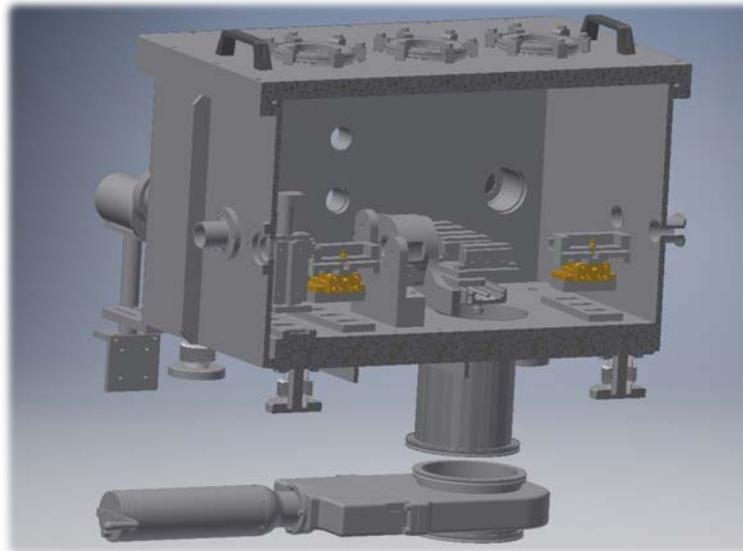


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[RSD product category B]

VUV monochromator UHV chamber TP17_011



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1. Introduction

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints on the VUV monochromator UHV chamber and auxiliary parts to be used with the HHG source in the E1 experimental hall of the ELI Beamlines facility.

1.2. Scope

This RSD contains all of the technical requirements: functional, design, delivery, safety and quality requirements for the following product (*PBS: E.E1.VUV.MONO.1*): **VUV monochromator UHV chamber and auxiliary parts**. In addition to the requirements specified in this RSD, the product shall comply completely with the requirements given in the Reference documents [see chapter 1.4].

This Product is a **product Category B** according to the ELI Beamlines RSD categories of products. A category B product is based on an existing design with minor adaptations to the existing model. As such, no formal design phase is required but the final design suggestion has to be accepted by the Contracting Authority (CA) before manufacturing starts. Verification (testing) of all specified parameters for every item listed in this RSD shall be undertaken by the Supplier before delivery to the ELI Beamlines facility and all items shall be furnished with a certificate of conformity, or other such document, to reflect their proper characteristics. Further, all items will be subject to verification upon delivery to the ELI Beamlines facility by ELI qualified personnel (or external contractors if required). All non-conformances (if any) must be addressed by the Supplier in a timely manner.

1.3. Terms, Definitions and Abbreviations

For the purpose of this document, the following abbreviated terms apply:

| Abbreviation | Meaning |
|--------------|--|
| AMO | Atomic, Molecular and Optical sciences |
| CA | Contracting Authority |
| CDI | Coherent Diffractive Imaging |
| CEM | Channel Electron Multipliers |
| E1 | Experimental hall 1 |
| ELI | Extreme Light Infrastructure |
| HV | High Vacuum (better than $5 \cdot 10^{-6}$ mbar) |
| MAC | Multipurpose chamber for AMO and CDI experiments |
| RA4 | Research activity 4 (Applications in Molecular, biomedical and materials sciences) |
| RGA | Residual Gas Analyzer |

| Abbreviation | Meaning |
|--------------|--|
| RSD | Requirements Specification Document |
| TMP | Turbomolecular Pump |
| UHV | Ultra-High Vacuum (better than $5 \cdot 10^{-8}$ mbar) |

1.4. Reference documents

| Number of doc. | Title of Document/File |
|----------------|--|
| RD-01 | 00153092-A_5.3_ES_DW_Drawings_for_VUV_monochromator_UHV_chamber_TP17_011.rar |
| RD-02 | 00112523-A_E1_Room_Datasheet.pdf |

Detailed list of drawings including within **RD-01**:

| DRAWING/FILE NAME | FILE FORMAT |
|--|-------------|
| VUV_monochromator_UHV_and_custom_equipment | stp |
| Stand-alone_refocusing_optic_chamber_B4MAC | stp |
| MAC_Chamber_Cross-refocusing_optic_chamber_B4MAC | pdf |
| Slit_Box | pdf |

1.5. References to standards

If this document includes references to standards or technical documents the CA allows/permits also another equal solution to be offered. If the Supplier offers another equal solution the CA shall not reject its bid, once the Supplier by appropriate means in the bid proves that the offered supplies, services or works meet in an equivalent manner the requirements including references to standards or technical documents.

2. General system requirements

2.1. System Configuration

REQ-021327/A

The VUV monochromator UHV chamber and its auxiliary parts (further "**System**") shall consist of the following main components:

1. Main chamber (for toroidal mirrors and Richardson gratings);
2. Slit box;
3. Detector chamber (for CEM and/or auxiliary photodiode);
4. Refocusing optic chamber assembly B4MAC (for ellipsoidal or toroidal refocusing mirror).

NOTE: The components that will be used into the chambers are only mentioned for reference. Such components are shown in brackets and they are not part of this tender.

2.1.1. Schematic drawing of the System (Figures 1-5)

Schematic drawings of the VUV monochromator UHV chamber and its auxiliary parts are shown in Figures 1-5 below (for further information see **RD-01**, 3D CAD data: *VUV_monochromator_UHV_and_custom_equipment.stp* and *Stand-alone_refocusing_optic_chamber_B4MAC.stp*).

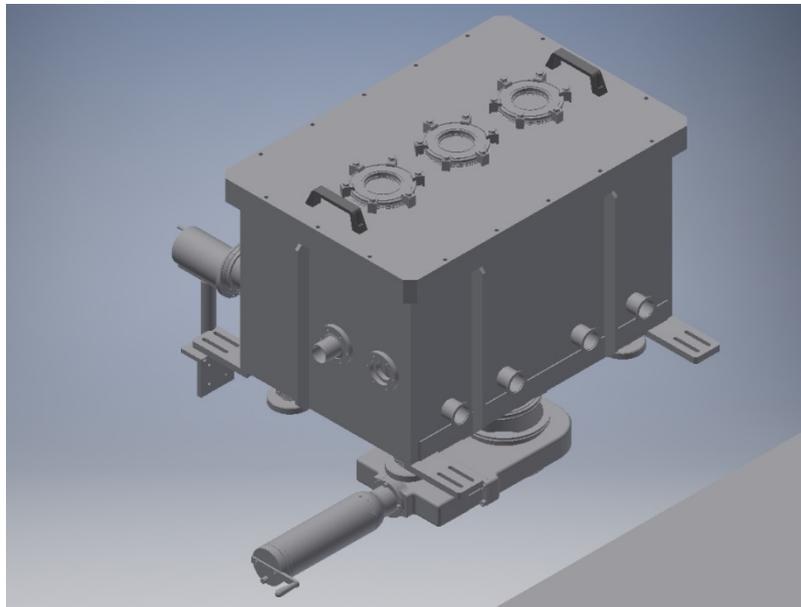


Figure 1: The VUV monochromator UHV chamber incl. ISO-KF flanges, TMP-valve and viewports.

Note that the TMP-valve is not included in this tender.

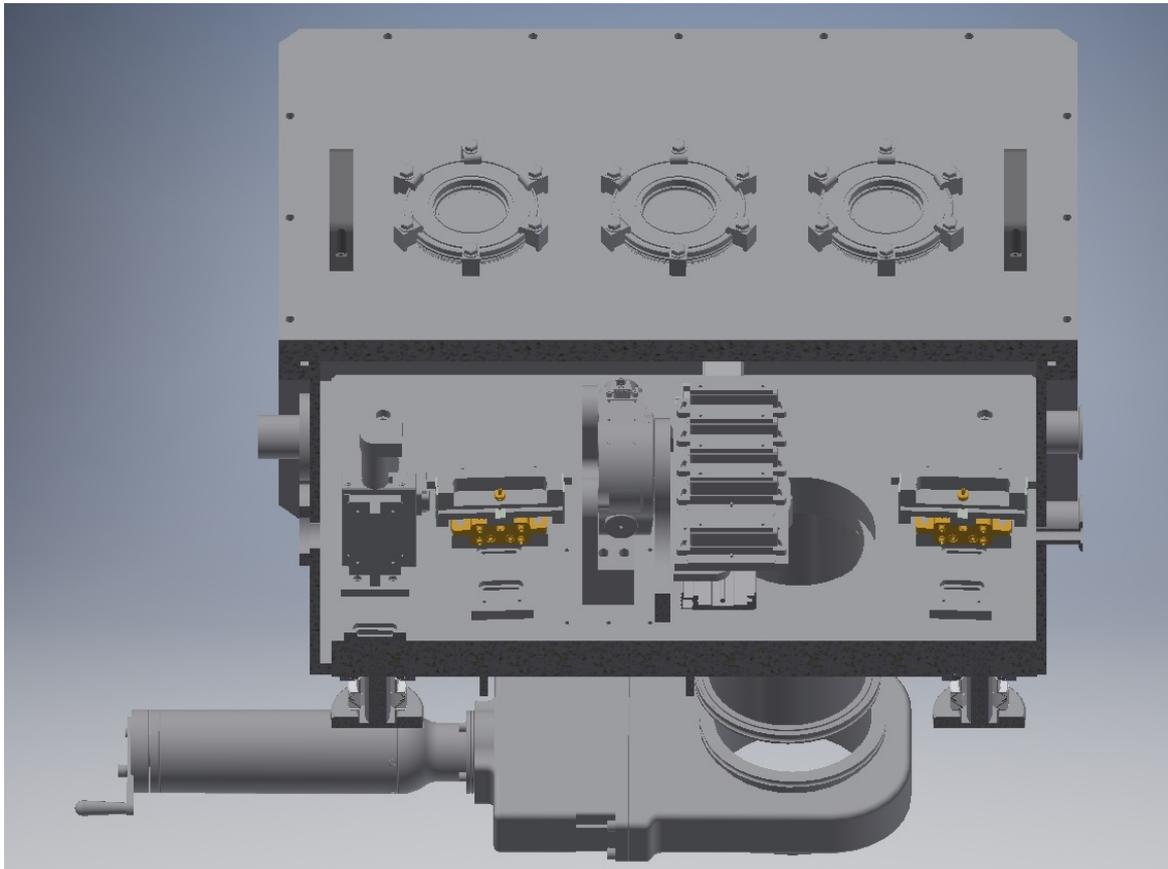


Figure 2: The VUV monochromator UHV chamber in cross-section view (internals: stages, toroidal mirrors, Richardson gratings are not included in this tender).

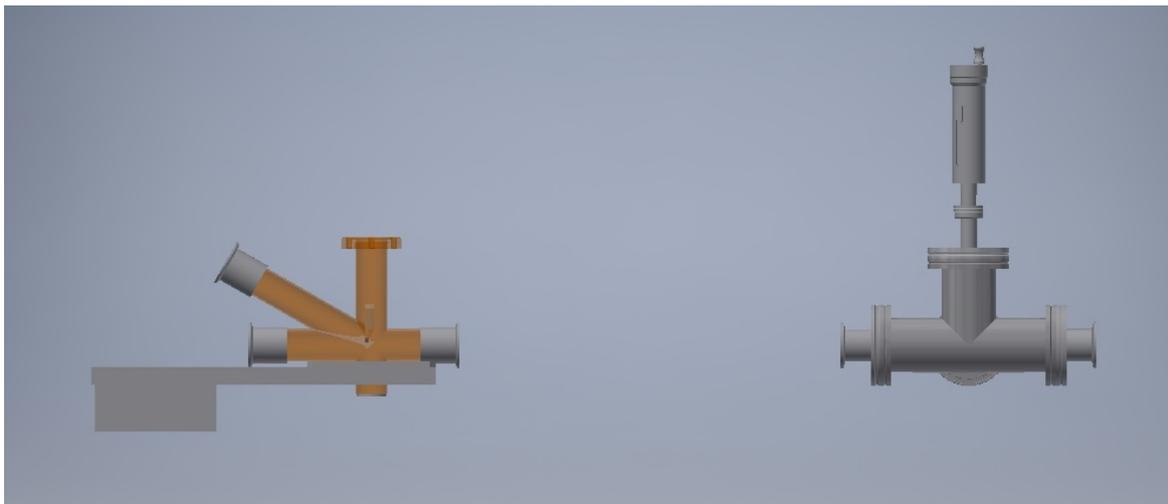


Figure 3: Auxiliary parts of the VUV monochromator UHV chamber: Slit box (left side), Detector chamber (right side). Note that the manipulator in the Detector chamber is not part of the tender.

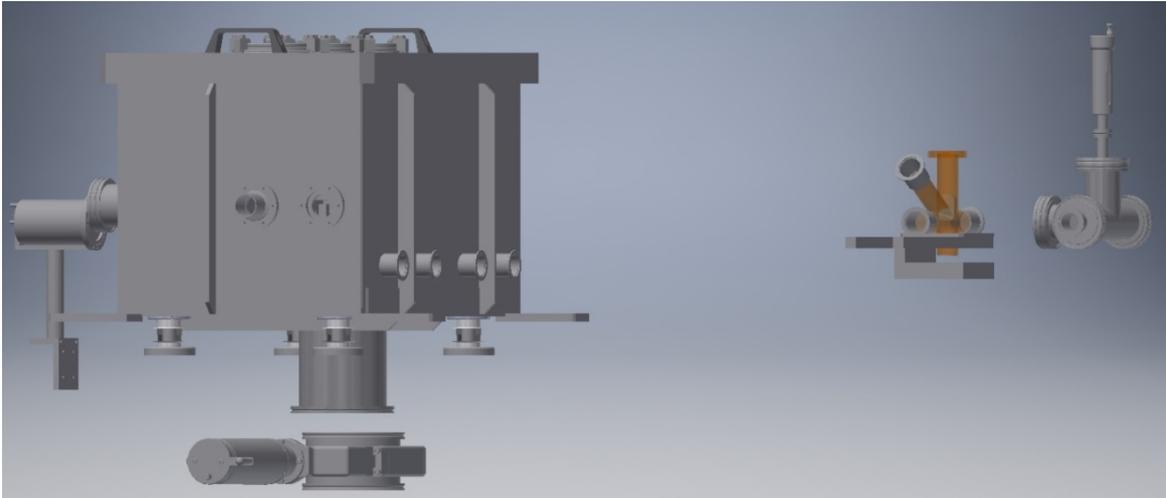


Figure 4: Oblique view of the first three components of the VUV monochromator UHV chamber.
Note that the IR beam dump (left margin) is not part of the tender.

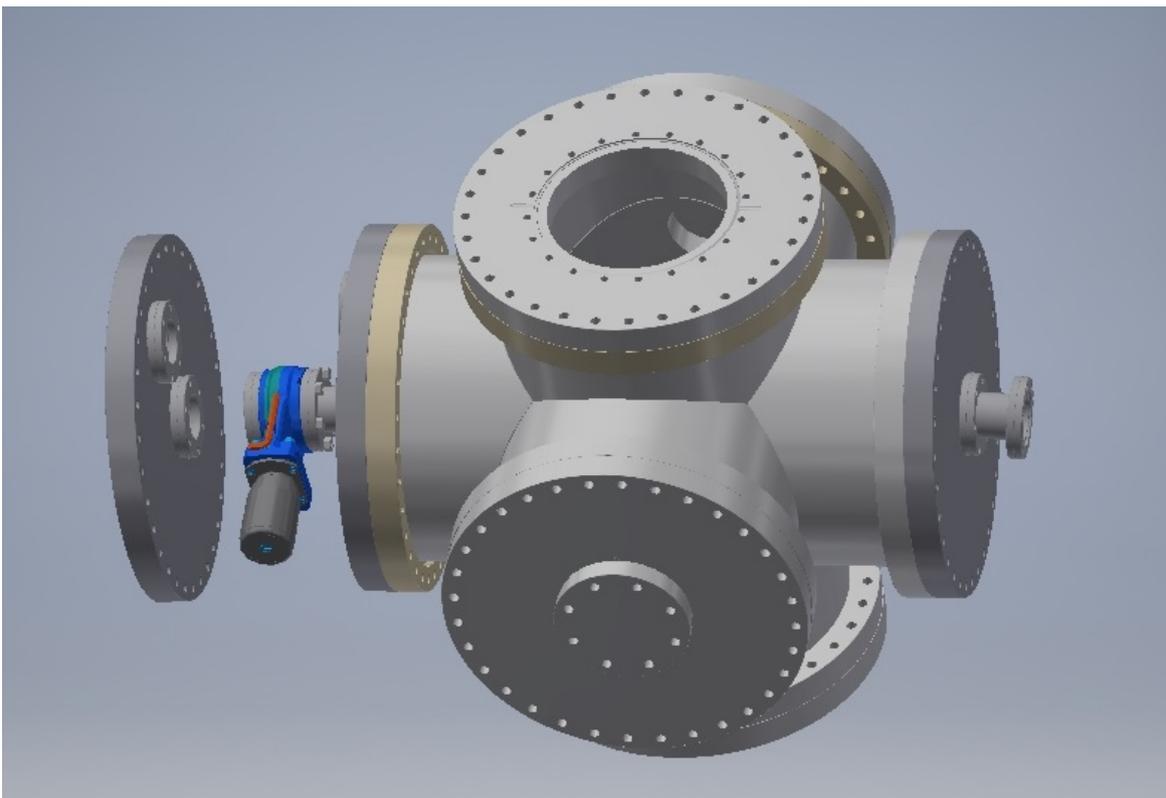


Figure 5: Refocusing optic chamber B4MAC housing a build-in breadboard, an ellipsoidal or a toroidal mirror, and a 5-degree-of-freedom stage. An Angled-Full-Nipple with DN250/40 ISO-CF Flange (left grey flange) shall be attached to the B4MAC as the entrance DN40 ISO-KF of the VUV beam. The angle shall be 5 degrees.

3. Design and Functional requirements

3.1. General requirements: VUV monochromator UHV chamber and auxiliary parts

- REQ-021329/A
Enclosed drawings and related 3D CAD data (see **RD-01**, chapter 1.4) shall be used as the CA's specified design for manufacturing.
- REQ-021330/A
The design of the System shall be made by the Supplier in conformity with the CA conceptual design.
- REQ-021331/A
Before manufacturing starts of the System, the Supplier shall provide a design suggestion for approval by the CA.
NOTE: The manufacturing of the System shall be started only after the design approval by the CA.
- REQ-021332/A
Precautions shall be taken in the design and assembly of all vacuum components during fabrication to avoid trapped and inaccessible volumes that could result in virtual leaks and complicate cleaning.
- REQ-021333/A
The System shall be designed and manufactured for operation at vacuum level better than $5 \cdot 10^{-6}$ mbar.
NOTE: For the Refocusing optics chamber B4MAC the vacuum level shall be better than $5 \cdot 10^{-8}$ mbar.
- REQ-021334/A
All vacuum components shall be HV (or UHV, for the B4MAC) compatible to comply with REQ-021333/A ($5 \cdot 10^{-6}$ mbar, or $5 \cdot 10^{-8}$ mbar for the B4MAC) and shall be manufactured using materials and procedures that will guarantee a low outgassing rate (including seal and weld integrity).
- REQ-021335/A
All cutting fluids, greases etc. used during manufacturing shall be removed by subsequent cleaning operations.
- REQ-021336/A
Sealing surfaces shall be in particular free of scratches or dents.
- REQ-021337/A
Internal surfaces of the all chambers (monochromator and auxiliary chambers) shall be electro-polished.
- REQ-021338/A
Tolerances for linear and angular dimensions shall be in accordance with ČSN ISO 2768-1 with m tolerance class; and, for geometrical tolerances, shall be in accordance with ČSN ISO 2768-2 with tolerance class K, unless stated otherwise in specific sections.

REQ-021339/A

Seal faces shall be suitably protected immediately after final machining to minimize the risk of damage.

NOTE: This protection shall only be removed for the purposes of cleaning and inspection, prior to final assembly.

REQ-021340/A

Outer surfaces shall have a uniform matte finish, obtained e.g. through Ballotini (glass beads) blasting.

NOTE: Other finish technologies are possible if agreed with the CA.

3.2. Monochromator chamber

REQ-021341/A

The Monochromator chamber shall consist of the following parts:

1. Monochromator chamber, including decoupled breadboard;
2. ISO-K flanges specified in details in REQ-021343/A.

REQ-021342/A

The Monochromator chamber and ports shall be made from stainless steel of the following type:

- 1.4306 or 1.4307 (AISI 304L);
- 1.4301 (AISI 304).

REQ-021343/A

Monochromator chamber shall be a rectangular chamber with the following lateral ports (see **RD-01**, 3D CAD data VUV_monochromator_UHV_and_custom_equipment.stp):

- 3 ports of DN100 ISO-K type for view port flanges including BK7 type of optical windows with at least 60 mm clear aperture (largest possible);
- 4 ports of DN40 ISO-KF type, wall mounted (entrance and exit of IR/EUV beam);
- additional multipurpose DN40 ISO-KF ports on side walls;
- 1 port of DN100 ISO-K type for IR beam rejection system including AR coated (for 850 nm central wavelength) fused silica window with at least 60 mm clear aperture (largest possible);
- 1 port of DN160 ISO-K type for TMP.
- 2 ports of DN100 ISO-K type or suitable size (for controller electronics feedthroughs).

NOTE: The flanges will be provided separately by the controller manufacturers and will not be included in this tender. Therefore all open ports shall be fitted with blind flanges.

REQ-021344/A

The Monochromator chamber shall be opened/closed using a steel cover plate with thickness > 6 mm. The cover shall be equipped with at least two carry handles.

NOTE: Utilization of (external) hinges shall be avoided if possible.

REQ-021345/A

The breadboard shall be made of aluminum alloy (EN AW-5083 or EN AW-6082) and shall have a thickness between 12 and 13 mm, M6 holes with thread and through 25 mm hole spacing.

REQ-021346/A

The positioning of the breadboard shall be such that 12.5 mm thick breadboards have their surfaces 160 mm from the chamber's center line when mounted.

REQ-021347/A

Between the decoupled breadboard and chamber bottom shall be at least 10 mm space to enable proper operation of TMP, located at the bottom.

REQ-021348/A

A decoupling of the breadboard shall be established (details see in **RD-01**, 3D CAD data VUV_monochromator_UHV_and_custom_equipment.stp).

REQ-021349/A

The view port flanges shall be delivered with the following compatible components:

- BK7 type of optical windows - 3 pcs;
- AR-coated fused silica window – 1 pcs.

NOTE: The clear aperture of the windows shall be at least 60 mm (largest possible).

REQ-021350/A

AR-coating for fused silica windows shall be optimized for wavelengths between 700-900 nm.

3.3. Slit box

REQ-021351/A

The Slit box shall consist of the following parts:

1. Slit housing;
2. DN40 ISO-KF view port flange with BK7 type of optical window with at least 60 mm clear aperture (largest possible).

REQ-021352/A

The Slit housing shall have the following ports:

- 3 ports of DN40 ISO-KF type (beam entrance/exit and CCD detector for HHG beam observation);
- 1 port of DN40 ISO-CF type for slit stage manipulator.

NOTE: The CCD detector and manipulator are not part of this tender. Therefore all open ports shall be fitted with blind flanges.

REQ-021353/A

Supporting mounting bracket for the Slit box shall be in accordance with 3D CAD data VUV_monochromator_UHV_and_custom_equipment.stp (see **RD-01**) and shall meet the space and design restrictions of the surrounding area.

3.4. Detector chamber

REQ-021354/A

The Detector chamber shall consist of the following parts:

1. Detector housing;
2. DN100 ISO-K view port flange with BK7 type of optical window with at least 60 mm clear aperture (largest possible).

REQ-021355/A

The Detector housing shall have the following ports:

- 2 ports of DN100 ISO-KF to DN40 ISO-KF type of reducers (beam entrance and exit);
- 1 port of DN100 ISO-K type (for view port with BK7 type of optical window with at least 60 mm clear aperture or largest possible);
- 1 port of DN100 ISO-K to DN16 CF type of zero-length reducer (for detector and/or target manipulation).

NOTE: Manipulator is not part of the tender. Therefore all open ports shall be fitted with blind flanges.

REQ-021356/A

The Detector chamber shall be able to house a CEM (Channel Electron Multiplier) and an auxiliary photodiode.

NOTE: The CA will provide detailed information about size and weight of the detector before the manufacturing starts.

3.5. Refocusing optic chamber assembly, B4MAC

REQ-021357/A

The B4MAC assembly shall consist of the following parts:

1. B4MAC chamber;
2. Entry and exit adapter parts;
3. Gate valve and edge welded bellow.

REQ-021358/A

The B4MAC assembly shall have bakeable flanges and shall be according to the following standard:

- ISO/TS 3669-2:2007 - Vacuum technology - Bakeable flanges - Part 2: Dimensions of knife-edge flanges.

REQ-021359/A

All of the B4MAC assembly parts shall fit together according to the provided 3D CAD data Stand-alone_refocusing_optic_chamber_B4MAC.stp (see chapter 1.4, **RD-01**).

3.6. B4MAC chamber and decoupled breadboard

REQ-021360/A

The B4MAC chamber shall have six ports of DN250 ISO-CF type and overall dimensions according to the provided 3D CAD data Stand-alone_refocusing_optic_chamber_B4MAC.stp (see chapter 1.4, **RD-01**).

REQ-021361/A

The flanges of the B4MAC chamber, the adaptor flanges and edge shall be made of stainless steel of the following type:

- 1.4429-ESU (AISI 316LN ESR).

REQ-021362/A

The tubes of the B4MAC chamber shall be made of the following type of stainless steel:

- 1.4404 (AISI 316L).

3.7. Entry and exit adapter parts

The B4MAC chamber assembly shall include the entry and exit adapter parts listed below with given features (details see in **RD-01**, 3D CAD data VUV_monochromator_UHV_and_custom_equipment.stp).

REQ-021363/A

One KF/CF entry adapter to the B4MAC chamber shall have the following characteristics:

- Angled reducer nipple with DN250 ISO-CF and DN40 ISO-KF types of ports to meet the reflection angle of the exit toroidal mirror in the Monochromator chamber;
- The angle shall be 5 degrees.

REQ-021364/A

One CF/CF exit adapter from the B4MAC chamber shall have the following characteristics:

- Angled reducer nipple with DN250 ISO-CF and DN40 ISO-CF types of flanges to meet the reflection angle of the refocusing mirror in the B4MAC chamber;
- The angle shall be 5 degrees.

REQ-021365/A

One DN250 ISO-CF to DN40 ISO-CF zero length reducer with an additional off-center hole for a DN 63 CF viewport (see **RD-01**, 3D CAD data Stand-alone_refocusing_optic_chamber_B4MAC.stp for details).

REQ-021366/A

One reducer flange DN250/100 ISO-CF for a DN100 ISO-CF feedthrough flange.

NOTE: Feed through flange will be provided by controller manufacturer and is not included in this tender.

REQ-021367/A

The adapter parts shall be made of the same material as the flanges of the B4MAC cross (i.e. 1.4429-ESU / AISI 316LN ESR).

3.8. Gate valve and edge welded bellow

REQ-021368/A

The gate valve shall be of DN40 CF type and shall have a window with a diameter of at least 10 mm.

REQ-021369/A

The gate valve shall be manually operated.

REQ-021370/A

The edge welded bellow shall have DN40 CF mounting flanges.

REQ-021371/A

The contracted length (knife edge to knife edge) of the edge welded bellow shall be > 45 mm and < 60 mm.

REQ-021372/A

The extended length (knife edge to knife edge) of the edge welded bellow shall be > 70 mm and < 100 mm.

3.9. Vacuum leak tests

REQ-021377/A

The Supplier shall perform a leak test on the System and provide a test report containing the total leak rate and the RGA spectrum after 30 minutes and 15 h of pumping.

REQ-021378/A

After 30 min of pumping the mass 18 amu (peak) of the leak-free System shall reach a pressure below $5 \cdot 10^{-6}$ mbar using a TMP smaller or equal to 700 l/min.

4. Building and Environmental conditions

REQ-021373/A

The System shall be suitable for operation in the building and environmental conditions of the CA.

NOTE: For further information regarding building and environmental conditions see the document "E1 room datasheet" (RD-02).

5. Delivery requirements

REQ-021374/A

Each item shall be cleaned and packaged in clean environment of class 7 according to ČSN EN ISO 14644 (equivalent to ISO 14644) or cleaner.

NOTE: If the Supplier cannot fulfill class 7 cleanliness requirements, the Supplier and the CA shall agree on the cleaning method to be used to clean the System without decreasing the Systems' properties and to avoid contamination of the clean space of the CA.

REQ-021375/A

The System shall be delivered in protective package preventing damage and contamination with a minimum of two plies separate clean packaging (see REQ-021374/A).

REQ-021376/A

The transportation to the final destination shall be conducted by the Supplier.

6. Safety Requirements

REQ-021379/A

The Supplier shall supply a Declaration of Conformity or any other equivalent document legally recognized and accepted in the Czech Republic for each product type if the appropriate legislation determines the Supplier's obligation to have a Declaration of Conformity (or the equivalent document) for the purposes of a Device sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.

7. Quality Requirements

7.1. General Quality Requirements

REQ-021381/A

The Supplier shall provide a Product User Manual as part of the delivered System. The Manual shall include the instructions and descriptions regarding the following procedures:

- transport, handling, storage, cleaning and installation;
- all approved "requests for deviation/wavier";
- safe operation and maintenance procedures.

REQ-021382/A

The Supplier shall provide information on execution of outgoing check of the product. At least this information shall comprise declaration about execution of outgoing check and declaration of conformity with technical requirements defined by the product RSD and completeness of the product.

REQ-021383/A

The Supplier shall provide a report outlining the results of any testing executed on all components of the System provided by the Supplier to confirm specification conformity.

7.2. Documentation and data control

REQ-021386/A

The Supplier shall provide with the delivery of the System the following types of documents:

- the updated manufacturing drawings (3D model and 2D drawings) in electronic form as defined in REQ-021387/A and REQ-021330/A;
- Test report (see REQ-021377/A, REQ-021378/A and REQ-021383/A).

REQ-021387/A

The Supplier shall use following data formats:

- *.JPG, *.PNG, *.PDF/A, *.HTML;
- CAD 2D: *.dwg;
- CAD 3D: STEP type files (*.stp; *.ste; *.step);
- text processors *.doc, *.docx, OpenDocument Format;
- spreadsheet processors *.xls, *.xlsx, OpenDocument Format;
- presentations *.ppt, *.pptx; OpenDocument Format.

7.3. Non-Conformance Control System

REQ-021385/A

The Supplier shall establish and maintain a non-conformance control system compatible with ČSN EN ISO 9001 (equivalent to EN ISO 9001).

7.4. Specific Quality requirement

REQ-021384/A

In case of a warranty repair of the System by the Supplier, the Supplier shall redo necessary parts of the verification procedure. The results of this process shall be provided to the CA.

7.5. Acceptance

The Acceptance phase (as defined in the Contract) shall demonstrate following:

- Final delivered System have been successfully verified and this process has been documented in an appropriate way;
- All detected non-conformities have been solved in accordance with REQ-021331/A, REQ-021383/A and REQ-021385/A;
- The final System is free of fabrication errors and is ready for the intended operational use.

Acceptance will be carried out by the CA (or external contractors if required) on the final delivered complete System.

In case of successful acceptance phase the CA shall provide to the Supplier signed acceptance protocol.

In case of unsuccessful acceptance stage the CA shall provide to the Supplier Non-Conformance Report (NCR) and ELI non-conformance control process shall be applied (see REQ-021385/A).

REQ-021388/A

Upon delivery of the final System in appropriate and undamaged packaging the CA shall provide to the Supplier with Handover / takeover protocol.

REQ-021389/A

Acceptance shall be complete when the final System complies with all specifications verified by the Supplier's outgoing tests (see REQ-021382/A) and by passing additional acceptance verification carried out by the CA after delivery and installation at its own premises.

NOTE 1: Supplier's outgoing tests shall be carried out prior to delivery.

NOTE 2: In the acceptance phase, the verification of the final System and required documentation will be carried out by the CA within 4 weeks after the issuing of the Handover/takeover protocol.