important Functions and Components Classification Criteria and Methodology (ITER_D_347SF3v1.8).

[7] Decree No.2012-1248 dated 9 November 2012 authorising IO to create a licensed nuclear facility called “ITER” (ITER_D_CZK7M5v.1).

[8] List of ITER-INB Protections Important Activities (ITER_D_PSTTZL v2.2).

[9] Procedure for the management of Deviation Request (ITER_D_2LZJHB v5.5).

[10] Procedure for management of Nonconformities (ITER_D_22F53X v8.2).

[11] ITER Vacuum Handbook (ITER_D_2EZ9UM v2.5).

[12] Quality Classification Determination (ITER_D_24VQES v5.2).

[13] ITER Seismic Nuclear Safety Approach (ITER_D_2DRVPE).

[14] EN 10204:2005 Metallic products - Types of inspection documents

[15] Chemical composition and impurity requirements for Materials (ITER_D_REYV5Vv2.3).

[16] International Union of Pure and Applied Chemistry (IUPAC).

[17] IVH Appendix 13 Cleaning and Cleanliness, (ITER_D_2ELUQH).

[18] Nuclear Safety Roombook, (ITER_D_KF63PB v2.11).

[19] Procedure for Transportation of Components to ITER Site (RY5C6Q v1.7).

[20] Working Instruction for Manufacturing Readiness Review (44SZYP v5.0)

[21] Working Instruction for the Delivery Readiness Review (ITER_D_X3NEGB).

[22] Qualification guidelines (ITER_D_WGFF3G).

[23] Design Seismic Floor Response Spectra in the Tokamak Complex (ITER_D_SVBRJZ v1.1).

[24] Appendix 12 Leak Testing (ITER_D_2EYZ5F v1.4).

[25] IAEA, Safety Standard SGR Part 2 Leadership and Management for Safety.

[26] ITER Integrated Safety, Quality and Security Policy (ITER_D_43UJN7 v2.0).

[27] ITER Procurement Quality Requirements (ITER_D_22MFG4 v5.1).

[28] ITER Overall Supervision Plan of External Interveners Chain for Protection Important Components, Structures and Systems and Protection Important Activities

(ITER_D_4EUQFL v6.1).

[29] Requirements for Producing a Quality Plan (ITER_D_22MFMW v4.0).

[30] Quality Assurance for ITER Safety Codes (ITER_D_258LKL v3.1).

[31] ASME BPVC Section VIII Div 2, 2015.

[32] EN 13445 Unfired Pressure Vessels - Part 3 Design.

[33] RCC-MRx Section 2 REC2230.

[34] System Load Specification for DMS Vacuum Extension Bellows (7MKUW3)

[35] BS EN 14917:2021 Metal bellows expansion joints for pressure applications

[36] - Procedure for Analyses and Calculations (22MAL7 v6.6)

[37] - Instructions for the Storage of Analysis Models(U34WF3 v2.0)

[38] - Instructions for Structural Analyses (35BVV3 v4.0)

[39] - Software Qualification Policy (KTU8HH v2.0)

[40] - Instructions for the Storage of Analysis Models (U34WF3 v2.0)

[41] - Template for Structural Analysis Reports (VQVTQW v1.0)

[42] - Guideline for Structural Integrity Report (35QTKD v2.0)

[43] - Template for Structural Integrity Reports (4GDQM6 v1.0)

[44] - Reviewer Checklist for Structural Analyses (RYATXV v2.0)

[45] - Technical Checker Checklist for Structural Analyses (TK33SU v2.0)

[46] - Independent Peer Reviewer Checklist for Structural Analyses (VQVFEN v1.0)

[47] Provisions for Implementation of the Generic Safety Requirements by the External Actors/Interveners (SBSTBM v2.2)