PURCHASE CONTRACT

This purchase contract ("**Contract**") was concluded pursuant to Sec. 2079 *et seq*. of the Act No. 89/2012 Coll., Civil Code ("**Civil Code**"), on the day, month and year stated below by and between:

(1) **Fyzikální ústav AV ČR, v.v.i.**
(Institute of Physics of the Czech Academy of Sciences, public research institution)
with its registered office at: Na Slovance 2, Praha 8, ZIP 182 21
registration No.: 68378271
enrolled in the Register of public research institutions kept by MEYS
represented by: RNDr. Michael Prouza, PhD. – director

("**Client**"); and

(2) **STREICHER, spol. s r.o. Plzeň**
with its registered office at: Plzeňská 565, 332 09 Štěnovice
registration No.: 147 06 768
enrolled in the commercial register kept by Regional Court in Plzeň, item C 301
represented by: Dr. Jiří Lopata - CEO

("**Supplier**").

(The Client and the Supplier are hereinafter jointly referred to as "**Parties**" and individually as "**Party**".)

WHEREAS

(A) The Client is a public contracting authority and the beneficiary of grants of the Ministry of Education, Youth and Sports of the Czech Republic for different projects aimed on building and further development of the international research laser facility ELI Beamlines ("**Projects**"), within the Operational Programme Research, Development and Education (hereinafter the "**Operational Program**").

(B) For the successful realization of the Projects, it is necessary to purchase the Object of Purchase (as defined below) in accordance with the Act No. 134/2016 Coll., on public procurement, as amended, and with binding rules of the Operational Program.

(C) The Supplier's bid for the public contract titled "*L4 10PW Laser Beam Distribution Vacuum Infrastructure [TP20_040],*" whose purpose was to procure the Object of Purchase (hereinafter the "**Bid**" and the "**Public Contract**"), was selected by the Client as the most suitable. Relevant parts of the Bid describing the Object of Purchase (as defined below) and some other related aspects of performing this Contract form Annex 5 (*Supplier's Bid*) to this Contract.

IT WAS AGREED AS FOLLOWS:

1. **BASIC PROVISIONS**

1.1 Under this Contract, the Supplier shall design, manufacture, test and deliver to the place of delivery a laser beam distribution infrastructure consisting of large vacuum chambers, of interconnecting tubing and of supporting structures

(the entire infrastructure hereinafter also referred to as the "**Object of Purchase**" and each separate chamber, interconnecting tubing or supporting structure individually as "**System Component**"),

as specified in this Contract, mainly in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*), Annex 2 (*Detailed Technical Specifications of the Object of Purchase*), Annex 3 (*Verification Control Document*) and Annex 5 (*Supplier´s Bid*) to this Contract and shall transfer to the Client ownership right to the Object of Purchase,

and the Client shall take over the Object of Purchase and shall pay the Supplier the Purchase Price (as defined below),

all under the terms and conditions stipulated herein.

1.2 The following contractual call in options are hereby agreed by the Parties:

a) Optional manufacture and factory testing of CH6 and delivery to ELI-Beamlines in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 1**");

b) Optional manufacture and factory testing of CH5, of the tubing segment TS2A and of its support, of TS2B and TS5, delivery to ELI-Beamlines in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 2**");

c) Optional transport of the chambers, tubing segments and tubing segment supports to the final location in the L4c and E3 halls, installation of the chambers in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 3**");

d) Optional technical installation works on primary vacuum piping and /or on utilities (cooling water, compressed dry air) in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 4**");

e) Optional Manufacture of up to 3 DN1000 ribbed aluminium flanges in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 5**");

(all options are referred to hereinafter together as "**Options**"),

(except for the Art. 8 hereof any provisions of this Contract applicable on the Object of Purchase apply on the performance of the Options (if activated) and results of the performance of the Options by the Supplier similarly).

1.3 If, for the fulfilment of the requirements of the Client under this Contract or for the proper operation of the Object of Purchase, other deliveries and activities, not expressly mentioned in this Contract, are necessary, the Supplier shall procure such deliveries or shall carry out such activities at its own expense without any effect on the Purchase Price.

1.4 During performance of this Contract, the Client is entitled to further specify or clarify the requirements stipulated in Annex 2 (*Detailed Technical Specification of the Object of Purchase*). Such further requirements can be requested by the Client no later than one month before the scheduled completion of the D2 Deliverable in relation to the System Components falling within the scope of D2, and/or one month before the scheduled completion of the D3 Deliverable in relation to the System Components falling within the scope of D3. These further requirements shall be binding for the Supplier. Under this provision, the Client is not entitled to substantially change the existing requirements stipulated in Annex 2 (*Detailed Technical Specifications of the Object of Purchase*). Should any request for change result in increase of the Purchase Price, such request is binding for the Supplier only if the Purchase Price modification is agreed between the Parties and such modification complies with Act No. 134/2016 Coll., on public procurement, and with binding rules of the Operational Program.

1.5 The Object of Purchase and its components and parts shall be new (i.e. not remanufactured).

1.6 The following activities:

- design of integration of the vacuum chambers with top lids and hinged doors;
- welding of the vacuum chambers;
- final cleaning of all vacuum components;
- assembly of parts of the vacuum chambers and tubing segments for performance testing;
- testing of vacuum performance and of vacuum cleanliness of the chambers and of the tubing segments in ISO 7 (or better cleanroom space);

must not be performed by a subcontractor.

1.7 The Supplier shall perform this Contract in Deliverables defined in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*).

2. SUPPLIER'S DUTIES

2.1 The Object of Purchase shall comply with all technical specifications and performance requirements stipulated in Annex 2 (*Detailed Technical Specifications of the Object of Purchase*). The Object of Purchase and/or its subsystems shall meet valid safety, technical and quality Czech and EU standards.

2.2 During the performance of this Contract, the Supplier proceeds independently, unless hereunder stated otherwise. If the Supplier receives instructions from the Client, the Supplier shall follow such instructions unless those contradict to the applicable law or this Contract. Should the Supplier find out or should it have found out by exercising professional care that the instructions are inappropriate or contradicting valid law, Czech or EU standards or contradict to this Contract, the Supplier must notify the Client.

3. CLIENT´S CONFIDENTIAL INFORMATION

3.1 For the purposes of the detailed design and manufacture of the Object of Purchase, the Client may provide to the Contractor conceptual drawings, 3D models, schemes and other materials related to the Object of Purchase, which are of confidential nature and which will be labelled as "Confidential and Proprietary" ("**Client's Confidential Information**"). The Supplier acknowledges that the Client's Confidential Information is of proprietary and confidential nature and that such information might be protected under laws that cover industrial or other intellectual property or trade secrets and that disclosure of such information may cause damage or other harm to the Client and/or other third persons. The Supplier may use the Client's Confidential Information solely for the purposes of the fulfilment of this Contract, i.e. for the manufacture and delivery of the Object of Purchase.

3.2 The Supplier shall ensure that Client's Confidential Information will be accessed only by persons (e.g. employees and/or subcontractors) that need such access for the fulfilment of this Contract. The Supplier shall take all reasonable steps to ensure that the Client's Confidential Information will not be accessed by any unauthorized person and/or or third party.

3.3 Should the Supplier breach any of his duties stipulated in this Article 3, the Client is entitled to charge him with contractual penalty in the amount of 4 000 EUR for each case of such breach.

4. DESIGN AND MANUFACTURE OF THE OBJECT OF PURCHASE

4.1 The detailed engineering drawings developed by the Supplier in the Deliverables D2 and D3 must comply with the requirements of this Contract and shall be approved by the Client prior to proceeding to elaboration of the production (manufacture) drawings. If the Client suggests modifications to these drawings, the Supplier shall incorporate such modifications or shall explain in writing the reason for refusing to incorporate them.

4.2 The Supplier must act in such a way that this Contract is performed in time and in due manner.

5. LICENCE OF THE SUPPLIER

5.1 If any part of the Object of Purchase forms an object protected by intellectual property rights laws and/or forms related know-how, the Supplier grants to the Client a right to use such part of the Object of Purchase, including related documentation ("**Supplier's**

Proprietary Information") in the original or modified version ("**Licence**") for the purposes listed in Art. 5.3.

5.2 The License is granted:

a) royalty free worldwide;

b) for the period of validity of the rights to each of the licensed intellectual property object, which applies adequately to the related know-how.

5.3 The Licence comprises the right to use the Object of Purchase for research and development activities within operation of the International Laser Research Facility ELI Beamlines including necessary modifications to the Object of Purchase including software and limited handover of necessary documentation upon signature of a non-disclosure agreement to third parties for the purposes of operation, servicing and further development of the Object of Purchase.

5.4 This granted License also includes the Supplier's permission to the Client to modify and/or alter and/or otherwise change any part of the Supplier's Proprietary Information; either by itself or with assistance of any third party. This permission shall apply *mutatis mutandis* to the Client's entitlement to combine and/or merge any part of the Supplier's Proprietary Information with any other work; either by itself or with assistance of any third party.

5.5 The Client is entitled to transfer/ assign the License on any third party if the ownership or operation of the International Laser Research Facility ELI Beamlines passes on such third party. In such case, the Client shall inform the Supplier within undue delay thereabout. The Client is entitled to grant wholly or partially the License to any third party (sublicense) if the right to use the Object of Purchase is granted to such third party.

5.6 The Client is not required to use the Licence, unless the maintaining of the right depends on the exercise thereof.

5.7 The Supplier hereby represents and warrants to the Client that:

a) It is entitled to use and enforce all intellectual property rights to the Supplier's Proprietary Information, in order to be ensured that the Client may use the Supplier's Proprietary Information properly and without any interference; and

b) It is entitled to grant the License to the Client in the extent specified in this Contract.

5.8 If the Licence is endangered or infringed, the Client shall inform the Supplier accordingly without undue delay after ascertaining this fact. The Supplier shall provide the Client with cooperation to ensure the legal protection of the Licence. The Supplier shall give the Client consent to enforce the industrial property rights and/or related know-how rights covered by the License.

6. MONITORING AND IMPLEMENTATION OF THE INSPECTION PLAN

6.1 The Supplier undertakes to enable the Client exercising inspections of the performance of this Contract. For this purpose, the Supplier shall provide the Client with all information regarding the status of the design and manufacture of the Object of Purchase at the request of the Client, anytime during performance of this Contract.

6.2 The Supplier shall provide to the Client all cooperation, assistance and information that the Client needs for the purposes of full evaluation of the status of the design or manufacture of the Object of Purchase.

6.3 If the Client, especially during an inspection, ascertains any breach of the Supplier's duties under this Contract, the Client shall notify in written the Supplier of such breaches. The Supplier has to respond to such notification and suggest, in an appropriate detail, remedying the deficiencies, within fourteen (14) calendar days, unless the Parties agree otherwise.

6.4 Each Party shall invite the other Party to attend a meeting in writing at least 14 calendar days in advance. The Parties may replace, upon mutual agreement, meetings in person by other forms of communication, as long as they agree on such in advance. Each Party shall bear its expenditures related to their participation in meetings at the other Party's facility; however, costs which would arise due to an error, faulty performance or a breach of contractual provisions of the Parties shall be borne by that Party which caused it.

6.5 The Supplier shall follow the Quality and Verification Plan addressing all requirement items stated in Annex 3 (*Verification Control Document*) and shall invite the Client at least 14 calendar days in advance to participate in all relevant activities of this Plan.

6.6 In fulfilment of Deliverables D1, D2 and D3, where early agreement on specific design features as described in Annex II (*Detailed Technical Specifications of the Object of Purchase*), and/or where guidance by the Client may be needed for proper execution of the works, the Supplier will contact the Client with a written technical query, which the Client shall respond in 14 calendar days. If the Client does not respond within 14 calendar days, the Supplier is entitled to choose the technical solution he considers most appropriate.

6.7 If the Client does not participate in an inspection and/or verification activity according to Annex 3 (*Verification Control Document*) at the date communicated in accordance with Art. 6.5, the Supplier is not entitled to carry out respective activities in absence of the Client. However, in such a case the Supplier is not in delay with delivery of the corresponding Deliverable and subsequent Deliverables with proven dependency on the corresponding Deliverable and delivery periods of such Deliverables shall extend by the time of the Client´s delay, unless the Parties agree otherwise.

7. **THE PLACE AND TIME OF DELIVERY**

7.1 The place of delivery shall be the International Research Laser Facility ELI-Beamlines located at Průmyslová 835, Dolní Břežany (district Prague-West), ZIP 252 41, Czech Republic (hereinafter also "**ELI Beamlines**" or "**ELI Beamlines site**").

7.2 The Supplier shall perform individual Deliverables in terms stipulated in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*).

7.3 The Supplier shall carry out performance and verification tests of all System Components of the Object of Purchase (i.e. of the vacuum chambers, tubing segments, tubing segment supports, and of the tubing adaptor) at his premises (factory acceptance tests), in relation with Deliverables D4 and D5, and with Optional Deliverables OD1, OD2 and OD5, prior shipment of the respective System Components, on the dates agreed with the Client in accordance with Art. 6.5, according to Annex 3 (*Verification Control Document*).

7.4 For the purpose of determination of individual deadlines stipulated hereby the **Commencement Day** shall be the seventh calendar day after the Contract is concluded (i.e. signed by the second of the Parties).

8. **PRICE AND PAYMENT TERMS**

8.1 The total purchase price for the Object of Purchase excluding Options is **30 430 000,-** Czech Crowns (CZK) without value added tax ("**VAT**")("**Purchase Price**"). The Purchase Price represents the Supplier´s binding maximum price.

The prices for performing the Options are stipulated in Annex 4 *(Prices)* hereto.

The Purchase Price shall be invoiced and paid upon acceptance of any Deliverable in instalments (hereinafter also "**Payments**") stated in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*). The Payment for the accepted Deliverable as stated in Annex 1 is understood to correspond to the price of the Deliverable.

The VAT shall be imposed on top of all payments made hereunder according to valid legislation.

8.2 The Purchase Price and prices of Options cannot be exceeded.

8.3 The Purchase Price includes all costs and expenses of the Supplier related to the performance of this Contract excluding Options. The Purchase Price include especially all expenses related to the design, manufacture, assembly, factory testing, cleaning, performance verification and delivery to ELI-Beamlines of the Object of Purchase or its parts, costs of the Licence, insurance, warranty service, development of prices of materials, development of foreign currency exchange rates, customs (if applicable) and any other costs and expenses related to the performance of this Contract excluding Options. Similar rules shall *mutatis mutandis* apply on the prices of Options.

8.4 The Purchase Price and prices of the Options may be changed only in accordance with the Act No. 134/2016 Coll., on public procurement, as amended.

8.5 If the Supplier performs the subject-matter hereof duly in line herewith without substantial breaches of the Contract and if there are no obvious reasons for doubts on continuing of the due performance hereof by the Supplier, by taking into account the overall approach of the Supplier to the Contract performance (presented particularly by due preparation for performance of follow-up activities), and if it might ease further performance hereof by the Supplier, the Client reserves the right fully on its discretion to provide the Supplier with the Payments or any parts of them sooner than scheduled hereunder or in higher amount than stipulated by Annex No 1 hereto, Summary of Deliverables, Time Schedule and Payments (i.e. any Payments might be increased with proportional decreasing of subsequent Payments). If the conditions stipulated above are met, the Client is entitled to modify the payment schedule included in the Annex No 1 hereto anyhow in favour of the Supplier and to provide it with any prepayment. Similar rules apply on payments of prices of Options.

8.6 The Purchase Price instalments and prices of Options shall be paid based on tax documents – invoices, to the account of the Supplier designated in the invoice. The Purchase Price shall be paid following the payment schedule set out in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*). The prices of Options shall be paid according to Annex 1. The Supplier is entitled to issue any invoice no sooner than on the moment a Deliverable is duly completed and accepted by the Client in accordance with this Contract.

8.7 The Client shall execute payments on the basis of duly issued invoices within 30 days from their receipt. If the Supplier stipulates any shorter due period in an invoice such different due period shall not be deemed relevant and the due period stipulated herein prevails. Any invoice shall be considered to be paid for on the day when the invoiced amount is deducted from the Client's account on behalf of the Supplier's account.

The invoices shall be sent to the Client solely in the electronic form to the address efaktury@fzu.cz

8.8 Any invoice issued by the Supplier as a tax document must contain all information required by the applicable laws of the Czech Republic. The Client shall advice the Supplier on the proper contents of invoices if requested prior to invoicing.

Furthermore, invoices shall include:

a) registration number of this Contract, which the Client shall communicate to the Supplier based on Supplier's request before the issuance of the invoice,

b) registration number and a title of a grant Project in accordance with information provided by the Client,

and must comply with the double tax avoidance agreements, if applicable.

8.9 In case that the invoice does not contain the above mentioned information, the Client is entitled to return it to the Supplier during its maturity period and this shall not be

considered as a default. The new maturity period shall begin from the receipt of the supplemented or corrected invoice to the Client.

Material costs development

8.10 For the raw materials essential for manufacture of major components of the Object of Purchase (chambers, tubing segments and their supports, tubing adaptor, and DN1000 ribbed flanges), namely stainless steel and aluminium alloy(s), the Supplier is entitled to identify in its Bid specific categories (e.g. slabs of specific thickness, monolithic blocks of specific size, prefabricated plates of specific size / thickness, etc.) that it considers the most volatile (unstable in respect of the price) in the current situation on the market. For each identified category of the raw materials (stainless steel and aluminium alloy(s)) the Supplier shall in such a case identify in its Bid the total expected amount, necessary for fulfillment of the Object of Purchase, and the corresponding unit price (e.g. per kg of identified metal raw-material product).

Should the actual price of the identified categories of the raw materials at the moment of purchase for fulfilment of this Contract increase or decrease by more than 10 % with respect to their price considered in the Bid, the Supplier and the Client shall proceed in compliance with the below-stated conditions relating to price increase and price decrease.

The Supplier shall purchase raw materials in connection with Deliverables D4 and D5 and with Optional Deliverables OD1, OD2 and OD5, namely stainless steel and aluminium, essential for manufacture of major components of the Object of Purchase (chambers, tubing segments and their supports, tubing adaptor and DN1000 ribbed flanges).

The Supplier shall make all reasonable efforts to secure as low as possible price made possible by the overall behaviour of the market for designated raw materials.

For the extent of the identified categories of stainless steel and aluminium alloy(s), as specified in the Bid, the Supplier shall inform the Client, without undue delay, on selection of the suppliers (sub-contractors) for each purchase, with justification of the selection. The justification shall be based on a competitive tender (i.e. to demonstrate that the price does not exceed the value usual at the given place and time, documented for example by quotes, or responses to request for price enquiry, from different suppliers), and shall use the criterion of the most economically advantageous tender to select the supplier (sub-contractor).

Price increase

Should the actual unit price of the identified categories of raw materials, as mentioned above and for the extent specified in the Bid, at the moment of purchase for fulfilment of this Contract increase by more than 10 % with respect to their price considered in the Bid, the Supplier is entitled to ask the Client for compensation of the extra costs incurred, in the amount above the price level considered in the Bid.

The Supplier must in such a case document, in appropriate detail, the difference between the unit cost used in the Bid and the actual unit cost associated with procurement of these materials in connection with Deliverables D4 and D5 and with Optional Deliverables OD1, OD2 and OD5.

Should the following conditions:

a) the increased price is documented by the outputs of the competitive tender;
and

b) the difference between the unit price in the Bid and the actual purchase price is consistent with the overall behaviour of the market for the respective materials in the relevant timeframe (using the indexes published by the London Metal Exchange (https://www.lme.com/);

be met, the Client shall agree with the Supplier on corresponding increase of the prices of the raw materials in this Contract.

Due to the budgetary limitations of the Client, the total permitted price increase of the raw materials under this clause is limited to 3 mil. CZK excl. VAT for the firm scope of the contract (Deliverables D4 and D5 together), and to 0.2, 1 and 0.1 mil CZK excl. VAT respectively for the Optional Deliverables OD1, OD2 and OD5.

Should the Client have doubts regarding the cost figures of the raw materials presented by the Supplier, it is entitled to refuse any such price increase.

Price decrease

Should, based on the competitive tender, the actual unit price of the identified categories of raw materials, as mentioned above and for the extent specified in the Bid, decrease by more than 10 % with respect to their price considered in the Bid, the Purchase Price shall be decreased by the corresponding amount (in the amount with respect to the price level considered in the Bid).

The Purchase Price shall be decreased by the financial amount saved by decreasing Payments for the corresponding Deliverables.

Joint provision

Agreements or understandings between the Parties needed to implement the reserved changes in obligations above shall be made in written, however, they do not need to take the form of an amendment to this Contract.

9. ACCEPTANCE OF DELIVERABLES, HANDOVER OF INDIVIDUAL PARTS OF OBJECT OF PURCHASE

9.1 Upon receiving any documents, reports or designs necessary for completion of Deliverables D1, D2 and D3, the Client shall provide the Supplier within 10 working days

with his comments to the submitted documents. The Supplier shall be obliged to take the Client's comments into account, i.e. the Supplier shall accept all justified and materially correct comments and requirements for changes made by the Client. Should the Supplier consider any of the comments or requirements made by the Client as materially incorrect or unacceptable, the Supplier shall specify in writing his reasons for refusing to accept them. The Supplier will produce final documents containing all justified and materially correct comments and requirements for changes raised by the Client.

9.2 Upon due completion of any Deliverable and upon fulfilling the requirements of the Client as set forth herein and in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*), the Client shall issue to the Supplier, without undue delay, a confirmation on the due execution of the Deliverable (the "**Deliverable Acceptance Protocol**").

9.3 On-site acceptance, and handover and takeover of individual parts of the Object of Purchase (System Components), upon fulfilling the requirements of the Client as set forth in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*), related to Deliverables D4 and D5, and of the Optional Deliverables OD1, OD2 and OD5 shall be realized on the basis of a Deliverable Acceptance Protocol, which shall contain at least the following information:

a) identification of the Supplier, Client and subcontractors, if there are any;

b) identification of the Deliverable;

c) declaration of the Client that he received from the Supplier all technical information and documentation related to the Deliverable;

d) statement of the Client on acceptance of the Deliverable;

e) list of defects, and/or backlogs or performance deficiencies, if any;

f) date of the signature.

9.4 The Deliverable Acceptance Protocol for D4 and D5, and for onsite acceptance of OD1, OD2 and OD5, must contain the following annexes, which shall be provided by the Supplier:

a) list of items (accessories) handed over within the corresponding Deliverable;

b) protocols with full results of all design and/or manufacturing inspections and of performance verification testing, carried out according to Annex 3 (*Verification Control Document*);

c) drawings, 3D models, and other contractually required information and documentation corresponding to the Deliverable.

9.5 In case of deficiencies (i.e. defects and/or backlogs) of the delivered subsystems related to Deliverables D4 and D5, and optional OD1, OD2, and OD5, mainly if the Supplier does not hand over to the Client all required documentation, or if a Deliverable does not comply with this Contract, the Client is entitled to refuse the takeover and acceptance of that Deliverable. Whenever technically possible the Supplier shall remedy the deficiencies within ten (10) working days, unless Parties agree otherwise (particularly due

to the fact that period of 10 working days is technically impossible); however these periods do not imply that the Supplier is not in delay with the delivery of the respective Deliverable. The Client is entitled at his discretion (but not obliged) to take over and accept the respective Deliverable despite the above mentioned deficiencies, in particular if such deficiencies do not prevent the Client from the proper operation of the respective part of the Object of Purchase (System Component). In such case the Parties shall list the deficiencies in the respective Deliverable Acceptance Protocol(s), including the manner and the date of their removal (remedy). If the Parties do not reach agreement regarding the date of the removal, the Supplier shall remove the deficiencies within ten (10) working days. Should the deadline of ten (10) working days be technically impossible and should the Supplier document an actually needed longer term, the Client shall agree on the documented longer term. Until the remedy of the deficiencies, the Client shall be entitled to postpone the corresponding payment up to the amount corresponding to the significance of the deficiency.

9.6 The Client shall not be obliged to verify the correctness of all calculations and/or technical solution details during the course of the acceptance of the Deliverables relating to the detailed design, fabrication process, and on-shop testing. Acceptance of these individual Deliverables does not release the Supplier from his liability for the technical compliance and completeness of the Object of Purchase.

9.7 Should it be necessary to modify any part of the already accepted Deliverable in order to meet any requirement stipulated herein, the Supplier undertakes to perform such modifications and accepts that the costs related thereto are included in the Purchase Price or price of the Options.

10. THE OWNERSHIP RIGHT

The ownership right to the subsystems of the Object of Purchase or to the optional deliveries, corresponding to the Deliverables D4 and D5, and of optional OD1, OD2 and OD5 (if the Options are activated), shall pass to the Client upon their handover and acceptance confirmed by the signature of the respective Deliverable Acceptance Protocol by both Parties.

11. WARRANTY

11.1 The Supplier provides a warranty of quality related to any already accepted and handed over part of the Object of Purchase (System Component) for the period of 24 months from execution of the Deliverable Acceptance Protocol for the respective System Component, except for the parts of the Object of Purchase for which the warranty length is specified in Annex 5 (*Supplier´s Bid)*. If on a warranty list or other document submitted by the Supplier the warranty period is of longer duration, then this longer warranty period shall have priority over the period stated in this Contract.

11.2 If any Deliverable Acceptance Protocol for D4 and D5, and for any of OD1, OD2 and OD5 lists any deficiencies, the warranty period for the respective System Component shall begin on the day on which the last deficiency was removed.

11.3 The Supplier shall remove defects for which he is responsible according hereto that occur during the warranty period free of charge and in the terms stipulated in this Contract. The Supplier shall bear all the expenses (e.g. shipments, travelling, accommodation expenses and price of equipment rental or purchase) related to removal of the defects.

11.4 If the Client ascertains a defect of the Object of Purchase during the warranty period, the Client shall notify such defect without undue delay to the Supplier. Defects may be notified on the last day of warranty period, at the latest.

11.5 The Client notifies defects in writing via e-mail. The Supplier shall accept notifications of defects on the following e-mail address: benda@streicher-machinery.cz. The Supplier shall confirm receipt of the notification within two working days.

11.6 In the notification, the Client shall describe the defect and the manner of removal of the defect. The Client has the right to:

a) ask for the removal of the defect by the delivery of a replacement individual part of the Object of Purchase,

b) ask for the removal of the defect by repair, or

c) ask for the adequate reduction of the price, i.e. the Purchase Price or the price of Option, particularly in case of irremovable defects.

11.7 The Supplier shall remove the defect within 21 calendar days from its notification, unless Parties agree otherwise. The Client shall agree an extended deadline for the defect removal with the Supplier if the Supplier submits evidence (e.g. subcontractors bid etc.) that the removal of the defect within 21 calendar days is impossible for objective reasons (i.e. independent of the will of the Supplier), or if technical nature of the defect makes not possible its removal within 21 calendar days.

11.8 The Supplier shall remove the defect within terms stipulated in this Contract even if the notification of the defect is in his opinion unjustified. In such a case, the Supplier is entitled to ask for reimbursement of the costs of the removal of the defect. If Parties disagree on whether the notification of the defect is justified or not, the Client shall secure an expert opinion (by an expert also agreed by the Supplier). If the expert considers the notification to be justified, then the Supplier shall return the reimbursement amount paid to him in accordance with the second sentence of this paragraph.

11.9 Parties shall sign a protocol on the removal of the defect, which shall contain the description of the defect and the confirmation that the defect was removed. The warranty period of the relevant defective System Component shall be extended in case of defects preventing the Client from use of the System Component for intended use by the period of time that elapses between the notification of the defect and its removal.

11.10 Should the Supplier not remove the defect within the stipulated or mutually agreed term or should the Supplier refuse to remove the defect, the Client is entitled to remove the

defect at his own costs and the Supplier shall reimburse these costs within 30 days after the Client's request to do so. In such a case, the existing warranty remains intact.

12. **REPRESENTATIONS AND WARRANTIES OF THE SUPPLIER**

12.1 The Supplier represents and warrants to the Client that

a) he possesses all professional qualifications to supply the Object of Purchase, has all the professional prerequisites necessary for the proper fulfilment of this Contract and is able to carry out activities foreseen hereunder with the due care, skill and knowledge of well-experienced experts in his particular professional field,

b) is fully authorized to perform this Contract, and

c) there are no obstacles on his side that would preclude him from the due performance of this Contract.

12.2 The Supplier is aware of the importance to the Client of the fulfilment of this Contract in terms of quality, performance and schedule. In the event of a failure by the Supplier to meet them (e.g. in case of delay with delivery of Deliverables and/or in the case if the Object of Purchase does not meet the performance requirements), substantial damage may arise to the Client.

13. **PENALTIES**

13.1 If the Supplier is in delay with the Deliverables D1, D2 or D3 for more than one month, the Supplier shall pay starting with the first day of the second month of the delay to the Client a contractual penalty in the amount of 0.05% of the price of the respective Deliverable (excl. VAT) for every even incomplete day of delay. The Payment for any Deliverable as stated in Annex 1 is considered to be the price of the Deliverable for the purposes of this Art. 13.1.

13.2 If the Supplier is in delay with the Deliverables D4 or D5 the Supplier shall pay to the Client a contractual penalty in the amount of 0.05% of the Purchase Price (excl. VAT) for every even incomplete day of delay.

13.3 If the Supplier is in delay with the optional Deliverables OD1, OD2 or OD5, the Supplier shall pay to the Client a contractual penalty in the amount of 0.05% of the price of the respective optional Deliverable (excl. VAT) for every even incomplete day of delay. The Payment for any optional Deliverable as stated in Annex 1 (i.e. the price of the Option) is considered to be the price of the optional Deliverable for the purposes of this Art. 13.3.

13.4 If the Supplier is in delay with the removal of a defect of the Object of Purchase preventing the Client from proper operation of the Object of Purchase, the Supplier shall pay to the Client a contractual penalty in the amount of 0.05% of the Purchase Price (excl. VAT) for every even incomplete day of delay. In case of defects that do not prevent the Client from proper operation of the Object of Purchase the contractual penalty shall amount to 0.02% of the Purchase Price (excl. VAT) for every even incomplete day of delay.

13.5 The Supplier shall pay any of the contractual penalties charged under this Contract within thirty (30) days from the day, on which the Client enumerated its claim for the contractual penalty. The payment of contractual penalties shall not affect the right of the Client to damages in the extent in which such damages exceed the contractual penalty.

13.6 The amount of the contractual penalty for delay with completion of any of the Deliverables D1, D2 or D3 shall not exceed 5% of the price of each respective Deliverable.

The total amount of contractual penalties for delay with completion of Deliverables D4 and D5 (i.e. the summed up amount of all penalties for delays with the Deliverables D4 and D5) shall not exceed 5% of the Purchase Price.

The amount of the contractual penalty for delay with completion of any of the optional Deliverables OD1, OD2 or OD5 shall not exceed 5% of the price of each respective Deliverable.

13.7 Should a delay of the Supplier be caused by a documented impact of the Covid-19 pandemic on the course of performance of this Contract by the Supplier (e.g. sick workers, sub-supplies delays or failures, etc.), the contractual penalties for delay above do not apply. The Supplier shall in sufficient detail document when an obstacle occurred and how long it lasted. The penalties do not apply also in the case of such obstacle caused by Covid-19 pandemic, which could have been overcome but only with unreasonable efforts or disproportionate costs.

13.8 The Client is entitled to unilaterally set off claims arising from the contractual penalties against even yet undue claim of the Supplier for the payment of the Purchase Price or prices of Options.

14. RIGHT OF WITHDRAWAL AND VIS MAJOR

14.1 The Client is entitled to withdraw from this Contract without any penalties, if any of the following circumstances occur:

a) the Supplier breaches this Contract in a substantial manner;

b) the Supplier repeatedly fails to follow the mandatory activities listed in the Verification Control Document, stipulated in Annex 3, and/or does not allow the Client to inspect the Supplier's premises for the purposes of ascertaining status of fulfilment of the Contract;

c) the Supplier is in delay with any contractual Deliverable stipulated in Annex 1 for a period exceeding 3 (three) calendar months, except where the delay has been caused by the Client;

d) results of the factory testing, even after third testing attempt, do not meet the requirements stipulated in Annex 2 (*Detailed Technical Specifications of the Object of Purchase*);

e) the insolvency proceeding is initiated against the Supplier; or

f) the Client ascertains that the Supplier provided in its Bid submitted for the Public Contract information or documents that do not correspond to the reality and that had or could have had impact on the result of the tendering procedure for the Public Contract.

14.2 The Supplier is entitled to withdraw from this Contract in the following cases:

a) the Client breaches this Contract in a substantial manner;

b) the Client is in delay with the payment of any Deliverable for a period longer than 3 calendar months; or

c) the Client repeatedly refuses his attendance at the respective verification activities specified in the Verification Control Document, stipulated in Annex 3.

14.3 The act of withdrawal from the Contract shall become effective on the day of delivery of the notification in writing from one Party to the other with consequences of the Contract termination effective in the "ex tunc" regime, unless the Parties agree otherwise.

14.4 Circumstances precluding liability shall be deemed to have been constituted by such circumstances / obstacles which arose independently of the will of the obliged Party, and which prevent fulfilment of that Party's obligation, provided that it could not be reasonably expected that the obliged Party could overcome or avert this obstacle or its consequences, and furthermore that such Party could foresee such obstacle when it entered into the respective covenants. Liability cannot be precluded by obstacles that arose only after the obliged Party was in default with fulfilment of its obligations, or which arose in connection with its economic situation. The effects precluding liability shall be limited to the period during which the obstacles causing these effects persist.

14.5 Any particular effects or impacts on the Supplier or his performance under this Contract of the Covid-19 pandemic that meet the conditions set out above in Art. 14.4 (unless differently stated in this Art. 14.5) and that could have been overcome only with unreasonable efforts or disproportionate costs will be considered as vis major cases, despite the fact of the existence of the epidemic outbreak as of the date of conclusion of this Contract.

14.6 Should a situation occur, which a Party could reasonably consider to constitute vis major (force majeure), and which could affect fulfilment of its obligations hereunder, such Party shall immediately notify the other Party and attempt to continue in its performance hereunder in a reasonable degree. Simultaneously, such Party shall inform the other one of any and all its proposals, including alternative modes of performance, however, without the other Party's consent, the Party shall not proceed to carry out such alternative performance. If a situation constituting vis major occurs, the deadlines imposed hereunder shall be extended by the period of the duration of the said vis major.

15. **CONFIDENTIALITY**

Parties shall not disclose information that shall become available to them in connection with this Contract and its performance and whose disclosure could harm the other Party. Duties of the Client ensuing for the applicable legal regulations remain unaffected.

16. **SOCIAL, ECOLOGICAL AND INNOVATIVE ASPECTS**

The Client aims to conclude contracts with suppliers that take into account and implement the principles of social responsibility, ecological sustainability and innovation. Therefore, the Supplier shall ensure that:

a) this Contract is fulfilled only by persons that are employed in accordance with the applicable legal regulations (no illegal or child workers);

b) while performing this Contract, all applicable health and safety regulations and rules at work place are observed;

c) all persons performing this Contract are employed under fair and non-discriminatory working conditions;

d) if presented with different manners of fulfilling this Contract, the Supplier shall select the solution/process that is in accordance with the principles governing nature conservation and nature protection, ecological sustainability and ecological waste management; and

e) if presented with different manners of fulfilling this Contract, the Supplier shall select the solution/process that is the most innovative.

17. **REPRESENTATIVES OF THE PARTIES**

17.1 The Supplier appoints the following representative for the communication with the Client in technical matters:

Name: Michal Benda

E-mail: benda@streicher-machinery.cz

Tel.: +420 377 150 126

17.2 The Client appoints the following representative for the communication with the Supplier in technical matters:

Name: Ing. Bedřich Rus, PhD.

E-mail: rus@fzu.cz

Tel.: +420-603-570-558

18. **FINAL PROVISIONS**

18.1 This Contract is governed by the laws of the Czech Republic, especially by the Civil Code.

18.2 All disputes arising out of this Contract or out of legal relations connected with this Contract shall be preferably settled by a mutual negotiation. In case that the dispute is

not settled within sixty (60) days, such dispute shall be decided by courts of the Czech Republic in the procedure initiated by one of the Parties.

18.3 The Supplier takes into account that the Client is not in relation to this Contract an entrepreneur, nor the subject matter of this Contract is connected with the business activities of the Client.

18.4 The Supplier is not entitled to set off any of its claims or his debtor's claims against the Client's claims. The Supplier is not entitled to transfer its claims against the Client that arose on the basis or in connection with this Contract on third parties. The Supplier is not entitled to transfer rights and duties from this Contract or its part on third parties.

18.5 All modifications and supplements of this Contract must be in writing.

18.6 If any provision of this Contract is or becomes invalid or ineffective, then such invalidity, ineffectiveness or unenforceability shall not cause the invalidity, ineffectiveness, or unenforceability hereof as a whole and the Parties shall change this Contract in such a way that the invalid or ineffective provision is replaced by a new provision that is valid and effective and to the maximum possible extent correspond to the original invalid or ineffective provision as well as most closely reflects the intentions of the Parties at the time of conclusion hereof, to an extent permitted by the laws and regulations of the Czech Republic.

18.7 If any Party breaches any duty under this Contract and knows or should have known about such breach, it shall notify it to the other Party and shall warn such Party of possible consequences of the breach.

18.8 Integral parts of this Contract are:

Annex 1 (*Summary of Deliverables, Time Schedule and Payments*)

Annex 2 (*Detailed Technical Specifications of the Object of Purchase*)

Annex 3 (*Verification Control Document*)

Annex 4 (*Prices*)

Annex 5 (*Supplier's Bid*)

In case of any discrepancy between any provisions of this Contract and any provisions of its Annexes the provisions of this Contract shall prevail. In case of any discrepancy between any provisions of Annexes hereof the provisions containing conditions and specifications that are more favourable to the Client (i.e. higher technical specification values and/or more technically advanced or demanding solutions etc.) shall prevail.

18.9 This Contract shall be valid on the date of the signature of both Parties and effective on the date of its publication in the Register of contracts according to special legal regulation.

IN WITNESS WHEREOF attach Parties their signatures:

Client

Signature: _____

Name: RNDr. Michael Prouza, PhD

Position: Director

Supplier

Signature: _____

Name: Dr. Jiří Lopata

Position: CEO

ANNEX 1

SUMMARY OF DELIVERABLES, TIME SCHEDULE AND PAYMENTS

Institute of Physics ASCR, v. v. i.
Na Slovance 2
182 21 Prague 8
Czech Republic
eli-cz@fzu.cz
www.eli-beams.eu

Annex No. 1
Summary of Deliverables,
Time Schedule and Payments

L4 10 PW Laser Beam Distribution Vacuum Infrastructure [TP20-040]

TC ID/Revision: 00309996/A
Confidentiality: BL - Restricted for internal use
WBS code: 4.3 – Beam Transport
PBS code: SE.BDS.BT.L4BT.E34F.VCH

Deliverable	Description	Completion	Payment
	Commencement day (CD) = Contract signature + 7 calendar days	-	-
D1	Detailed schedule of project activities and all corresponding Quality and Verification Plans, and of work procedures	1 month from CD	10% of Purchase Price
D2	Detailed engineering design of CH3 and CH4, of all tubing segments and support structures between TS2C and TS4, and of tubing adaptor TAP3	3 months from CD	15% of Purchase Price
D3	Detailed engineering design of CH1, CH2, CH5, CH6, and CH-DT, and of all tubing segments and support structures between TS0 and TS5 /TSDT	7 months from CD	15% of Purchase Price
D4	Manufacture and factory testing of CH3 and CH4, of all tubing segments and support structures between TS2C and TS4, and of tubing adaptor TAP3, delivery to ELI-Beamlines	9 months from CD	30% of Purchase Price
D5	Manufacture and factory testing of CH1, CH2, CH-DT, of tubing segments TS0, TS1, and TSDT, and of their support structures, delivery to ELI-Beamlines	15 months from CD	30% of Purchase Price

Contractual options

Deliverable	Description	Completion	Payment
Optional OD1	Manufacture and factory testing of CH6, delivery to ELI-Beamlines	4 months after order	Price of the Option
Optional OD2	Manufacture and factory testing of CH5, of the tubing segment TS2A and of its support, of TS2B and TS5, delivery to ELI-Beamlines	8 months after order	Price of the Option
Optional OD3	Transport of the chambers, tubing segments and tubing segment supports to the final location in the L4c and E3 halls, installation of the chambers	2 working weeks after agreed dates	Price of the Option
Optional OD4	Technical installation works on primary vacuum piping and /or on utilities (cooling water, compressed dry air)	2 working weeks after order	Hourly rate
Optional OD5	Manufacture of up to 3 DN1000 ribbed aluminium flanges	3 months after order	Price of parts

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

I. Contractual Deliverables description

1. Deliverable D1:
Detailed schedule of project activities and all corresponding quality plans and work procedures

The supplier to whom the Public Contract will be awarded (hereinafter the "***Supplier***") shall provide a detailed schedule of all project activities; by which is meant a schedule that defines all the activities necessary to individually define, produce or procure and deliver every component within the scope of supply. All activities shall be resourced, allocated start / finish times and linked with relevant dependencies. The amount of detail should be sufficient to identify the longest path of activities through the entire program, thus providing confidence in the overall programme for Deliverables. The scheduled activities shall not be restricted to those of the Supplier but shall include all relevant activities of sub-suppliers, the Client or relevant third parties.

Also within the first month following the Commencement Day, the Supplier shall provide a draft set of Quality and Verification Plan and associated Work Procedures detailing all the work activities and processes required for the design, procurement, fabrication, assembly and test of all products to be supplied under the contract. This shall include aspects such as design review, inspection, analysis and test procedures (Verification Plan), and configuration management, material traceability, cleanliness control, welding procedures and qualifications (Quality Plan). The provided draft set of Quality and Verification Plan shall incorporate as a minimum all required activities listed in Annex 3 (*Verification Control Document*).

Completion: 1 month after Commencement Day

2. Deliverable D2:
Detailed engineering design of CH3 and CH4, of all tubing segments and support structures between TS2C and TS4, and of tubing adaptor TAP3

a) The Supplier shall develop detailed engineering 3D models of the chambers CH3 and CH4, of the tubing segments TS2C, TS3 and TS4, and of the tubing adaptor TAP3 to P3 chamber, based on the preliminary design drawings and 3D models supplied by the Client. These detailed engineering models produced by the Supplier will be used in the subsequent step (Deliverable D4) to make production drawings. The purpose of the detailed engineering design is to develop the Client's preliminary design into a full model including all necessary mechanical details and to optimize the overall design with respect to the technologies, functionality, and fabrication methods that will be employed for manufacturing. The accepted detailed 3D model and the detailed engineering drawings developed in this Deliverable will be binding for the Supplier in the manufacturing phase (Deliverable D4).

b) A part of this Deliverable D2 will be elaboration of specific details of the design, such as:

- Lifting mechanism / lifting points (e.g. lifting eyes) for manipulation with the chambers, lids, doors, and tubing segments
- Paths along the chambers for utilities, primary backing vacuum and electrical cables, followed by design of C-rails and cable trays on the chambers, and by determination of holes in the ribs for utilities *Note: The points of arrival of the primary vacuum and utilities, as well as connection to backbone facility cable tray(s) will be specified by FZU*.
- Double O-ring arrangement for the top lids and side doors
- Door hinges with double pivot arrangement
- Chamber support legs and the floor plates with removable blocks for chamber fine positioning
- Supporting aluminium structure of the EMP panels, including the system of fixing to the chamber walls

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

- Tubing segment supports, with the system for accurate horizontal positioning of the tubes
- Determination of materials, welding procedures, surface finishes and other similar matters necessary to optimize for fabrication

c) The Supplier shall verify the stiffness and stress of the developed detailed design of the CH3 and CH4 chambers, of the tubing segments TS3 and TS4, and of the tubing adaptor TAP3, by means of FEA (Finite Element Analysis) simulations. The acceptable limit of deformation under atmospheric pressure differential is included in the detailed specification of performance requirements in Annex 2 to this Contract. Analysis of the concept design made by the Client shows that the specified requirement is realistic. Results of the analysis shall be provided by Supplier to Client for review. Status of appropriate requirements to be verified by the analysis shall be tracked by the Verification Control Document (VCD), see Annex No. 3.

d) A brief technical report shall be provided by the Supplier that lists all the significant changes and enhancements between the FZU concept design and the agreed detail design. For each change there shall be a brief description of the reason for change and justification of the selected solution. This will provide a means of checking that no important features of the concept design have been inadvertently lost or corrupted.

e) The Supplier shall provide updated drawings and detailed 3D model of CH3, CH4, TS2C, TS3, TS4, TAP3, TSS3, and TSS4, including the finally agreed configuration.

f) The Supplier shall provide final Quality and Verification Plan for all the main components and other documentation, which will be reviewed by the Client.

The provided documentation shall be reviewed by Client by means of Critical Design Review (CDR) process for the part of supply corresponding to D2, and its results will be recorded in a CDR Report. The verification of the Design shall be considered complete when the Client and the Supplier mutually agree that, on the basis of the CDR Report and on the basis of the Verification Control Document (VCD) that all corresponding requirements related to the Design were closed out and that all associated verification objectives were fully achieved. The status of the requirements verified in the Review of Design shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of the Design.

The Supplier shall further submit a timetable of individual major steps in the manufacturing process and factory testing related to D4. The Client reserves the right to witness verification and testing of the individual components and subsystems at the Supplier's premises at any of the indicated steps in the manufacturing process, and to monitor implementation of the contract.

Completion: 3 months after Commencement Day

3. Deliverable D3:
Detailed engineering design of CH1, CH2, CH5, CH6, and CH-DT, and of all tubing segments and support structures between TS0 and TS5 /TSDT

a) The Supplier shall develop detailed engineering 3D models of the chambers CH1, CH2, CH5, CH6 and CH-DT, and of the tubing segments TS0, TS2A, TS2B, TS5, and TSDT, based on the preliminary design drawings and 3D models supplied by the Client. These detailed engineering models produced by the Supplier will be used in the subsequent step (Deliverable D5) to make production drawings related to CH1, CH2, CH-DT, and to the respective tubing segments and their supports. The purpose of the detailed engineering design is to develop the Client's preliminary design into a full model including all necessary mechanical details and to optimize the overall design with respect to the technologies, functionality, and fabrication methods that will be employed for manufacturing. The accepted detailed 3D model and the detailed engineering drawings developed in this Deliverable will be binding for the Supplier in the manufacturing phase (Deliverable D5).

b) A part of this Deliverable D3 will be elaboration of specific details of the design, such as:

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

- Lifting mechanism / lifting points (e.g. lifting eyes) for manipulation with the chambers, lids, doors, and tubing segments
- Paths along the chambers for utilities, primary backing vacuum and electrical cables, followed by design of C-rails and cable trays on the chambers, and by determination of holes in the ribs for utilities *Note: The points of arrival of the primary vacuum and utilities, as well as connection to backbone facility cable tray(s) will be specified by FZU*.
- Double O-ring arrangement for the top lids and side doors
- Door hinges with double pivot arrangement
- Chamber support legs and the floor plates with removable blocks for chamber fine positioning
- Supporting aluminium structure of the EMP panels, including the system of fixing to the chamber walls
- Tubing segment supports, with the system for accurate horizontal positioning of the tubes
- Determination of materials, welding procedures, surface finishes and other similar matters necessary to optimize for fabrication

c) The Supplier shall verify the stiffness and stress of the developed detailed design of the CH1, CH2, CH5, CH6 and CH-DT chambers, of the tubing segments TS2A, TS2B, TS5, and TSDT, by means of FEA (Finite Element Analysis) simulations. The acceptable limit of deformation under atmospheric pressure differential is included in the detailed specification of performance requirements in Annex 2 to this Contract. Analysis of the concept design made by the Client shows that the specified requirement is realistic. Results of the analysis shall be provided by Supplier to Client for review. Status of appropriate requirements to be verified by the analysis shall be tracked by the Verification Control Document (VCD), see Annex No. 3.

d) A brief technical report shall be provided by the Supplier that lists all the significant changes and enhancements between the FZU concept design and the agreed detail design. For each change there shall be a brief description of the reason for change and justification of the selected solution. This will provide a means of checking that no important features of the concept design have been inadvertently lost or corrupted.

e) The Supplier shall provide updated drawings and detailed 3D model of CH1, CH2, CH5, CH6, CH-DT, TS2A, TS2B, TS5, and TSDT, TSS1, TSS2, and TSSD, including the finally agreed configuration.

f) The Supplier shall provide final Quality and Verification Plan for all the main components and other documentation, which will be reviewed by the Client.

The provided documentation shall be reviewed by Client by means of Critical Design Review (CDR) process for the part of supply corresponding to D3, and its results will be recorded in a CDR Report. The verification of the Design shall be considered complete when the Client and the Supplier mutually agree that, on the basis of the CDR Report and on the basis of the Verification Control Document (VCD) that all corresponding requirements related to the Design were closed out and that all associated verification objectives were fully achieved. The status of the requirements verified in the Review of Design shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of the Design.

The Supplier shall further submit a timetable of individual major steps in the manufacturing process and factory testing related to D5. The Client reserves the right to witness verification and testing of the individual components and subsystems at the Supplier's premises at any of the indicated steps in the manufacturing process, and to monitor implementation of the contract.

Completion: 7 months after Commencement Day

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

4. Deliverable D4:
Manufacture and factory testing of CH3 and CH4, of all tubing segments and support structures between TS2C and TS4, and of tubing adaptor TAP 3, delivery to ELI-Beamlines

The Supplier shall develop a full set of final production drawings of the chambers CH3 and CH4, of the tubing segments TS2C, TS3, TS4, of the tubing adaptor TAP3, and of the tubing segment supports TSS3 and TSS4, in line with the documentation produced within the D2 Deliverable.

The Supplier shall manufacture CH3, CH4, TS2C, TS3, TS4, TAP3, TSS3, and TSS4, and will perform inspection and testing of vacuum welds according to requirements in Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document) of this Contract.

The chambers CH3 and CH4, tubing segments TS2C, TS3, TS4 and the tubing adaptor TAP3 shall be vacuum cleaned according to requirements in Annex 2 to this Contract. The Supplier shall transport the chambers, the tubing segments and the tubing adaptor TAP3 into a Class 7 or better cleanroom at his premises, where all assembly operations, vacuum performance testing, and vacuum cleanliness verification shall be made.

The Supplier shall provide all equipment for the required vacuum performance and cleanliness testing, namely vacuum pumps, vacuum gauges, He leak detector, and RGA mass spectrometer.

The Supplier shall validate the vacuum performance and vacuum cleanliness of the chambers CH3 and CH4, and of the tubing segments TS2C, TS3, and TS4 at their works, according to requirements of Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document), namely:

- Performance of vacuum leak test using He leak detector
- Demonstration of pump down to pressure at least 10^{-6} mbar
- Performance of vacuum cleanliness measurement by Residual Gas Analyzer (RGA) mass-spectrometer to demonstrate residual pressures of molecular compounds according to requirements in Annex 2 to this Contract.

The verification of vacuum and cleanliness performance of the individual elements shall be made according to the Verification Plan. The Client will witness the RGA cleanliness measurement. The results of vacuum performance verification and testing will be provided in Protocol on Factory Testing of CH3, CH4, TS2C, TS3, and TS4.

The Client will inspect vacuum cleanliness of the tubing adaptor TAP3 by his own measurement procedure.

In the subsequent step the Supplier shall prepare for transport of all elements and components manufactured in this Deliverable 4, according to requirements in Annex 2 to this Contract.

For the duration of its transport the chambers and tubing segments shall be hermetically sealed. The initial wrapping of all parts shall be in multiple layers of plastic film (as sheet or bags) with low outgassing rate as specified by requirements in Annex 2 to this Contract. This clean conditions wrapping will be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

The Supplier will transport the elements to the ELI-Beamlines facility and will remain responsible for them (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, all delivered elements will be unpacked by Supplier in a Class 7 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

The statuses of the verified requirements relevant to D4 and inspection of delivered elements shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of D4.

Completion: 9 months and after Commencement Day

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

5. Deliverable D5:
Manufacture and factory testing of CH1, CH2, CH-DT, and of tubing segments TS0, TS1, and TSDT, and of their support structures, delivery to ELI-Beamlines

The Supplier shall develop a full set of final production drawings of the chambers CH1, CH2 and CH-DT, of the tubing TS0, TS1, and TSDT, and of their supporting structures TSS1, and TSSD, in line with the documentation produced within the D3 Deliverable.

The Supplier shall manufacture CH1, CH2, CH-DT, TS0, TS1, TSDT, TSS1, and TSSD, and will perform inspection and testing of vacuum welds according to requirements in Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document) of this Contract.

The chambers CH1, CH2, and CH-DT, and the tubing segments TS0, TS1, and TSDT, shall be vacuum cleaned according to requirements in Annex 2 to this Contract. The Supplier shall transport the chambers into a Class 7 or better cleanroom at his premises, where all assembly operations, vacuum performance testing, and vacuum cleanliness verification shall be made.

The Supplier shall provide all equipment for the required vacuum performance and cleanliness testing, namely vacuum pumps, vacuum gauges, He leak detector, and RGA mass spectrometer.

The Supplier shall validate the vacuum performance and vacuum cleanliness of the chambers CH1, CH2, CH-DT, TS0, TS1, and TSDT, at their works, according to requirements of Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document), namely:

- Performance of vacuum leak test using He leak detector
- Demonstration of pump down to pressure at least 10^{-6} mbar
- Performance of vacuum cleanliness measurement by Residual Gas Analyzer (RGA) mass-spectrometer to demonstrate residual pressures of molecular compounds according to requirements in Annex 2 to this Contract.

The verification of vacuum and cleanliness performance of the individual elements shall be made according to the Verification Plan. The Client will witness the RGA vacuum cleanliness measurement. The results of vacuum performance verification and testing will be provided in Protocol on Factory Testing of CH1, CH2, CH-DT, TS0, TS1, and TSDT.

In the subsequent step the Supplier shall prepare for transport of all elements and components manufactured in this Deliverable 5, according to requirements in Annex 2 to this Contract.

For the duration of its transport the chambers shall be hermetically sealed. The initial wrapping of all parts shall be in multiple layers of plastic film (as sheet or bags) with low outgassing rate as specified by requirements in Annex 2 to this Contract. This clean conditions wrapping will be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

The Supplier will transport the elements to the ELI-Beamlines facility and will remain responsible for them (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, all delivered elements will be unpacked by Supplier in Class 7 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

The statuses of the verified requirements relevant to D5 and inspection of delivered elements shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of D5.

Completion: 15 months after Commencement Day

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

II. Contractual options

Contractual Option OD1: Manufacture and factory testing of CH6, delivery to ELI-Beamlines

As part of this Optional Deliverable the Supplier shall develop detailed engineering drawings of the CH6 vacuum chamber, in line with the documentation produced within the D3 Deliverable.

The Supplier shall manufacture the CH6 and will perform inspection and testing of vacuum welds according to requirements in Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document) of this Contract.

The chamber CH6 shall be vacuum cleaned according to requirements in Annex 2 of this Contract. The Supplier shall transport the chamber into Class 7 or better cleanroom at his premises, where all assembly operations, vacuum performance testing, and vacuum cleanliness verification shall be made.

The Supplier shall provide all equipment for the required vacuum performance and cleanliness testing, namely vacuum pumps, vacuum gauges, He leak detector, and RGA mass spectrometer.

The Supplier shall validate the vacuum performance and vacuum cleanliness of the chamber CH6 at their works, according to requirements of Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document), namely:

- Performance of vacuum leak test using He leak detector
- Demonstration of pump down to pressure at least 10^{-6} mbar
- Performance of vacuum cleanliness measurement by Residual Gas Analyzer (RGA) mass-spectrometer to demonstrate residual pressures of molecular compounds according to requirements in Annex 2 to this Contract.

The verification of vacuum and cleanliness performance of CH6 shall be made according to the Verification Plan. The Client will witness the RGA vacuum cleanliness measurement. The results of vacuum performance verification and testing will be a provided in Protocol on Factory Testing of CH6.

In the subsequent step the Supplier shall prepare the chamber CH6 for transport, according to requirements in Annex 2 to this Contract.

For the duration of its transport the chamber shall be hermetically sealed. The initial wrapping shall be in multiple layers of plastic film (as sheet or bags) with low outgassing rate as specified by requirements in Annex 2 to this Contract. This clean conditions wrapping will be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

The Supplier will transport CH6 to the ELI-Beamlines facility and will remain responsible for it (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, CH6 will be unpacked by Supplier in Class 7 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

The statuses of the verified requirements relevant to OD1 and inspection of delivered CH6 shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of OD1.

The Client is entitled to activate this Option 1 with a written request at any time after completion of D3, up to 12 months after the end of the firm scope part (i.e. excluding Options) of the Contract. The Supplier is entitled to invoice the Client with the price of Option 1 after its completion, i.e. upon acceptance of OD1.

Completion: 4 months after OD1 activation

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

Contractual Option OD2: Manufacture and factory testing of CH5, of the tubing segment TS2A and of its support, of TS2B and TS5, delivery to ELI-Beamlines

As part of this Optional Deliverable the Supplier shall develop detailed engineering drawings of the CH5 vacuum chamber, of the tubing segments TS2A, TS2B, and TS5, and of the tubing segment supporting structure TSS2, in line with the documentation produced within the D3 Deliverable.

The Supplier shall manufacture the CH5, TS2A, TS2B, TS5, and TSS2, and will perform inspection and testing of vacuum welds according to requirements in Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document) of this Contract.

The chamber CH5 and the tubing segments TS2A, TS2B, and TS5 shall be vacuum cleaned according to requirements in Annex 2 of this Contract. The Supplier shall transport the chamber and the tubing segments into Class 7 or better cleanroom at his premises, where all assembly operations, vacuum performance testing, and vacuum cleanliness verification shall be made.

The Supplier shall provide all equipment for the required vacuum performance and cleanliness testing, namely vacuum pumps, vacuum gauges, He leak detector, and RGA mass spectrometer.

The Supplier shall validate the vacuum performance and vacuum cleanliness of the chamber CH5 and of the tubing segments TS2A, TS2B, and TS5 at their works, according to requirements of Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document), namely:

- Performance of vacuum leak test using He leak detector
- Demonstration of pump down to pressure at least 10^{-6} mbar
- Performance of vacuum cleanliness measurement by Residual Gas Analyzer (RGA) mass-spectrometer to demonstrate residual pressures of molecular compounds according to requirements in Annex 2 to this Contract.

The verification of vacuum and cleanliness performance of the individual elements shall be made according to the Verification Plan. The Client will witness the RGA vacuum cleanliness measurement. The results of vacuum performance verification and testing will be a provided in Protocol on Factory Testing of CH5, TS2A, TS2B, and TS5.

In the subsequent step the Supplier shall prepare the chamber CH5, the tubing segments TS2A, TS2B, and TS5, and the tubing segment support TSS2 for transport, according to requirements in Annex 2 to this Contract.

For the duration of its transport the chamber and the tubing segments shall be hermetically sealed. The initial wrapping shall be in multiple layers of plastic film (as sheet or bags) with low outgassing rate as specified by requirements in Annex 2 to this Contract. This clean conditions wrapping will be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

The Supplier will transport CH5 and the tubing segments to the ELI-Beamlines facility and will remain responsible for them (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, all delivered elements will be unpacked by Supplier in Class 7 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

The statuses of the verified requirements relevant to OD2 and inspection of the delivered CH5, of the tubing segments TS2A, TS2B, and TS5, and of the tubing segment support TSS2, shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of OD2.

The Client is entitled to activate this Option 2 with a written request at any time after completion of D3, up to 12 months after the end of the firm scope part (i.e. excluding Options) of the Contract. The Supplier is entitled to invoice the Client with the price of Option 2 after its completion, i.e. upon acceptance of OD2.

Completion: 8 months after OD2 activation

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

Contractual Option OD3: Transport of the chambers, of the tubing segments and of the tubing segment supports to the final location in the L4c and E3 halls, installation of the chambers

Within this Optional Deliverable 3, the Supplier shall transport the vacuum chambers manufactured within this Contract from the ELI-Beamlines offloading ramp through the ELI-Beamlines building right up to the point of fixing down at the final location in the L4c laser hall (chambers CH1, CH2 and CH-DT, tubing segments TS0, TS1, and TSDT, and the tubing segment supports TSS1 and TSDT) and/or in the E3 experimental hall (chambers CH3 and CH4, tubing segments TS2C, TS3, and TS4, and tubing segment supports TSS3 and TSS4), and shall install them in their designated positions.

The Client is entitled (but has no duty to do so) to ask the Supplier to transport and install the respective components only in one of the L4c or E3 halls, or in both halls L4c and E3, and to ask for installation of all the components as mentioned above (i.e. chambers, tubing segments and tubing segment supports) or of the chambers only.

Transport through the Laser Building will involve the use of a goods lift to transition between floors and in order to fit in the lift the maximum dimensions of the chamber body (in its transport configuration) must not exceed 5.5 m (length) x 5.1 m (width) x 3 m (height) and its weight must not exceed 10 tons. Movement through corridors and rooms will require wheels, or rollers fitted to a suitable support structure, whose design and supply will be within the scope of the Supplier.

Upon transport of the respective chambers to the L4c and/or E3 hall of ELI-Beamlines, to the point of fixing, the Supplier shall fine position and bolt the chambers to the floor plates (installed by the Client). The device (laser tracker) for accurate position measurements of the chambers will be provided by the Client.

The chambers shall be positioned with respect to the local coordinate system, with a tolerance of +/- 1 mm. This positioning will be referenced to patterns centered on the flanges of the input and output laser beam flanges of each chamber.

An electric overhead travelling crane with a capacity of 1,000 kg is installed in the E3 hall above the area where the chambers CH3 and CH4 will be installed. However, no reliance shall be placed on using this crane for fine positioning of the chambers.

Upon due provision of works Protocol on transport and installation of the respective chambers will be issued and shall be basis for acceptance of the respective part of the Contractual Option 3.

The Client is entitled to activate this Option 3 with a written request no later than one month before completion of D4 (for transport and installation of CH3 and CH4 in the E3 hall) or D5 (for transport and installation of CH1, CH2 and CH-DT in the L4c hall). The Client will agree with the Supplier the date of performance of the transport and installation works in each case.

The Supplier is entitled to invoice the Client with the price of Option 3 for each hall L4c and E3 upon due provision of the service in each of the halls L4c and E3, i.e. upon acceptance of the respective part of OD3.

Completion: 2 weeks after the agreed date for each hall L4c and/or E3

Contractual Option OD4: Technical installation works on primary vacuum piping and /or on utilities (cooling water, compressed dry air)

Within this Optional Deliverable 4, the Client is entitled to require provision of optional technical installation works associated with installation of the primary vacuum piping connecting the L4 10PW laser beam distribution infrastructure to the primary vacuum circuits of ELI-Beamlines, and with installation to the cooling water and compressed dry air (CDA) piping.

The Client is entitled (but has no duty to do so) to ask the Supplier for the services at its full discretion before or at the time of acceptance of the D4 Deliverable, if related to the E3 hall, or before or at the time of acceptance of the D5

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

Deliverable, if related to the L4c hall. The maximum extent of this contractual option is 20 man days. Detailed conditions of provision of the services (extent, time of provision, profession of specialists, etc.) shall be agreed between the Contractual parties. The Supplier will commence provision of the services no later than 10 working days after written request by the Client. The price of optional services (hourly rate) is stipulated by the Supplier's bid and shall be paid after due provision of the works.

Completion: Two working weeks (10 days) after OD4 activation

Contractual Option OD5: Manufacture of up to 3 DN1000 ribbed aluminium flanges

Within this Optional Deliverable 3, the Supplier shall manufacture up to 3 pieces of DN1000 ribbed aluminium vacuum flanges, according to the drawing provided in Annex 2 (Requirements Specification Document) to this Contract. The flanges shall be manufactured from aluminium alloy EN 5083 (equivalent to ČSN 42 4415, equivalent to ANSI AA5083), or equivalent.

The Supplier will inspect flanges and their vacuum welds according to procedures described in Annex 2 (Requirements Specification Document) and Annex 3 (Verification Control Document) to this Contract. The manufactured and inspected flanges shall be cleaned according to requirements in Annex 2 to this Contract, and shall be transported into the Supplier's Class 7 or better cleanroom for final cleanliness inspection and for packaging.

The Supplier shall subsequently prepare the flanges for transport, according to requirements in Annex 2 to this Contract. Each flange will be wrapped in multiple layers of plastic film (as sheet or bags) with low outgassing rate as specified by requirements in Annex 2 to this Contract. This clean conditions wrapping will be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

The Supplier will transport the flanges to the ELI-Beamlines facility and will remain responsible for them (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading at the ELI-Beamlines building entrance will be made by fork lift truck.

Upon delivery to ELI-Beamlines the flanges will be unpacked by Supplier in a Class 7 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD), using the same procedure as for other components delivered within D4 and D5.

The statuses of the verified requirements and inspection of delivered flanges shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of OD5.

The Client is entitled to activate this Option 5 with a written request at any time up to 12 months after the end of the firm scope part of the Contract (i.e. excluding Options). The Supplier is entitled to invoice the Client with the price of Option 5 after its completion, i.e. upon acceptance of OD5.

Completion: 3 months after OD5 activation

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX 2

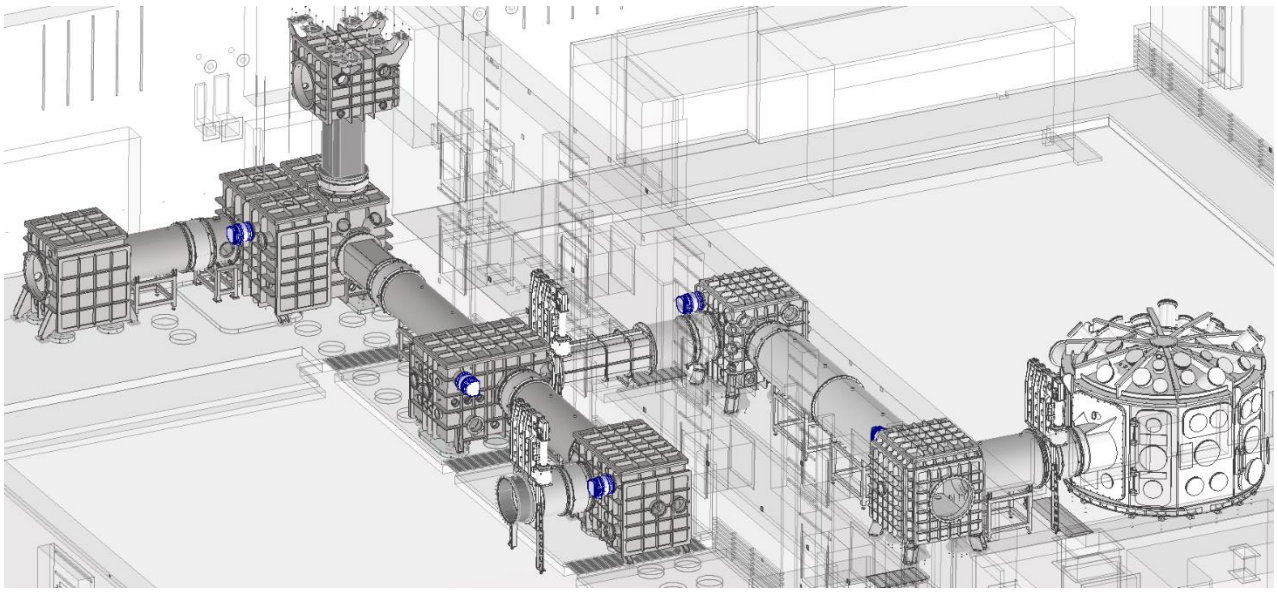
DETAILED TECHNICAL SPECIFICATIONS OF THE OBJECT OF PURCHASE

Confidentiality Level	*BL - Restricted for internal use*	**TC ID / Revision**	00306040/C
Document Status	*Document Released*	**Document No.**	N/A
WBS code	*4.3 – Beam Transport*		
PBS code	*SE.BDS.BT.L4BT.E34F.VCH*		
Project branch	*Engineering & Scientific documents (E&S)*		
Document Type	*Specification (SP)*		

[RSD product category C]

L4 10 PW Laser Beam Distribution Vacuum Infrastructure

TP20_040



Keywords

N/A

	Position	Name
Responsible person	Head of department of Laser Systems	Bedřich Rus
Prepared by	Head of department of Laser Systems Senior Optomechanical Designer Senior Optomechanical Designer	Bedřich Rus Jean Claude Lagron Petr Brabenec

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

RSS TC ID/revision	RSS - Date of Creation	RSS - Date of Last Modification	Systems Engineer
022960/A.001	23.07.2021	23.07.2021	Jakub Adamec
022960/A.003	09.08.2021	09.08.2021	Jakub Adamec

Reviewed By

Name (Reviewer)	Position	Date	Signature
Pavel Bakule	Group Leader of L1 Allegra Laser		
Lukáš Brabec	Vacuum and Cryogenics Group Leader		
Radek Toman	Legal Group leader		
Martin Laub	Head of department of Construction and Design Support		
Daniel Kramer	Group leader of Optical Materials Development		
Ladislav Půst	Group Leader of Installations		
Stefan Weber	Head of Department of Plasma Physics and High Intensity Interaction		
Jakub Janďourek	Infrastructure technology coordinator		
Roman Kuřátko	Head of Department of Building Infrastructure and IT		
Veronika Olšovcová	Group Leader of Safety		
Viktor Fedosov	Group Leader of Quality and Planning		

Approved by

Name (Approver)	Position	Date	Signature
Bedřich Rus	Head of department of Laser Systems		

Revision History / Change Log

Change No.	Made by	Date	Change description, Pages, Chapters	TC rev.
1	B. Rus	16.7.2021	RSD draft creation	A
2	Jakub Adamec	23.07.2021	Version for review	B
3	J. Adamec, P. Bakule, S. Weber, D. Hanusková, V. Fedosov	09.08.2021	Final version	C

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Table of Content

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

1. Introduction

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints on a product related to the RA1 program of the ELI Beamlines project. This can lead to the identification of product interfaces with the ELI Beamlines science-based technology and ELI Beamlines building facility. This RSD also acts as the parent document for technical requirements that are addressed in lower level design description documents (see section 3.1).

1.2. Scope

The RSD contains all the technical requirements: functional and manufacturing design, manufacture, cleaning, packaging and transportation, as well as safety and quality, requirements for the following product (tender number: TP20_040): **L4 10 PW Laser Beam Distribution Vacuum Infrastructure** ("**System**" in further text, where appropriate).

This RSD states and describes the technical requirements for fabrication of the System which will provide the vacuum environment for transporting the L4 10PW laser beam from the pulse compressor located in the L4c hall to the E3 experimental hall, and for the system of on-line measurement of parameters of the 10PW laser beam. The laser beam distribution infrastructure consists of large vacuum chambers, of interconnecting tubing, and of supporting structures.

The System is registered in the PBS database under the following PBS code: SE.BDS.BT.L4BT.E34F.VCH.

1.3. Scope of Work

The scope of work includes detailed design, manufacture, testing and transport to ELI-Beamlines of major elements of vacuum infrastructure of the L4 10PW laser beam distribution from the L4 10PW compressor to the E3 experimental hall and for diagnostics of the 10PW beam. A schematic layout of the System is in Figure 1.

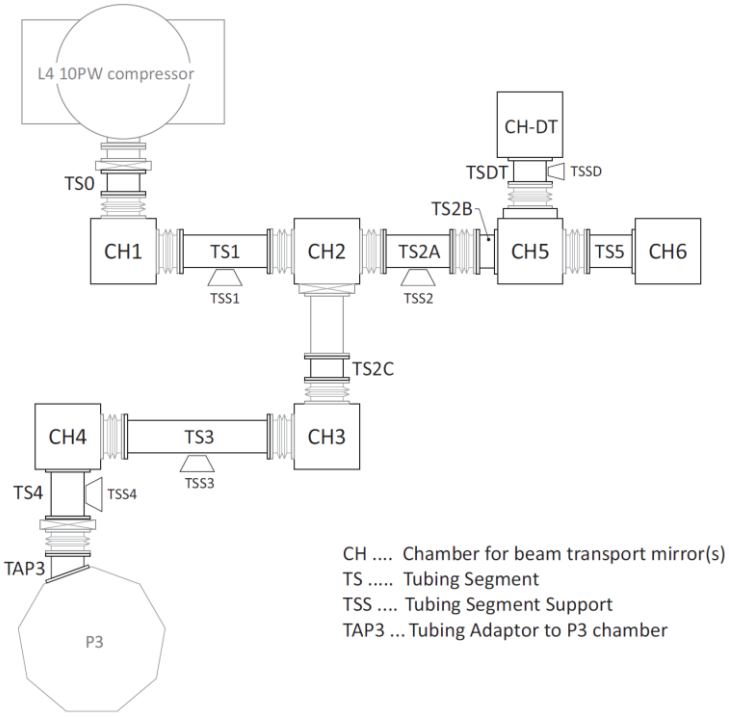


Figure 1: Block scheme of the L4 10PW beam distribution, indicating in black all elements which are within the scope of supply. The elements indicated in gray, i.e. bellows and vacuum valves, are not included within the scope of supply.

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

The System involves 6 node chambers which will accommodate plane mirrors reflecting the 650x650 mm laser beam along the optical path into the desired destination; the chambers CH2 and CH5 will involve translation mirror to switch the laser beam between the desired trajectories. The chamber CH-DT provides environment for large parabolic mirror that constitutes the main optical part of a de-magnifying telescope. The chambers CH1 and CH2 are similar, and CH3 and CH4 identical, in the design. The overall view of the entire system, involving both parts constituting the Scope of Work of this supply and parts that will be supplied by CA.

All optomechanical components inside the chambers will be mounted on massive aluminum optical tables supported by a bellows system for de-coupling from the vacuum vessel. The components of the internal structure are not within the scope of this supply.

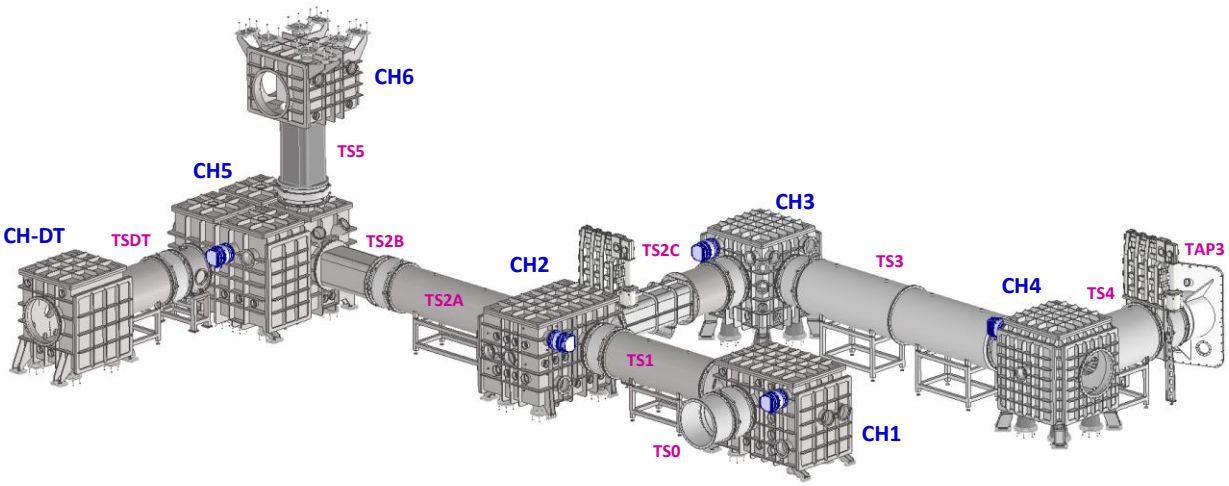


Figure 2: Overall view of the L4 10PW laser beam distribution assembly. The chambers CH1, CH2, CH5, CH6 and CH-DT will be located in the L4c laser hall, and the CH3 and CH4 will be in the E3 experimental hall.

The Scope of Work, in its nominal part or in options, includes the following components:

- Node chambers CH1, CH2, CH3, CH4, CH5, and CH6
- Chamber of the diagnostic telescope CH-DT
- Tubing segments TS0, TS1, TS2A, TS2B, TS2C, TS3, TS4, and TSDT
- Tubing segment supports TSS1, TSS2, TSS3, TSS4, and TSSD
- Tubing adaptor to the P3 chamber TAP3

The chambers CH1, CH2, CH5, CH6 and CH-DT shall be manufactured from stainless steel EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent. The chambers CH3 and CH4 shall be from aluminum EN AW 5083 (equivalent to ČSN 42 4415, equivalent to ANSI AA5083), or equivalent.

Except TS2C, TS3, TS4 and TAP3, all tubing segments shall be manufactured from stainless steel EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent. Analogously, except TSS3 and TSS4 all tubing segment supports shall be from stainless steel EN AW 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Table 1 – Components and materials

Component	Material
Node chambers **CH1**, **CH2**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Tubing segments **TS0**, **TS1,**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Node chambers **CH3**,**CH4**	EN AW 5083 (equivalent to ČSN 42 4415, equivalent to ANSI AA5083), or equivalent
Tubing segments **TS2C, TS3**, **TS4**	EN AW 5083 (equivalent to ČSN 42 4415, equivalent to ANSI AA5083), or equivalent
Tubing adaptor to the P3 chamber **TAP3**	EN AW 5083 (equivalent to ČSN 42 4415, equivalent to ANSI AA5083), or equivalent
Tubing segment supports **TSS1**, **TSS3**, **TSS4**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Tubing segments **TS2A**, **TS2B**, **TSDT**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Node Chambers **CH5**, **CH6**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Chamber of the diagnostic telescope **CH-DT**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent
Tubing segment supports **TSS2**, **TSSD**	EN 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent

Included in the Scope of Work are vacuum sealing for lids and doors of the chambers, blanks and fluoroelastomer O-rings required to test the chambers at the Supplier and to seal all circular flanges of the chambers and tubing segments for transport. Installation of the chambers, of the tubing segments and of their components is not part of the nominal supply but constitutes Contractual Option.

The chambers are cuboid-shaped (CH1, CH2, and CH5) or cube-shaped (CH3, CH4, CH6 and CH-DT) and are designed as ribbed structures. Except CH6 which will be attached to the ceiling all chambers are equipped with top lids to permit access to the chambers interior by the overhead crane. All chambers are also equipped with side hinged doors to obtain access for personnel for installation and/or servicing the optomechanical mounts and other devices inside the chamber interior.

The Supplier shall develop the advanced conceptual design provided by CA into detail design and subsequently to manufacture documentation. The Supplier shall elaborate design of specific features which are not covered in the CA design, in particular hinges of the chamber doors, and C-profiles for distribution of utilities (backing vacuum for turbomolecular pumps, compressed dry air for venting and for actuation of valves, cooling water) and for attachment of external cable trays on the chambers.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2. Specific elements of the design

In this section specific elements of the design, applying to all subsystems and/or components of the Scope of Work, are described.

2.1. Chambers

The conceptual design of the chambers structures, provided by CA, was optimized by FEM analysis of deformations and stress due to atmospheric pressure differential, so that deformations do not exceed 1 mm. The optimization took into account position of specific flanges with respect to spatial constraints (e.g., flanges for illumination and observation of the internal optics) and/or availability of utilities (roughing and backing vacuum, cooling water, and compressed dry air for venting) for operation of the chambers. The Supplier is not allowed to substantially modify the structure of the reinforcing ribs, but can locally optimize position and thickness of the ribs to improve the overall stiffness and to optimize the structure with respect to manufacture. The Supplier shall repeat the FEM analysis of the final design.

The Supplier is not allowed to modify positions of the chamber legs, as the design produced by CA takes into account topology of the existing floor and ceiling anchors in the ELI-Beamlines facility. The Supplier is furthermore not allowed to modify design of the suspension legs of the CH6 chamber as the existing design has been officially validated by an authorized structural engineering office.

All chambers shall be equipped with appropriately located bosses with threads for lifting eyes or device for safe manipulation of the chamber during transport and installation. Placement of these bosses will be agreed during the Supplier's detailed design phase. The Supplier shall dimension the bosses and threads according to relevant safety standards.

In order to assist positioning of the chamber during installation the external surface shall be equipped with mounting points consisting of boss with a precisely toleranced ø6 hole suitable for mounting a corner cube reflector for laser scanning. Appropriate position of these bosses will be agreed with CA during the detail design process. The supplier shall verify the precise relative position of these bosses after manufacture.

The side doors of all chambers shall be equipped by hinges. The hinges will be of double pivot arrangement to avoid crushing the O-rings when closing the door. The Supplier shall develop detailed design of the hinges. If needed, the doors can be aligned by locating pins providing a guide for closing. Each door shall be equipped with handle for safe manipulation during opening / closing. The design shall allow installation of the hinges and handles on both sides of each door.

All doors and top lids shall be equipped with bosses with threads of at least M16 (or equivalent) for mounting lifting eyes for manipulation with an overhead crane or with another lifting device. Alternatively, where appropriate, the ribs can be made with holes to enable attachment of lifting devices.

All top lids will be aligned by locating pins providing a guide for lowering to the chamber flange.

2.1.1. Supporting legs design with sliding pads for accurate positioning of the chambers

The chambers will be mounted to stainless steel floor plates which will be bolted and bonded to the floor (the chamber CH6 will be suspended on ceiling plates which are already installed). The system, which shall be implemented to each leg of the chambers, is conceptually illustrated in Figure 3. The Supplier shall design and manufacture all components of this positioning system; the design shall be subject to approval by CA. The floor plates will be installed by CA. Based on previous experience, the precision of installation of these plates is typically better than ±0.2 mm.

Upon being transported to the designed locations, the chambers will be accurately positioned by a leveling system using positioning screws located at each side of the floor plate. The screws will be in removable blocks.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

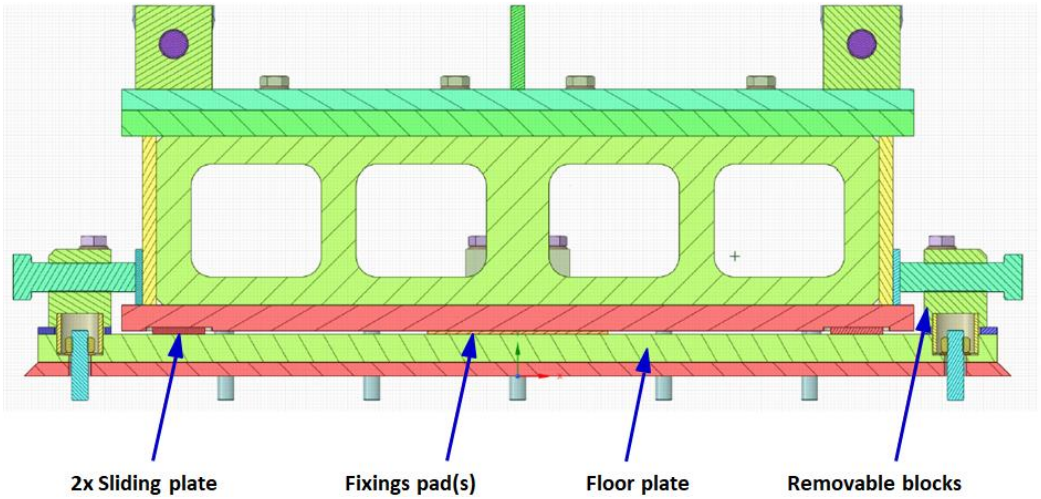


Figure 3: Cross section of the chambers support feet (conceptual design). All chambers will be mounted on accurately leveled stainless steel floor plates. The removable blocks at each end of the floor plate wills serve for accurate positioning of the chamber after its rough placing by the manipulation device(s).

2.1.2. C-rails for utilities and cable trays, preparation for TMP backing vacuum tubing

The outer side of the chambers shall be equipped by welded sections of rectangular C-rails with size of 28x11 mm (wall thickness 2 mm). The C-rails will serve for affixing stainless steel piping of the utilities, i.e. of compressed dry air (CDA) for vacuum valves and for automated venting, and of cooling water for the turbomolecular pumps (TMP). The C-rails will also be used to attach the cable trays for organizing the electrical cables for the TMP, valves, gauges, etc.

The Supplier shall draw up a line design for paths of all compressed air and water pipes on each chamber, together with a line design of the primary backing DN40 vacuum tubing. Holes in the chamber ribs shall be made for leading of all these pipes / tubes along the chamber walls. In parallel the Supplier shall also design paths for the electrical cables; the electrical cables will be along the outer structure of the chambers (i.e., not through holes in the ribs). The design will be based on planned use of the individual flanges, as described in Section 2.2 of this document.

Additionally to the cables for the vacuum elements the cable trays will serve to arrange electrical cables of motorized actuators from the flanges equipped with feedthroughs, see description of flanges in Section 2.2. The path of electrical cables should be separated from that for the cooling water.

The external cable trays will serve to arrange the cables of motorized actuators from the feedthroughs (see Section 2.2 Flange Schedule) to the control rack.

The conceptual design of the paths for utilities and electrical cables shall be agreed with CA.

Subsequently the Supplier shall develop design of the external cable trays. It is estimated that for each chamber typically 30 to 40 sections of C-rails (in length typically 30 cm per each section) will be needed.

2.1.3. Vacuum flanges

All top lids and side doors of the chambers shall be vacuum sealed by using a double fluoroelastomer O-ring seal arrangement minimizing effective gas load due to O-ring permeation, with the space between the O-rings actively pumped to ~10^{-2} mbar. The O-rings shall be located in the lids or flanges. The interspace pumping shall be performed from the chamber flange, i.e. lifting the lids or opening the doors shall not require disassembling of any vacuum tubes or bellows. The O-rings shall be retained in the grooves during the lifting of the lids or door

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

opening. Detail design of the double O-ring assembly and arrangement of corresponding flanges (DN10 ISO-KF) and tubes (inner diameter 12 mm) serving to active pumping of the space between the two O-rings shall be developed by the Supplier during the detailed design phase.

Except explicitly indicated, circular flanges (ISO-F or ISO-K) of the chambers and tubing segments shall be according to ISO standard 1609 (Ref. No ISO 1609-1986 rev. 2014), or equivalent.

All ISO-KF flanges shall be manufactured according to the ISO 2861:2020 Vacuum technology – dimension of clamped-type quick-release, or equivalent.

The large flanges DN 1000 ISO-F, or equivalent, see Figure 4, shall have oblong holes for the M24 assembly bolts to relieve constraints on precision of mutual alignment of the adjoining flanges during assembling. Additionally the flanges shall be equipped by three M6 tapped blind holes for retaining the O-ring (via the outer ring).

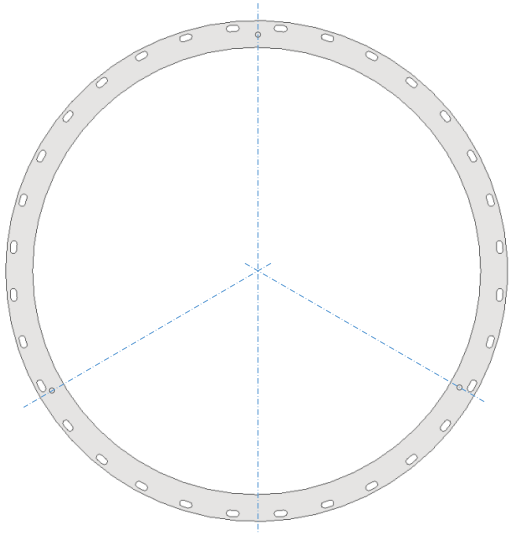


Figure 4 Nominal design of DN1000 ISO-F (or equivalent) flanges that shall be applied to all flanges of this size on the chambers and on the tubing segments. The 27-mm-diam holes for M24 compatible bolts are oblong +/-2°. The three M6 compatible tapped blind holes are outside the O-ring and serve to retain the O-ring assembly during installation.

2.1.4. Circular flange tolerances

The alignment of the flanges on the body of the chambers is in some places critical and elsewhere not critical. **Table 3** gives the permitted tolerance for individual tolerance grades applicable to all circular flanges specified for the individual node chambers CH1 to CH6 and for the chamber of the diagnostic telescope CH-DT.

All large flanges DN1000 ISO-F (or equivalent) on the tubing segments will have tolerance grade A.

Flange Tolerance Grade	Tolerance Specification
A	Co-axial tolerance of ±1 mm or better and angular tolerance of ±0.5 degrees or better with respect to their ideal axis
B	Co-axial tolerance of ±3 mm or better and angular tolerance of ±2.0 degrees or better with respect to their ideal axis
C	Normal manufacturing tolerance (in accordance with ISO 2768-mK, or equivalent)

Table 2: Circular Flange Tolerance Grade.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.2. Vacuum chambers flange schedule

The vacuum flanges are classified in the following way:

nAx

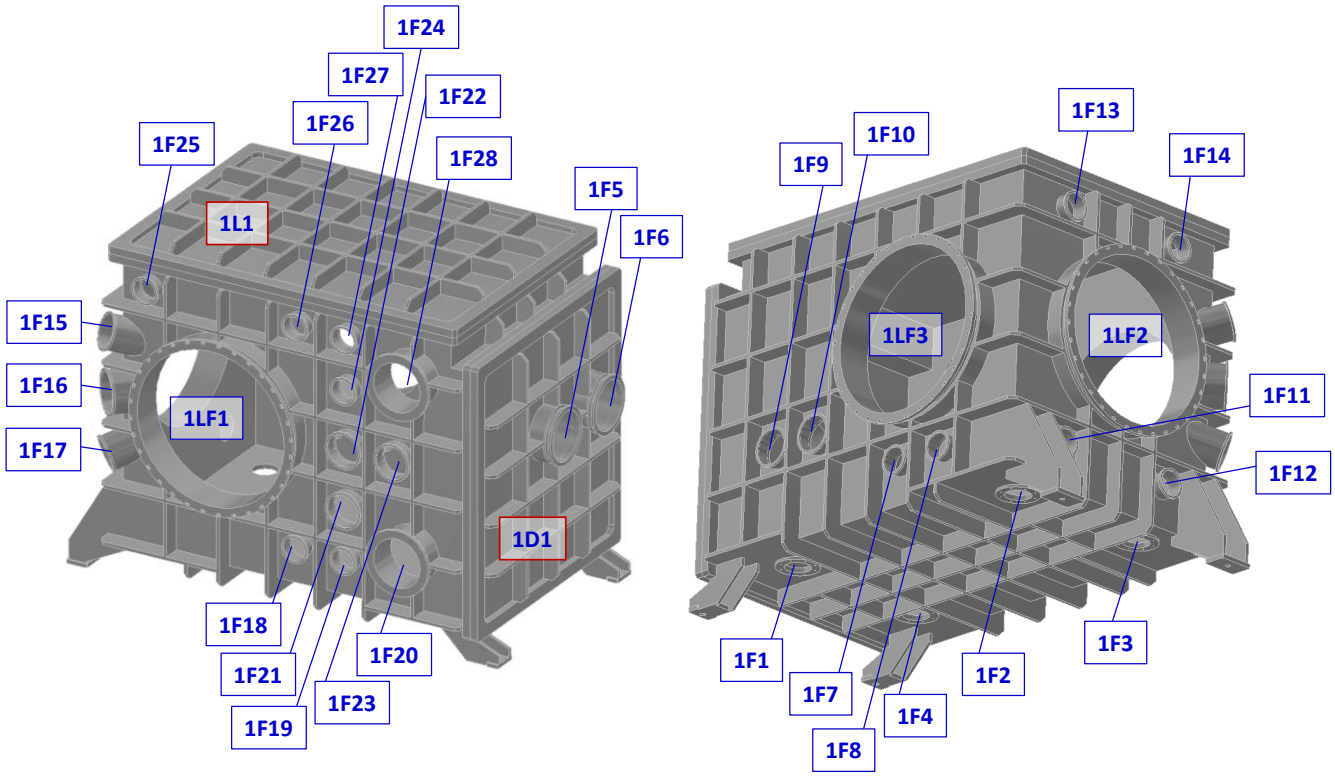
where

n ..... Chamber number
A ..... Type of flange:
L .... Lid
D .... Door
LF ... Large Flange ISO-F 1000
F .... Flange
x .... Flange number (within chamber n)

2.2.1. CH1 vacuum flange schedule

The chamber CH1 is designed as stainless steel ribbed structure with thickness of the walls of 15 mm. On the North side the chamber is equipped by hinged end door with size corresponding approximately to the chamber section. The upper lid will be used for Installation of the internal optical table and of the EMP absorbing structures into the chamber interior.

The net size of the CH1 internal space is 2385 (l) x 1500 (w) x 1850 (h) mm^3. The total weight of the chamber including the upper lid and the end door, without circular flanges, is approximately 5200 kg.



FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
1L1	Rectangular shape, outer size 2370 (l) x 1670 (w) mm, providing clear opening 2200 (h) x 1500 (w) mm, 15 mm thickness, ribbed	Lid 1 for crane access to interior of the chamber and for EMP absorption panels installation	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
1D1	Rectangular shape, outer size 1770 (h) x 1670 (w) mm, providing clear opening 1600 (h) x 1500 (w) mm, 15 mm thickness, ribbed	Door 1, North side of the chamber For installation of the internal optical table and access to the mirror and optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
1LF1	DN1000 ISO-F *	On chamber East side	Sealed by simple O-ring assembly	A
1LF2	DN1000 ISO-F *	On chamber South side	Sealed by simple O-ring assembly	A
1LF3	DN1000 ISO-F *	On chamber West side	Sealed by simple O-ring assembly	A
1F1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
1F2	160-mm-diam custom flange	Idem 1F1	Idem 1F1	A
1F3	160-mm-diam custom flange	Idem 1F1	Idem 1F1	A
1F4	160-mm-diam custom flange	Idem 1F1	Idem 1F1	A
1F5	DN320 ISO-K *	On Door 1, on laser beam axis, for alignment purposes or diagnostics of retro-reflected beam	Initially closed by blank flange	B
1F6	DN320 ISO-K *	On Door 1, for viewing port or alternative purposes	Initially closed by blank flange	B
1F7	DN160 ISO-K *	On chamber West side, for connection to roughing primary vacuum	Initially closed by blank flange	C
1F8	DN160 ISO-K *	On chamber West side, for alternative connection to roughing primary vacuum	Initially closed by blank flange	C
1F9	DN200 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
1F10	DN200 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
1F11	DN160 ISO-K *	On chamber South side, alternative for automated venting	Initially closed by blank flange	C
1F12	DN160 ISO-K *	On chamber South side, alternative for manual venting	Initially closed by blank flange	C
1F13	DN160 ISO-K *	On chamber South side, alternative for overpressure burst disk	Initially closed by blank flange	C
1F14	DN160 ISO-K *	On chamber South side, alternative for RGA	Initially closed by blank flange	C
1F15	DN200 ISO-K *	On chamber South-East edge, for illumination of the mirror	Initially closed by blank flange	B
1F16	DN250 ISO-K *	On chamber South-East edge, viewport for monitoring the mirror	Initially closed by blank flange	B
1F17	DN200 ISO-K *	On chamber South-East edge, for illumination of the mirror	Initially closed by blank flange	B
1F18	DN160 ISO-K *	On chamber East side, for automated venting	Initially closed by blank flange	C
1F19	DN160 ISO-K *	On chamber East side, for manual venting	Initially closed by blank flange	C
1F20	DN320 ISO-F *	On chamber East side, for electrical feedthroughs or alternative for TMP	Initially closed by blank flange	B
1F21	DN200 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
1F22	DN200 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
1F23	DN200 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
1F24	DN160 ISO-K *	On chamber East side, for vacuum gauges	Initially closed by blank flange	C
1F25	DN160 ISO-K *	On chamber East side, for overpressure burst disk	Initially closed by blank flange	C
1F26	DN160 ISO-K *	On chamber East side, for RGA	Initially closed by blank flange	C
1F27	DN160 ISO-K *	On chamber East side, for vacuum gauges	Initially closed by blank flange	C
1F28	DN320 ISO-F *	On chamber East side, for TMP	Initially closed by blank flange	B

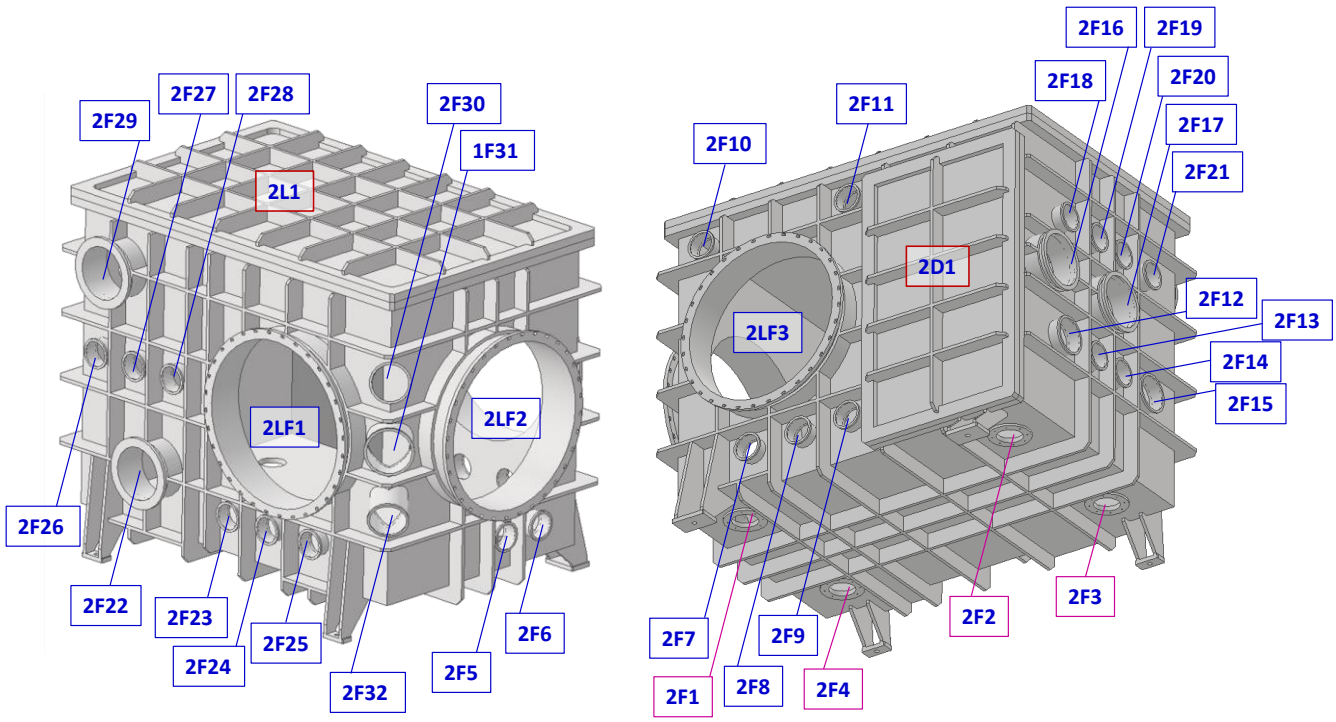
* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.2.2. CH2 vacuum flange schedule

The stainless steel chamber CH2 is similar in shape and size to CH1, with same walls thickness of 15 mm. On the South side the chamber is equipped by hinged door with clear width of 900 mm, allowing easy access to the chamber interior. The upper lid corresponds in size to the chamber footprint; similarly to CH1 it will be used for installation of the internal optical table and of the EMP absorbing structures into the chamber interior.

The net size of the CH2 internal space is 2400 (l) x 1500 (w) x 1850 (h) mm^3. The total weight of the chamber including the upper lid and the side door, without circular flanges, is approximately 5250 kg.



Flange	Size	Position / Purpose	Note	Tolerance
2L1	Rectangular shape, outer size 2570 (l) x 1670 (w) mm, providing clear opening 2400 (h) x 1500 (w) mm, 15 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
2D1	Rectangular shape, outer size 1770 (h) x 1070 (w) mm, providing clear opening 1600 (h) x 900 (w) mm, 15 mm thickness, ribbed	Door on South side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
2LF1	DN1000 ISO-F *	On chamber North side	Sealed by simple O-ring assembly	A

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
2LF2	DN1000 ISO-F *	On chamber West side	Sealed by simple O-ring assembly	A
2LF3	DN1000 ISO-F *	On chamber South side	Sealed by simple O-ring assembly	A
2F1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
2F2	160-mm-diam custom flange	Idem 2F1	Idem 2F1	A
2F3	160-mm-diam custom flange	Idem 2F1	Idem 2F1	A
2F4	160-mm-diam custom flange	Idem 2F1	Idem 2F1	A
2F5	DN160 ISO-K *	On West side, for connection to roughing primary vacuum	Initially closed by blank flange	C
2F6	DN160 ISO-K *	On West side, alternative connection to roughing primary vacuum	Initially closed by blank flange	C
2F7	DN160 ISO-K *	On chamber South side, for automated venting	Initially closed by blank flange	C
2F8	DN160 ISO-K *	On chamber South side, for manual venting	Initially closed by blank flange	C
2F9	DN160 ISO-K *	On chamber South side, alternative for manual venting	Initially closed by blank flange	C
2F10	DN160 ISO-K *	On chamber South side, for overpressure burst disk	Initially closed by blank flange	C
2F11	DN160 ISO-K *	On chamber South side, for plasma cleaning device	Initially closed by blank flange	C
2F12	DN200 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
2F13	DN160 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
2F14	DN160 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
2F15	DN200 ISO-K *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
2F16	DN320 ISO-K *	On chamber East side, for illumination of the interior	Initially closed by blank flange	B
2F17	DN320 ISO-K *	On chamber East side, for alignment purposes or diagnostics of retro-reflected beam	Initially closed by blank flange	B
2F18	DN160 ISO-K *	On chamber East side, contingency flange	Will be blanked	C

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
2F19	DN160 ISO-K *	On chamber East side, contingency flange	Will be blanked	C
2F20	DN160 ISO-K *	On chamber East side, contingency flange	Will be blanked	C
2F21	DN160 ISO-K *	On chamber East side, contingency flange	Will be blanked	C
2F22	DN320 ISO-F *	On chamber North side, alternative for TMP	Initially closed by blank flange	B
2F23	DN160 ISO-K *	On chamber North side, alternative for automated venting	Initially closed by blank flange	C
2F24	DN160 ISO-K *	On chamber North side, contingency flange	Will be blanked	C
2F25	DN160 ISO-K *	On chamber North side, contingency flange	Will be blanked	C
2F26	DN160 ISO-K *	On chamber North side, for vacuum gauges	Initially closed by blank flange	C
2F27	DN160 ISO-K *	On chamber East side, for vacuum gauges	Initially closed by blank flange	C
2F28	DN160 ISO-K *	On chamber East side, for RGA	Initially closed by blank flange	C
2F29	DN320 ISO-F *	On chamber North side, for TMP	Initially closed by blank flange	B
2F30	DN200 ISO-K *	On chamber North-West edge, for illumination of the mirror	Initially closed by blank flange	B
2F31	DN250 ISO-K *	On chamber North-West edge, viewport for monitoring the mirror	Initially closed by blank flange	B
2F32	DN200 ISO-K *	On chamber North-West edge, for illumination of the mirror	Initially closed by blank flange	B

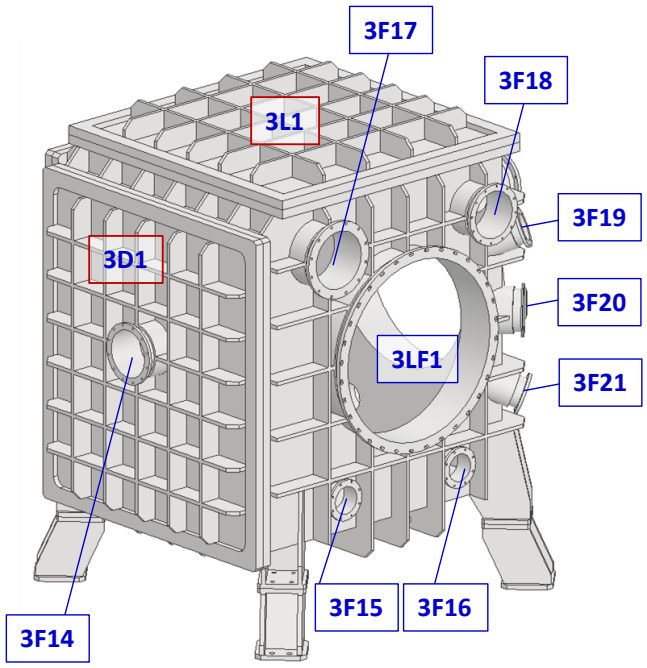
* or equivalent solution

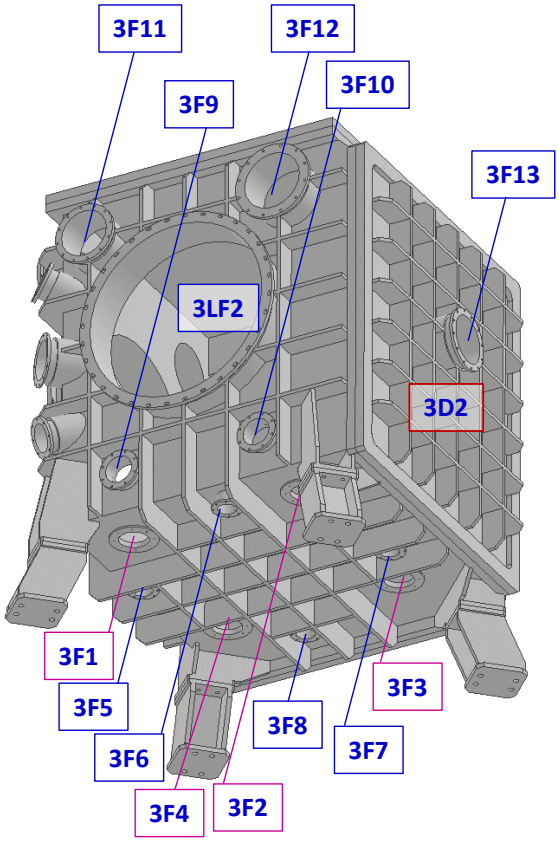
2.2.3. CH3 vacuum flange schedule

The chamber CH3 is designed as aluminium ribbed structure with thickness of the walls of 20 mm. On the South and West side the chamber is equipped by end door with size corresponding approximately to the chamber section. The upper lid will be used for Installation of the internal optical table and of the EMP absorbing structures into the chamber interior.

The net size of the CH3 internal space is 1720 (l) x 1720 (w) x 1880 (h) mm^3. The total weight of the chamber including the top lid and the side doors, without circular flanges, is approximately 2100 kg.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY





Flange	Size	Position / Purpose	Note	Tolerance
3L1	Square shape, outer size 1670 x 1670 mm, providing clear opening 1500 x 1500 mm, 20 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
3D1	Rectangular shape, outer size 1830 (h) x 1670 (w) mm, providing clear opening 1660 (h) x 1500 (w) mm, 20 mm thickness, ribbed	Door 1 on South side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
3D2	Rectangular shape, outer size 1830 (h) x 1670 (w) mm, providing clear opening 1660 (h) x 1500 (w) mm, 20 mm thickness, ribbed	Door 2 on West side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
3LF1	DN1000 ISO-F *	On chamber East side	Sealed by simple O-ring assembly	A

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
3LF2	DN1000 ISO-F *	On chamber North side	Sealed by simple O-ring assembly	A
3F1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
3F2	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
3F3	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
3F4	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
3F5	DN100 ISO-F *	On chamber underside, for connection to roughing primary vacuum	Initially closed by blank flange	C
3F6	DN100 ISO-F *	On chamber underside, alternative for connection to roughing primary vacuum	Initially closed by blank flange	C
3F7	DN100 ISO-F *	On chamber underside, for manual venting	Initially closed by blank flange	C
3F8	DN100 ISO-F *	On chamber underside, for automated venting	Initially closed by blank flange	C
3F9	DN160 ISO-F *	On chamber North side, for vacuum gauges	Initially closed by blank flange	C
3F10	DN160 ISO-F *	On chamber North side, for vacuum gauges	Initially closed by blank flange	C
3F11	DN250 ISO-F *	On chamber North side, for plasma cleaning device	Initially closed by blank flange	B
3F12	DN320 ISO-F *	On chamber North side, alternative for TMP	Initially closed by blank flange	B
3F13	DN250 ISO-F *	On Door D2 on West side, for alignment purposes	Initially closed by blank flange	B
3F14	DN250 ISO-F *	On Door D1 on South side, for alignment purposes or diagnostics of retro-reflected beam	Initially closed by blank flange	B
3F15	DN160 ISO-F *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
3F16	DN160 ISO-F *	On chamber East side, for electrical feedthroughs	Initially closed by blank flange	C
3F17	DN320 ISO-F *	On chamber East side, for TMP	Initially closed by blank flange	B
3F18	DN250 ISO-F *	On chamber East side, for RGA	Initially closed by blank flange	B
3F19	DN160 ISO-F *	On chamber North-East edge, for illumination of the mirror	Initially closed by blank flange	B

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

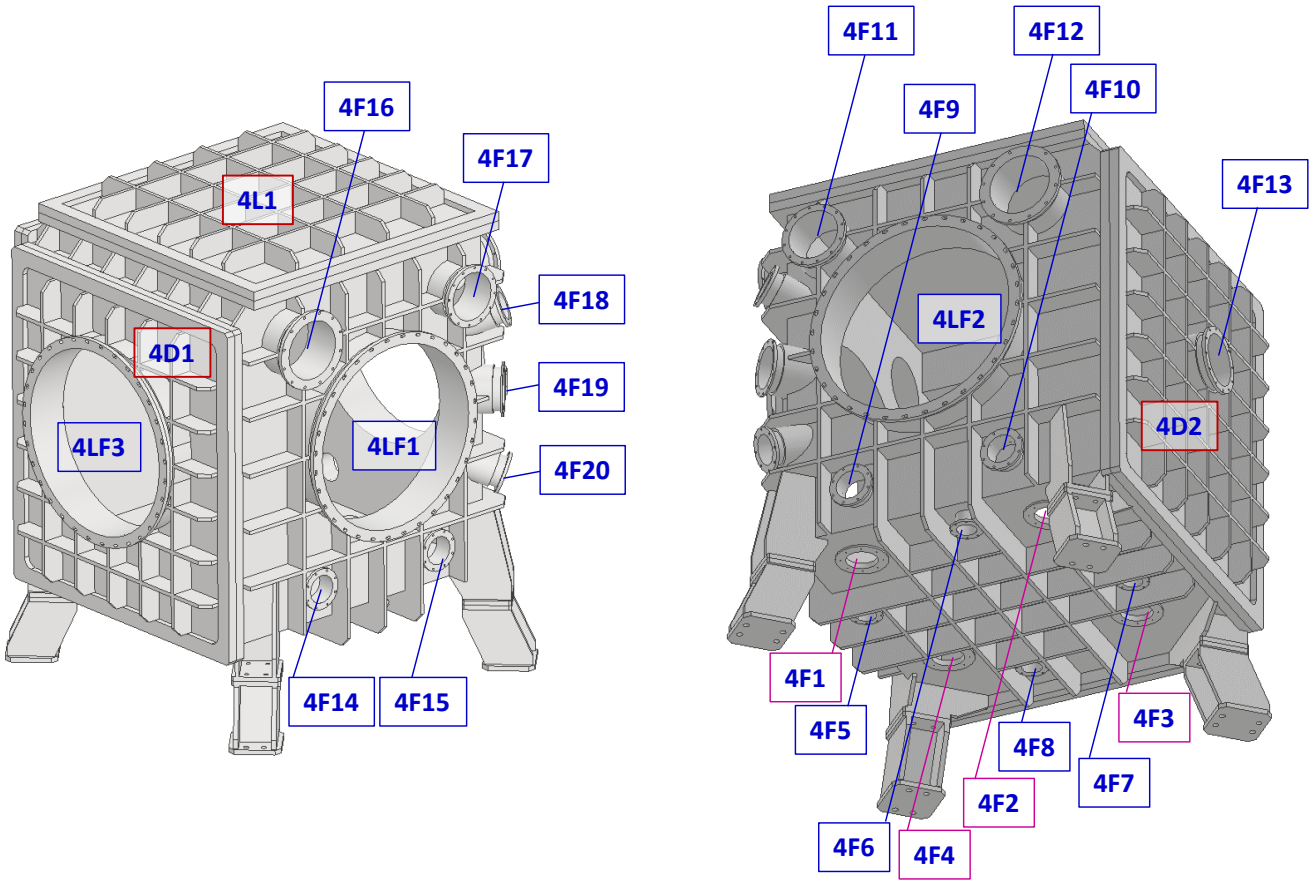
Flange	Size	Position / Purpose	Note	Tolerance
3F20	DN200 ISO-F *	On chamber North-East edge, viewport for monitoring the mirror	Initially closed by blank flange	B
3F21	DN160 ISO-F *	On chamber North-East edge, for illumination of the mirror	Initially closed by blank flange	B

* or equivalent solution

2.2.4. CH4 vacuum flange schedule

The chamber CH4 is identical in design to CH3. The chamber will be oriented in space so that the doors will be on the East and North side. The only difference with respect to CH3 is the North side door which is equipped by DN1000 ISO-F large flange.

The net size of the CH4 internal space is the same as for CH3, i.e. 1720 (l) x 1720 (w) x 1880 (h) mm^3. The total weight of the chamber including the top lid and the side doors, without circular flanges, is approximately 2070 kg (difference from CH3 is given by the DN1000 flange on the side door).



FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
4L1	Square shape, outer size 1670 x 1670 mm, providing clear opening 1500 x 1500 mm, 20 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
4D1	Rectangular shape, outer size 1830 (h) x 1670 (w) mm, providing clear opening 1660 (h) x 1500 (w) mm, 20 mm thickness, ribbed	Door 1 on North side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
4D2	Rectangular shape, outer size 1830 (h) x 1670 (w) mm, providing clear opening 1660 (h) x 1500 (w) mm, 20 mm thickness, ribbed	Door 2 on East side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
4LF1	DN1000 ISO-F *	On chamber West side	Sealed by simple O-ring assembly	A
4LF2	DN1000 ISO-F *	On chamber South side	Sealed by simple O-ring assembly	A
4LF3	DN1000 ISO-F *	On door D1, on chamber North side	Sealed by simple O-ring assembly	A
4F1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
4F2	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
4F3	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
4F4	160-mm-diam custom flange	Idem 3F1	Idem 3F1	A
4F5	DN100 ISO-F *	On chamber underside, alternative for connection to roughing primary vacuum	Initially closed by blank flange	C
4F6	DN100 ISO-F *	On chamber underside, for connection to roughing primary vacuum	Initially closed by blank flange	C
4F7	DN100 ISO-F *	On chamber underside, for manual venting	Initially closed by blank flange	C
4F8	DN100 ISO-F *	On chamber underside, for automated venting	Initially closed by blank flange	C

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
4F9	DN160 ISO-F *	On chamber South side, for electrical feedthroughs	Initially closed by blank flange	C
4F10	DN160 ISO-F *	On chamber South side, for electrical feedthroughs	Initially closed by blank flange	C
4F11	DN250 ISO-F *	On chamber South side, for RGA	Initially closed by blank flange	B
4F12	DN320 ISO-F *	On chamber South side, for TMP	Initially closed by blank flange	B
4F13	DN250 ISO-F *	On Door D2 on East side, for alignment purposes	Initially closed by blank flange	B
4F14	DN160 ISO-F *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
4F15	DN160 ISO-F *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
4F16	DN320 ISO-F *	On chamber West side, alternative for TMP	Initially closed by blank flange	B
4F17	DN250 ISO-F *	On chamber West side, for plasma cleaning device	Initially closed by blank flange	B
4F18	DN160 ISO-F *	On chamber North-West edge, for illumination of the mirror	Initially closed by blank flange	B
4F19	DN200 ISO-F *	On chamber North-West edge, viewport for monitoring the mirror	Initially closed by blank flange	B
4F20	DN160 ISO-F *	On chamber North-West edge, for illumination of the mirror	Initially closed by blank flange	B

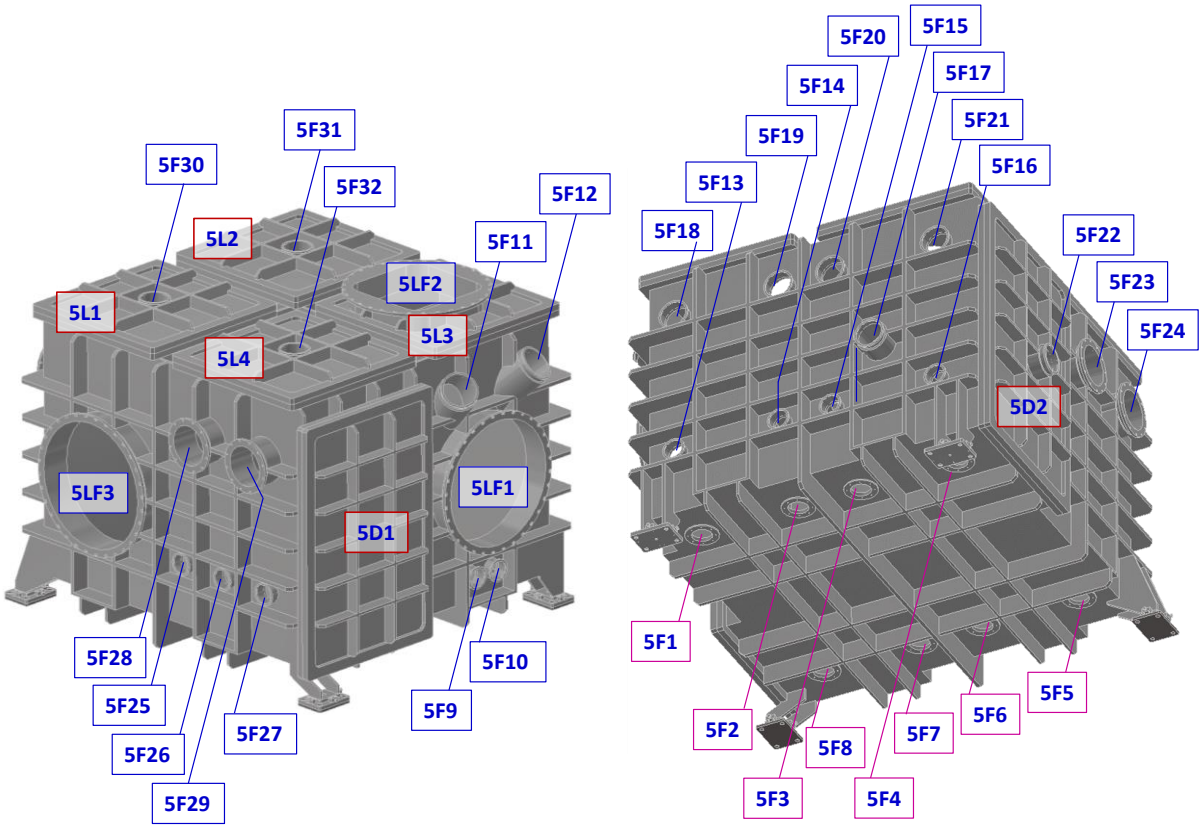
* or equivalent solution

2.2.5. CH5 vacuum flange schedule

The chamber CH5 is designed as stainless steel ribbed structure with thickness of the walls of 20 mm. On the North and South side the chamber is equipped by hinged doors both with clear width of 1150 mm, which will serve to installation of the internal optical tables and for personnel access into the chamber interior. The chamber has also four upper lids which will be used for installation of the EMP absorbing structures; one of these lids is equipped with a DN1000 ISO-F flange for the vacuum tubing segment TS5 connecting CH5 with the CH6 suspended chamber.

The net size of the CH5 internal space is 2,650 (l) x 2,600 (w) x 1,870 (h) mm^3. The total weight of the chamber, including the upper lids and the doors, without circular flanges, is approximately 12,100 kg. The chamber body weight without lids, doors and flanges is however 8,720 kg, which provides sufficient margin for lids and door covers and transporting envelope / transport pallet to get within the 10 tons capacity of the cargo elevator of ELI-Beamlines.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY



Flange	Size	Position / Purpose	Note	Tolerance
5L1	Rectangular shape, outer size 1320 x 1350 mm, providing clear opening 1120 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
5L2	Rectangular shape, outer size 1320 x 1350 mm, providing clear opening 1120 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Idem 5L1	N.A.
5L3	Rectangular shape, outer size 1320 x 1350 mm, providing clear opening 1120 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Lid with DN1000 flange for laser beam, for crane access to interior and for EMP absorption panels installation	Idem 5L1	N.A.
5L4	Rectangular shape, outer size 1320 x 1350 mm, providing clear opening 1120 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Lid for crane access to interior of the chamber and for EMP absorption panels installation	Idem 5L1	N.A.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
5D1	Rectangular shape, outer size 2050 (h) x 1350 (w) mm, providing clear opening 1850 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Door on North side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
5D2	Rectangular shape, outer size 2050 (h) x 1350 (w) mm, providing clear opening 1850 (h) x 1150 (w) mm, 20 mm thickness, ribbed	Door on South side of the chamber For access to the chamber interior and to internal optomechanics	Idem 5D1	N.A.
5LF1	DN1000 ISO-F *	On chamber North side, next to door 5D1	Sealed by simple O-ring assembly	A
5LF2	DN1000 ISO-F *	On chamber upper side, on lid 5L3	Sealed by simple O-ring assembly	A
5LF3	DN1000 ISO-F *	On chamber East side	Sealed by simple O-ring assembly	A
5F1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
5F2	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F3	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F4	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F5	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F6	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F7	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F8	160-mm-diam custom flange	Idem 5F1	Idem 5F1	A
5F9	DN160 ISO-K *	On chamber North side, for connection to roughing primary vacuum	Initially closed by blank flange	C
5F10	DN160 ISO-K *	On chamber North side, contingency for connection to roughing primary vacuum	Initially closed by blank flange	C
5F11	DN250 ISO-K *	On chamber North side, for illumination of the mirror	Initially closed by blank flange	B
5F12	DN250 ISO-K *	On chamber North side, viewport for monitoring the mirror	Initially closed by blank flange	B
5F13	DN160 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
5F14	DN160 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
5F15	DN160 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
5F16	DN160 ISO-K *	On chamber West side, for electrical feedthroughs	Initially closed by blank flange	C
5F17	DN200 ISO-K *	On chamber West side, for visual inspection	Initially closed by blank flange	B
5F18	DN200 ISO-K *	On chamber West side, for overpressure burst disk	Initially closed by blank flange	C
5F19	DN200 ISO-K *	On chamber West side, for vacuum gauges	Initially closed by blank flange	C
5F20	DN200 ISO-K *	On chamber West side, for vacuum gauges	Initially closed by blank flange	C
5F21	DN200 ISO-K *	On chamber West side, for illumination of the chamber interior	Initially closed by blank flange	C
5F22	DN200 ISO-K *	On chamber South side, on door 5D2, for visual inspection	Initially closed by blank flange	B
5F23	DN320 ISO-F *	On chamber South side, alternative for TMP	Initially closed by blank flange	B
5F24	DN320 ISO-K *	On chamber South side, for plasma cleaning device	Initially closed by blank flange	C
5F25	DN160 ISO-K *	On chamber East side, contingency for automated venting	Initially closed by blank flange	C
5F26	DN160 ISO-K *	On chamber East side, contingency for manual venting	Initially closed by blank flange	C
5F27	DN160 ISO-K *	On chamber East side, contingency for manual venting	Initially closed by blank flange	C
5F28	DN320 ISO-F *	On chamber East side, for TMP	Initially closed by blank flange	B
5F29	DN320 ISO-K *	On chamber East side, for RGA	Initially closed by blank flange	B
5F30	DN200 ISO-K *	On top lid 5L1, for alternative use	Will be blanked	C
5F31	DN200 ISO-K *	On top lid 5L2, for alternative use	Will be blanked	C
5F32	DN200 ISO-K *	On top lid 5L3, for alternative use	Will be blanked	C

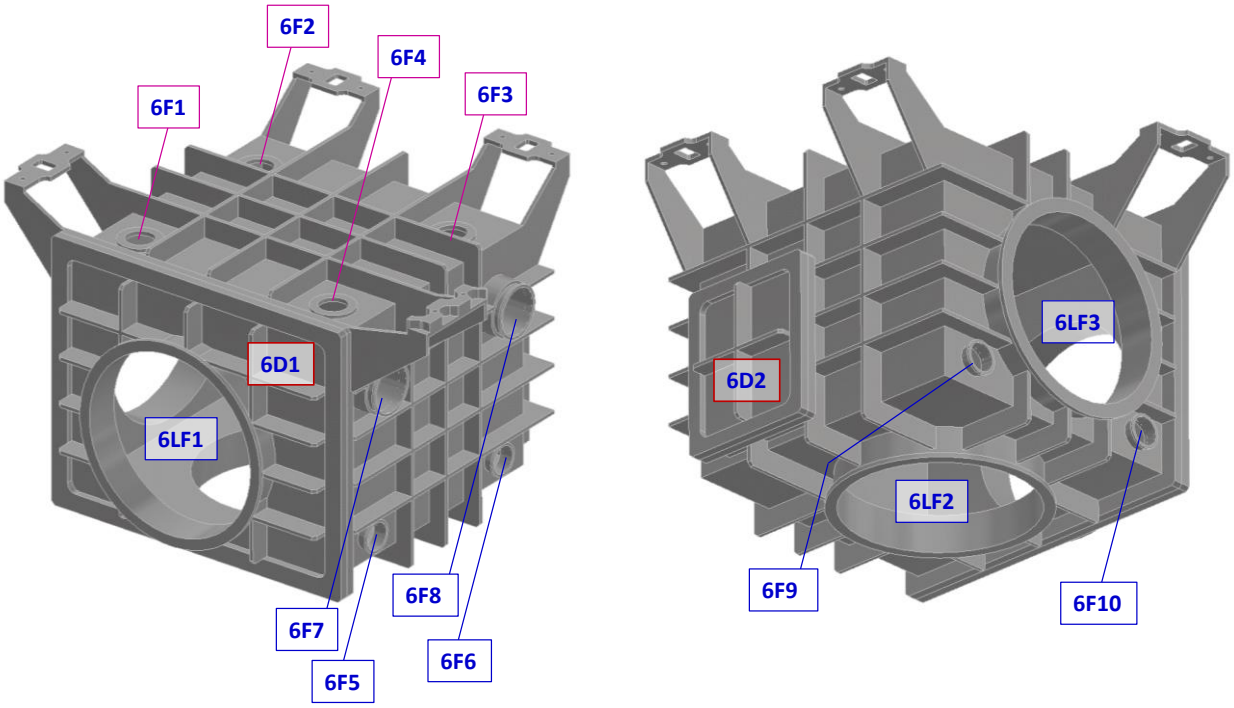
* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.2.6. CH6 vacuum flange schedule

The chamber CH6 is designed as stainless steel ribbed structure with thickness of the walls of 15 mm. It will be suspended on the structural concrete ceiling of the L4c hall of ELI-Beamlines. On the East side the chamber is equipped by hinged end door with size corresponding to the chamber section, which will serve to installation of the internal optomechanical structures. On the West side CH6 has another smaller hinged door with width 600 mm for local access to the chamber interior. The chamber CH6 will not be equipped by EMP shielding units.

The net size of the CH6 internal space is 1,600 (l) x 1,550 (w) x 1,300 (h) mm^3. The total weight of the chamber, including the upper lids and the doors, without circular flanges, is approximately 3,270 kg.



Flange	Size	Position / Purpose	Note	Tolerance
6D1	Rectangular shape, outer size 1500 (h) x 1800 (w) mm, providing clear opening 1300 (h) x 1600 (w) mm, 15 mm thickness, ribbed	Door 1 on East side of the chamber For access to the chamber interior and for installation of internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
6D2	Rectangular shape, outer size 875 (h) x 750 (w) mm, providing clear opening 725 (h) x 600 (w) mm, 15 mm thickness, ribbed	Door 2 on West side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
6LF1	DN1000 ISO-F *	On door 6D1, on chamber East side	Sealed by simple O-ring assembly	A

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
6LF2	DN1000 ISO-F *	On chamber West side	Sealed by simple O-ring assembly	A
6F1	160-mm-diam custom flange	On chamber upper side, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
6F2	160-mm-diam custom flange	Idem 6F1	Idem 6F1	A
6F3	160-mm-diam custom flange	Idem 6F1	Idem 6F1	A
6F4	160-mm-diam custom flange	Idem 6F1	Idem 6F1	A
6F5	DN160 ISO-K *	On chamber North side, for plasma cleaning device	Initially closed by blank flange	C
6F6	DN160 ISO-K *	On chamber North side, for overpressure burst disk	Initially closed by blank flange	C
6F7	DN250 ISO-K *	On chamber North side, for electrical feedthroughs	Initially closed by blank flange	C
6F8	DN250 ISO-F *	On chamber North side, for electrical feedthroughs	Initially closed by blank flange	C
6F9	DN160 ISO-K *	On chamber South side, for illumination of the mirror	Initially closed by blank flange	B
6F10	DN160 ISO-K *	On chamber South side, viewport for monitoring the mirror	Initially closed by blank flange	B

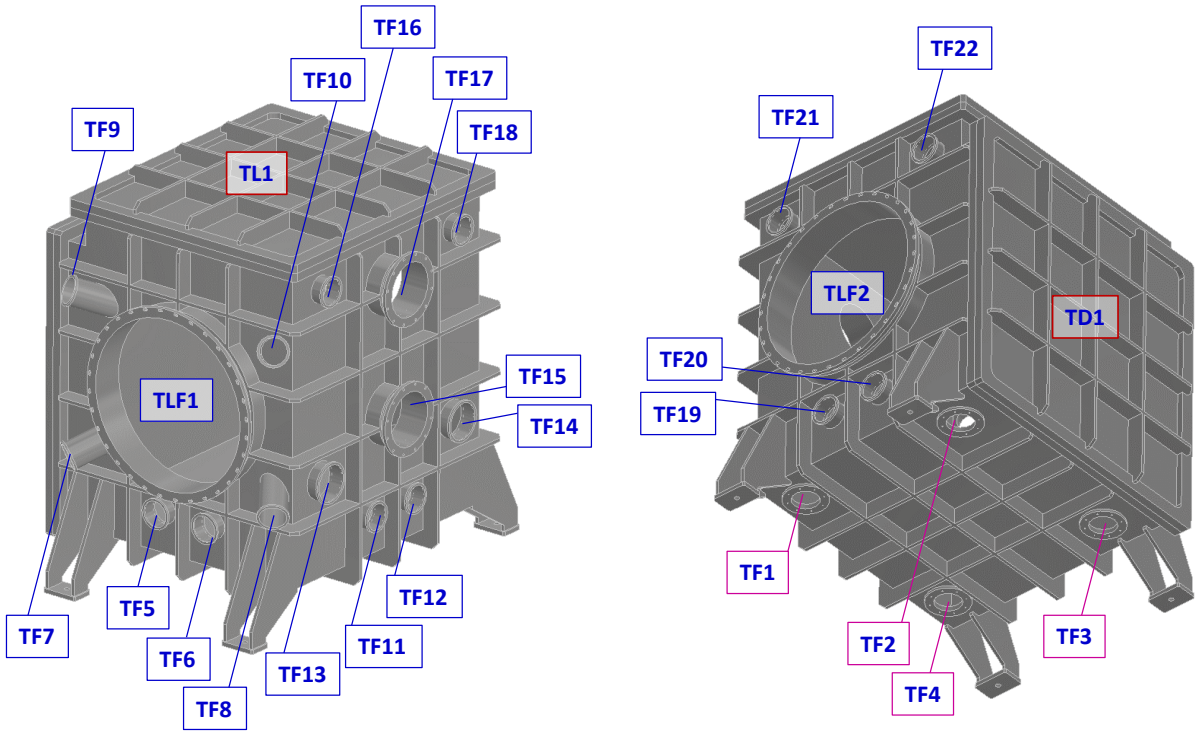
* or equivalent solution

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.2.7. CH-DT vacuum flange schedule

The chamber CH-DT is a stainless steel ribbed structure with thickness of the walls of 15 mm. On the North side, the chamber is equipped by hinged door with size corresponding approximately to the chamber section, which will provide unobstructed access to the chamber interior. The upper lid will be used to installation of the internal optical table and of the optomechanics. The chamber CH6 will not be equipped by EMP shielding units.

The net size of the CH6 internal space is 1,590 (l) x 1,500 (w) x 1,865 (h) mm^3. The total weight of the chamber, including the upper lid and the side door, without circular flanges, is approximately 4,023kg.



Flange	Size	Position / Purpose	Note	Tolerance
TL1	Square shape, outer size 1570 x 1670 mm, providing clear opening 1400 x 1500 mm, 15 mm thickness, ribbed	Lid for crane access to interior of the chamber	Sealed by double O-ring assembly with pumped interspace. Equipped by threads M16 for lifting eyes for manipulation by overhead crane or by other lifting device.	N.A.
TD1	Rectangular shape, outer size 1845 (h) x 1670 (w) mm, providing clear opening 1675 (h) x 1500 (w) mm, 15 mm thickness, ribbed	Door on North side of the chamber For access to the chamber interior and to internal optomechanics	Sealed by double O-ring assembly with pumped interspace Equipped by hinges (possibility of mounting on both sides) Equipped by threads M16 for lifting eyes for manipulation	N.A.
TLF1	DN1000 ISO-F *	On chamber West side	Sealed by simple O-ring assembly	A

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
TLF2	DN1000 ISO-F *	On chamber East side	Sealed by simple O-ring assembly	A
TF1	160-mm-diam custom flange	On chamber underside, for connection of bellows isolation of the internal optical table	Tapped holes for connection with the isolation bellows, see Drawing Package. Initially closed by blank flange.	A
TF2	160-mm-diam custom flange	Idem TF1	Idem TF1	A
TF3	160-mm-diam custom flange	Idem TF1	Idem TF1	A
TF4	160-mm-diam custom flange	Idem TF1	Idem TF1	A
TF5	DN160 ISO-K *	On chamber West side, connection to roughing primary vacuum	Initially closed by blank flange	C
TF6	DN160 ISO-K *	On chamber West side, alternative for connection to roughing primary vacuum	Initially closed by blank flange	C
TF7	DN160 ISO-K *	On chamber West side, alternative viewport for monitoring the mirror	Initially closed by blank flange	B
TF8	DN160 ISO-K *	On chamber West side, alternative for illumination of the mirror	Initially closed by blank flange	B
TF9	DN160 ISO-K *	On chamber West side, viewport for monitoring the mirror	Initially closed by blank flange	B
TF10	DN160 ISO-K *	On chamber West side, for illumination of the mirror	Initially closed by blank flange	B
TF11	DN160 ISO-K *	On chamber South side, for automated venting	Initially closed by blank flange	C
TF12	DN160 ISO-K *	On chamber South side, for manual venting	Initially closed by blank flange	C
TF13	DN200 ISO-K *	On chamber South side, for electrical feedthroughs	Initially closed by blank flange	C
TF14	DN200 ISO-K *	On chamber South side, for electrical feedthroughs	Initially closed by blank flange	C
TF15	DN320 ISO-F *	On chamber South side, alternative for TMP	Initially closed by blank flange	B
TF16	DN160 ISO-K *	On chamber South side, for plasma cleaning device	Initially closed by blank flange	C
TF17	DN320 ISO-F *	On chamber South side, for TMP	Initially closed by blank flange	B
TF18	DN160 ISO-K *	On chamber South side, for overpressure burst disk	Initially closed by blank flange	C

* or equivalent solution

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Flange	Size	Position / Purpose	Note	Tolerance
TF19	DN160 ISO-K *	On chamber East side, contingency	Initially closed by blank flange	C
TF20	DN160 ISO-K *	On chamber East side, contingency	Initially closed by blank flange	C
TF21	DN160 ISO-K *	On chamber East side, for vacuum gauges	Initially closed by blank flange	C
TF22	DN160 ISO-K *	On chamber East side, for vacuum gauges	Initially closed by blank flange	C

* or equivalent solution

2.3. Vacuum Tubing Segments (TS)

The tubing segments TS0, TS1, TS2A, TS2C, TS3, TS4, and TSDT will consist of round tubes; the segments TS2B and TS5 will be rectangular. The end flanges of all segments will be DN1000 ISO-F (see Figure 4), or equivalent. Each of the tubing segments TSDT and TS3 consists of two tubes, the individual tubes being supported by their own supports (chassis).

All round tubing segments shall be equipped on the top by round lumps with threads M16 for lifting eyes to be used during installation and/or manipulation. Selected segments, as indicted in Table 3, shall be equipped with legs for their mounting on the support chassis. The facing plates on the support chassis shall be equipped by adjustment bolts for fine positioning of the segments.

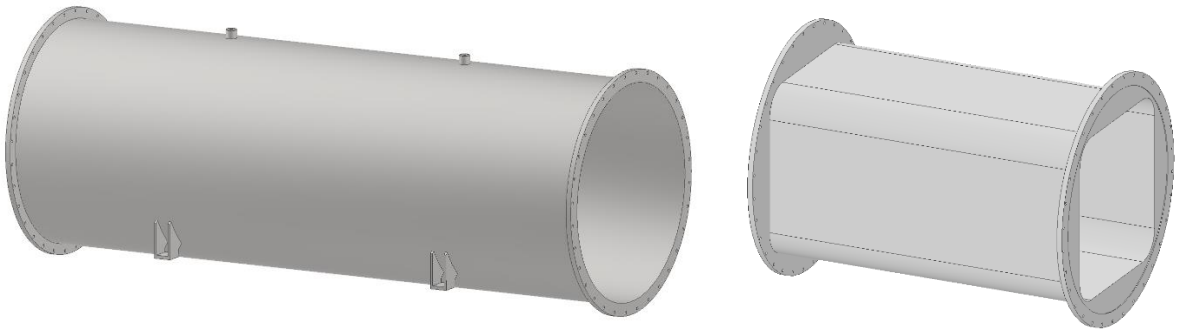


Figure 5: Examples of the stainless steel vacuum tubing segments (TS1 and TS5). Lumps with threads for lifting yes and legs interfacing with the supporting chassis are seen on the TS1 segment.

The tubing segments TS3 and TS4 are designed to accommodate internal EMP absorbing structures in order to reduce essentially intensity of the high-frequency electromagnetic radiation propagating from the interaction chamber. The internal diameter of these segments is therefore 1200 mm internal diameter to provide adequate space for the absorbing panels. The tubing segment TS3 consists of two tubes each with DN1000 ISO-F (or equivalent) flange on one end and with a custom flange with diameter 1200 mm on the other end, see Figure 6; the large custom flanges will serve for insertion of the absorbing structures into the tubes. Insertion of the absorbing structure into TS4 will be made by removing a reducer 1200 mm-to-DN1000-ISO-F (or equivalent), attached to one end of the segment.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

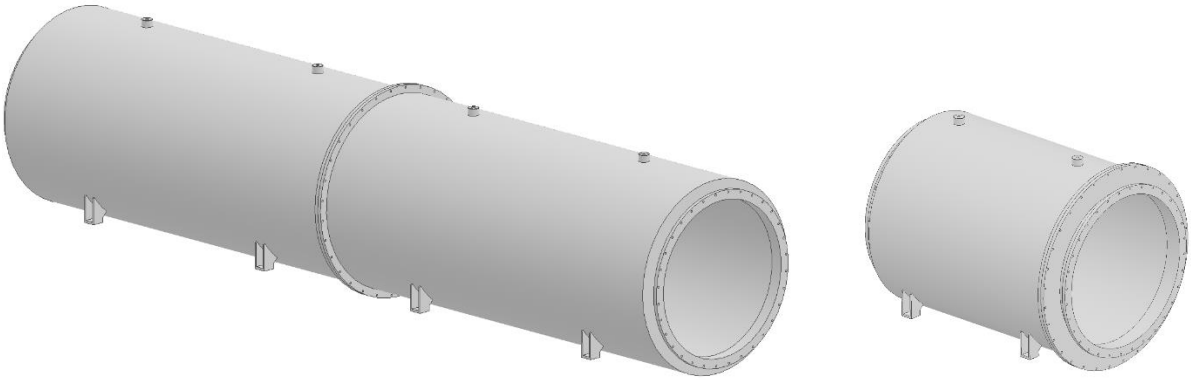


Figure 6: Tubing segments TS3 and TS4, with the internal diameter 1,200 mm. The TS4 is equipped by removable end reducer for insertion of the EMP absorption module.

The essential parameters of the individual tubing segments are in Table 3. The Supplier shall verify by FEM simulations the deformations of the segments under the vacuum pressure differential. The Supplier is allowed to modify thickness of the tube walls, provided that deformations will not exceed 1 mm anywhere on the tube.

Table 3: List of the Tubing Segments and their parameters.

Tubing Segment No	Type	Material	Length (mm)	Note
TS0	Round	Stainless steel	618	1000 mm internal diameter, 10 mm wall thickness, mounted on L4 compressor structure, without supporting chassis
TS1	Round	Stainless steel	2,906	1000 mm internal diameter, 10 mm wall thickness, supported by chassis
TS2A	Round	Stainless steel	3,290	1000 mm internal diameter, 10 mm wall thickness, supported by chassis
TS2B	Rectangular	Stainless steel	1,500	750x750 mm internal size, 15 mm wall thickness, without supporting chassis
TS2C	Round	Stainless steel	969	1000 mm internal diameter, 10 mm wall thickness, without supporting chassis
TS3	Round with internal EMP absorbers	Aluminum alloy	5,736	Consisting of two tubes each 2,868 mm, connected by custom flanges with O-ring in a groove Internal diameter 1,200 mm, 15 mm wall thickness Each tube supported by chassis
TS4	Round with internal EMP absorbers	Aluminum alloy	1,688	Internal diameter 1,200 mm, 15 mm wall thickness, at one end removable reduction flange to DN1000 Supported by chassis
TS5	Rectangular	Stainless steel	1,532	750x750 mm internal size,15 mm wall thickness, suspended on CH6
TSDT	Round	Stainless steel	1,598 + 568	1000 mm internal diameter, 10 mm wall thickness, composed from two segments (1598 mm and 568 mm), each supported by chassis
TAP3	Round	Aluminium alloy		Consists of a panel 2295 (h) x 1500 (w) mm^2 with thickness of 60 mm, with DN1000 ISO-F (or equivalent) flange extending under an angle of 22.30° with respect to the normal to the surface of the panel

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.4. Tubing Segments Supports

The tubing segment supports (TSS) will consist of welded chassis that will be equipped by adjustable legs to allow fine height setting. The profiles used for the chassis body will be from the same material as the supported tubing segment.

Figure 7: Conceptual design of the tubing segment supporting chassis (example of TSS1). The mounting plates on the top of the chassis shall be equipped with adjustment bolts making possible fine-tuning of the position / orientation of the tubing segment.

The tubing segments legs will be mounted on the plates located on top of the chassis. The plates will be equipped by adjustment side bolts for accurate horizontal positioning of the tube. The Supplier shall develop design of this adjustment positioning system, based on the conceptual design provided by CA.

2.5. Electromagnetic pulse (EMP) absorbers

REDACTED

Figure 8: REDACTED

REDACTED

Figure 9: REDACTED

REDACTED

Figure 10: REDACTED

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

2.6. Tubing Adaptor to P3 chamber (TAP3)

The tubing adaptor to the P3 chamber (TAP3) serves to interconnect the DN1000 ISO-F (or equivalent) tubing with the chamber. The adaptor consists of a panel 2295 (h) x 1500 (w) mm^2 with thickness of 60 mm, with DN1000 ISO-F (or equivalent) flange extending under an angle of 22.30° with respect to the normal to the surface of the panel. The adaptor shall be made from aluminium alloy 5083.

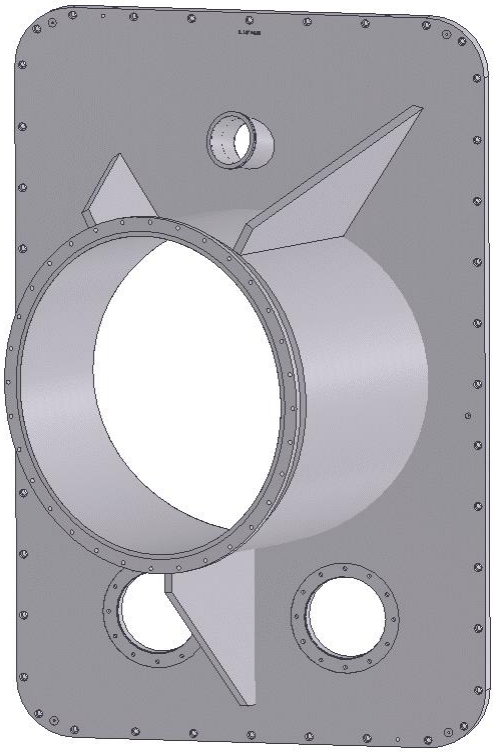


Figure 11: Tubing Adaptor to the P3 chamber (TAP3).

The panel is sealed to the P3 chamber by double O-ring with pumped interspace, according to the provided documentation (differently from the beam transport chambers, pumping of the O-rings interspace is made from the side of the TAP3 panel). The neck of the DN1000 ISO-F (or equivalent) flange is reinforced by three ribs for stiffness. Additionally to this flange, the panel is equipped in its lower part by interface to two DN250 ISO-F (or equivalent) flanges, and by one DN150 ISO-F (or equivalent) flange in the upper part.

Based on the conceptual design provided by CA, the Supplier shall develop design of the DN16 ISO-KF (or equivalent) flanges for pumping the interspace between the O-rings. The Supplier shall also elaborate design of the lifting eyes for manipulation of TAP3 by overhead crane.

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

3. Terms, Definitions and Abbreviations

For the purpose of this document, the following abbreviated terms are applied:

Abbreviation	Meaning
A	Analysis (as a verification method)
AMU	Atomic Mass Unit
BT	Beam Transport
CA	Contracting Authority (Institute of Physics CAS, FZU in Czech)
CDA	Compressed Dry Air
CH	(CH1 – CH6) BT chambers
CH-DT	Chamber – Diagnostic Telescope
DN	Diameter Nominal (for vacuum flanges)
ELI	Extreme Light Infrastructure
EMP	ElectroMagnetic Pulse
FEM / FEA	Finite Element Method / Finite Element Analysis
FTR	Factory Test Report
I	Inspection (as a verification method)
ISO	International Organization for Standardization
ISO-KF	Type of vacuum flanges
ISO-F	Type of vacuum flanges
L4	Identification code of ELI-Beamlines laser
L4c, E3	Identification code of ELI-Beamlines hall
NCR	Nonconformity Report
NVR	Non-Volatile Residue
PE	Polyester
RA1	Research activity 1
RGA	Residual Gas Analyzer
RSD	Requirements Specification Document
SEM	Secondary Electron Multiplier
SIR	on-Site Inspection Report
T	Test (as a verification method)
TAP3	Tubing Adaptor for P3 chamber
TC ID	Team Center IDentifier (unique identifier number)
TS	Tubing Segment
TSDT	Tubing Segment Diagnostic Telescope
TSS	Tubing Segment Support
TSSD	Tubing Segment Support Diagnostic
TMP	TurboMolecular Pump
UHV	Ultra High Vacuum
VCD	Verification Control Document

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Abbreviation	Meaning
VR	Verification Report

3.1. Reference Documents

Number of document	Title of Document/ File
RD-01	Drawing package L4 10PW Laser Beam Distribution Vacuum Infrastructure

Detailed list of documentation included within **RD-01 archive**:

Drawing No	Filename	File format
057-42 CH6	057-42 CH6.pdf	PDF
057-54 CH1	057-54 CH1.pdf	PDF
057-79 CH5	057-79 CH5.pdf	PDF
057-85 CH2	057-85 CH2.pdf	PDF
057-88 CH3	057-88 CH3.pdf	PDF
057-90 L410PW-CH2 assy	057-90 L410PW-CH2 assy.pdf	PDF
057-92 CH4	057-92 CH4.pdf	PDF
057-100 L410PW-CH3 assy	057-100 L410PW-CH3 assy.pdf	PDF
057-121 CH-DT	057-121 CH-DT.pdf	PDF
057-123 TAP3	057-123 TAP3.pdf	PDF
057-124 TSDT + TSSD Section 2	057-124 TSDT + TSSD Section 2.pdf	PDF
060-04 TS0	060-04 TS0.pdf	PDF
060-05 TS5	060-05 TS5.pdf	PDF
060-11 TS1+TSS1	060-11 TS1+TSS1.pdf	PDF
060-13 TS2B	060-13 TS2B.pdf	PDF
060-14 TS2C	060-14 TS2C.pdf	PDF
060-15 TS2A+TSS2	060-15 TS2A+TSS2.pdf	PDF
060-16 TS3+TSS3	060-16 TS3+TSS3.pdf	PDF
060-19 TS4+TSS4	060-19 TS4+TSS4.pdf	PDF
060-22 TSDT+TSSD	060-22 TSDT+TSSD.pdf	PDF
E floor 2021-07-21	E floor 2021-07-21.pdf	PDF

An overview of the **RD-01** reference drawing related to the L4 10PW Laser Beam Distribution Vacuum Infrastructure is shown in Section 8.

3.2. References to standards

If this document includes references to standards or standardized / standardizing technical documents the CA allows/permits also another equal solution to be offered. If a 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 all the contractual requirements including references to standards or technical documents

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

4. Specific contractual requirements

Following sections of this specification provide a summary of the specific contractual requirements. The total scope of the contract also comprises all the requirements stated or implied in the foregoing text, whether or not included in the summaries.

4.1. Functional, design, material, and manufacture requirements

REQ-032702/A **R1-01**
All elements of the System shall be detail designed and manufactured according to the requirements described herein and in **RD-01** assembly drawings (see also Section 3.1).
Verification method: R - Review of design, T – Test, I – Inspection

REQ-032703/A **R1-02**
For each chamber the Supplier shall design paths (on the outer surface of the chambers) for the utilities, primary backing vacuum and electrical cables for the vacuum elements and for motorized actuators, based on description of purpose of the flanges in Section 2.2.
Verification method: R - Review of design

REQ-032704/A **R1-03**
Based on the approved design of paths for utilities, primary backing vacuum and electrical cables, the Supplier shall develop corresponding design of cable trays and mounting C-rails, as well as holes in the ribs for the utilities and primary backing vacuum.
Verification method: R - Review of design

REQ-032705/A **R1-04**
The Supplier shall develop detail design of double O-ring arrangement for the top lids and side doors, with interspace pumping performed from the chamber flange.
NOTE: Detailed requirements are given in the Chapter 2.1.3.
Verification method: R - Review of design

REQ-032706/A **R1-05**
The Supplier shall develop design of door hinges with double pivot arrangement to avoid crushing the O-rings when closing the door.
Verification method: R - Review of design, T – Test

REQ-032707/A **R1-06**
For each chamber the Supplier shall develop design of the support legs and the floor plates with removable blocks for chamber fine positioning, based on conceptual design provided by CA.
Verification method: R - Review of design, T – Test

REQ-032708/A **R1-07**
For each chamber the Supplier shall develop design of the supporting aluminum structure of the EMP panels, including the system of fixing to the chamber walls.
NOTE: Detailed requirements are given in the Chapter 2.5.1.
Verification method: R - Review of design

REQ-032709/A **R1-08**
The Supplier shall develop design of the tubing segment supports, with the positioning system making possible accurate horizontal positioning of the tubes and fine height setting.
Verification method: R - Review of design

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

REQ-032710/A **R1-09**

The detailed design shall make all necessary allowance for transport of the chambers and tubing segments to their working locations. This shall include provision of designated lifting points and jacking points and positions to support the chambers on rollers for lateral movement. The lids and doors shall also be equipped with lifting features (e.g. bosses for screw-in lifting eyes) to enable their handling by overhead crane. The Supplier shall dimension the lifting features according to relevant safety standards. The used safety standard shall be agreed by the CA.

Verification method: R - Review of design, I – Inspection

REQ-032711/A **R1-10**

All DN1000 ISO-F (or equivalent) flanges shall be manufactured in accordance with Section 2.1.3 of this document.

Verification method: R - Review of design, I – Inspection

REQ-032712/A **R1-11**

All DN1000 ISO-F (or equivalent) flanges on the chambers and on the tubing segments shall have Tolerance Grade "A" (see Section 2.1.4), i.e. co-axial tolerance of ±1 mm or better and angular tolerance of ±0.5 degrees or better with respect to their ideal axis, for reasons of critical geometry.

NOTE: The required tolerance band for each flange is specified in Section 2.2 Vacuum Chambers Flange.

Verification method: R - Review of design, T- Test, I – Inspection

REQ-032713/A **R1-12**

All 160-mm-diameter custom flanges on underside of the chambers shall have Tolerance Grade "A" (see Section 2.1.4), i.e. co-axial tolerance of ±1 mm or better and angular tolerance of ±0.5 degrees or better with respect to their ideal axis, for reasons of critical geometry.

Verification method: R - Review of design, T- Test, I – Inspection

REQ-032714/A **R1-13**

All chambers and vacuum tubing segments shall be designed and manufactured for vacuum level of 10^{-7} mbar or better.

Verification method: R – Review of design, T – Test

REQ-032715/A **R1-14**

For all chambers and tubing segments the Supplier shall perform FEM analysis of the final design to demonstrate structural stability resulting in deformations of walls less than 1 mm upon pump down from atmospheric pressure.

Verification method: R – Review of design, A – Analysis

REQ-032716/A **R1-15**

The Supplier shall provide Certificate of Origin specifying manufacturer and composition of the raw material, and also details of the cast process for all aluminum blanks for CH3, CH4, TS3, TS4, and TAP3.

NOTE: Detailed information is given in the Table 1.

Verification method: R - Review

REQ-032717/A **R1-16**

The outer side of the chambers shall be equipped by welded sections of C-rails as resulting from the design process, see REQ-032704/A **R1-03**.

Verification method: R - Review of design, I – Inspection

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

REQ-032718/A **R1-17**

The outer side of the chambers shall be equipped with mounting points consisting of boss for a corner cube reflector for laser scanning.

Verification method: R - Review of design, I – Inspection

REQ-032719/A **R1-18**

The manufacturing drawings and detailed 3D models for manufacture shall be approved by CA.

Verification method: R - Review of design

REQ-032720/A **R1-19**

All welds will be visually inspected, and protocol for each chamber and tubing segment will be issued.

Verification method: I – Inspection

REQ-032721/A **R1-20**

All testable vacuum welds on the chambers and on the tubing segments will be inspected by ultrasonic probe, and protocol for each chamber and tubing segment will be issued.

Verification method: I – Inspection

REQ-032722/A **R1-21**

All inner vacuum surfaces shall have roughness Ra=0.8 µm or better (i.e. smaller). If grinding is used to achieve this finish, the following rules shall apply:
- prior the grinding the cleaning procedure involving degreasing, rinsing and drying, described in REQ-032729/A **R2-02** (for stainless steel) and REQ-032730/A **R2-03** (for aluminum alloy) shall be used;
- the grinding process shall not involve any abrasive paste or abrasive medium that can embed into the surface.

NOTE: the cleaning procedure described in REQ-032729/A **R2-02** and/or REQ-032730/A **R2-03** *can be complemented, before grinding, by laser cleaning. Details shall be approved in writing by the CA before such procedure is applied.*

Verification method: R - Review of design, I - Inspection

REQ-032723/A **R1-22**

The outer surface of the chambers and of the tubing segments shall be glass bead blasted.

Verification method: R – Review of design, I – Inspection

REQ-032724/A **R1-23**

The surface of tubing segments supports shall be glass bead blasted.

Verification method: R – Review of design, I – Inspection

REQ-032725/A **R1-24**

The Supplier shall check all major dimensions of the manufactured chambers and tubing segments, as defined in the manufacturing drawings approved by CA (see also REQ-032719/A **R1-18**). The result shall be provided in the form of the Factory Test Reports.

Verification method: R – Review, T – Test (M – Measuring)

REQ-033009/A **R1-25**

The Supplier shall dimension the vacuum flanges DN320 ISO-F (or equivalent) assigned to turbomolecular pumps to be able to withstand the torque 75 kNm in the event of a crash of the pump.

Verification method: R – Review of report

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

4.2. Cleaning and vacuum performance testing requirements

REQ-032728/A **R2-01**

Before final treatment on inner vacuum surfaces of each chamber and each tubing segment, especially if grinding is used for surface finish, the Supplier shall invite CA to perform inspection of the surface cleanliness (see REQ-032722/A R1-21).

Verification method: I – Inspection

REQ-032729/A **R2-02**

All finished stainless steel parts of the chambers and tubing segments shall be degreased by thorough cleaning with high pressure hot water jet (>120 bar), using appropriate high-performance detergent (e.g. 2% solution of General Purpose Cleaner/Degreaser mixture of Sodium Tripolyphosphate - 3 - < 5%, Modified Polyether Anionic Surfactant - 1 - < 3%, Non-ionic surfactant 1 - < 3%; pH >11; (5 - 15% - Non-Ionic Surfactants, 1 - 5% - Phosphates, 1 - 5% - Anionic Surfactants) or equivalent), at a temperature between 70°C and 75°C, for no less than 5 minutes /m2. The water jet strokes shall form a cross pattern on the cleaned surface. Subsequently, the parts shall be immediately, without letting the surface to dry, rinsed with hot demineralised water with at least 75°C.

The previous step, i.e. thorough cleaning with high-pressure water with appropriate high-performance detergent, followed by rinsing in demineralised water without letting the surface to dry, shall be repeated.

Subsequently, the parts shall be dried by clean pressure gas (e.g. nitrogen) in a way not leaving traces of residues from water drops.

It is not allowed to use wipes wetted with isopropanol or acetone after completion of the above procedure.

Spraying or flushing of parts of vacuum surfaces by ultraclean acetone (<5ppm evaporation residue) is allowed, provided it does not come into contact with any plastic parts such as squirt bottles or O-rings.

Dry wiping of smooth surfaces with polyester wipes to minimize particle contamination is allowed.

NOTE: Use of specific degreasing solution shall be approved in writing by CA. The CA also permits another equivalent cleaning procedure to be offered, however this shall be approved in writing by the CA.

NOTE: A possible additional step may involve cleaning by laser or by manual electro-polishing with 10% solution of H_3PO_4. If any of these techniques is used, detailed steps of the procedure shall be agreed in writing with CA.

Verification method: R – Review, I – Inspection

REQ-032730/A **R2-03**

All finished aluminium alloy parts of the chambers and tubing segments shall be degreased by thorough cleaning with high pressure hot water jet (>120 bar), using appropriate high-performance detergent (e.g. 2% solution of General Purpose Cleaner/Degreaser mixture of Sodium Tripolyphosphate - 3 - < 5%, Modified Polyether Anionic Surfactant - 1 - < 3%, Non-ionic surfactant 1 - < 3%; pH >11; (5 - 15% - Non-Ionic Surfactants, 1 - 5% - Phosphates, 1 - 5% - Anionic Surfactants) or equivalent), at a temperature between 70°C and 75°C, for no less than 5 minutes /m2. The water jet strokes shall form a cross pattern on the cleaned surface. Subsequently, the parts shall be immediately, without letting the surface to dry, rinsed with hot demineralised water with at least 75°C.

The previous step, i.e. thorough cleaning with high-pressure water with appropriate high-performance detergent, followed by rinsing in demineralised water without letting the surface to dry, shall be repeated.

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE Evropské strukturální a investiční fondy Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Subsequently, the parts shall be dried by clean pressure gas (e.g. nitrogen) in a way not leaving traces of residues from water drops.

In the next step, the walls shall be cleaned with 10% solution of phosphoric acid (H_3PO_4) applied with e.g. polyester (PE) wipes. Within less than 40 seconds the acid has to be removed by clean PE wipes. Immediately after, the walls shall be neutralized by 5% solution of analytical purity sodium bicarbonate ($NaHCO_3$); after approximately 2 minutes the sodium bicarbonate shall be removed by clean PE wipes.

After processing the chamber or tubing segment with the phosphoric acid and sodium bicarbonate, the component has to be rinsed by demineralised water. The rinsing shall be made by low pressure jet (spray).

It is not allowed to use wipes wetted with isopropanol or acetone after completion of the above procedure.

Spraying or flushing of parts of vacuum surfaces by ultraclean acetone (<5ppm evaporation residue) is allowed, provided it does not come into contact with any plastic parts including squirt bottles or O-rings.

Dry wiping of smooth surfaces with polyester wipes to minimize particle contamination is allowed.

NOTE: Use of specific degreasing solution shall be approved in writing by CA. The CA also permits another equivalent cleaning procedure to be offered, however this shall be approved in writing by the CA.

Verification method: R – Review, I - Inspection

REQ-032731/A **R2-04**

All O-rings shall be made from fluoroelastomer and vacuum baked in a clean oven at temperature of 120°C for 48 hours prior to use. After the bake-out, the O-rings shall not come in contact with isopropyl alcohol or any grease.

Verification method: I – Inspection

REQ-032727/A **R2-05**

After final cleaning (REQ-032729/A R2-02 (for stainless steel) and REQ-032730/A R2-03 (for aluminum alloy) the Supplier shall assemble each chamber and each tubing segment in ISO7 (or better cleanliness class), or equivalent, cleanroom and shall vacuum test the assembled chambers and tubing segments with blank flanges, bolting and O-rings which shall be part of the supply. The tests shall be done according to R2-06, R2-07, R2-08.

Note: DN1000 ISO-F blanks flanges used for vacuum testing of one chamber or tubing segment can be re-used for testing another chamber or tubing segment.

Verification method: R – Review, T – Test, I – Inspection

REQ-032732/A **R2-06**

The Supplier shall test the evacuated chambers and tubing segment for deformations due to the atmospheric pressure differential. The measured deformations shall not exceed 1 mm at any location. The result shall be provided in the form of the Factory Test Report.

Verification method: R – Review, T – Test, I – Inspection

REQ-032733/A **R2-07**

The Supplier shall perform vacuum leak test of each chamber and of tubing segment, using a helium leak detector. The measured single leak rate of any flange shall be less than $1x10^{-8}$ mbar·l/sec. The total leakage rate of each chamber shall be less than $1x10^{-3}$ mbar·l/sec. The results shall be provided in the form of the Factory Test Report.

NOTE: It is recommended that the single flange test (helium spray) shall be performed according to ČSN EN 1779, method A.3 , and the test of total leakage according to ČSN EN 1779, method D.2.

Verification method: R – Review, T – Test, I – Inspection

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

REQ-032734/A **R2-08**

The Supplier shall perform mass-spectrometer RGA (Residual Gas Analyzer) test on each chamber and on each tubing segment. The RGA shall have a range of at least 200 AMU (Atomic Mass Unit) and shall contain Secondary Electron Multiplier (SEM). The chamber or tubing segment shall be pumped by a dry vacuum pump and a turbomolecular pump to a pressure of 10^{-6} mbar for at least 12 hours before activating the RGA. The RGA filament shall be on for at least 4 hours before recording the final scan. The resulting RGA spectrum shall conform to the following criteria:

a) all peaks above AMU 45 shall be lower than 1/100 of AMU 44;
b) the AMU 45 peak shall be lower than 1/10 of AMU 44.

Verification method: R – Review, T – Test, I – Inspection

4.3. Packaging and transportation requirements

REQ-032736/A **R3-01**

The Supplier shall invite CA to inspect the vacuum cleanliness of each chamber and tubing segment in ISO 7 (or better cleanliness class), or equivalent, cleanroom before starting the packaging of these components for transport. The results of the inspection shall be recorded in the form of the Vacuum Cleanliness Inspection Report.

Verification method: I – Inspection

REQ-032737/A **R3-02**

Except CH5, all chambers shall be prepared for transport with the top lid and side doors fitted, and with all ISO circular flanges smaller than DN1000 mounted. The DN1000 ISO-F flanges and the flanges for the optomechanical legs on the underside of the chambers will be sealed by metal blanks cleaned to the same standard as the chambers.

Verification method: I – Inspection

REQ-032738/A **R3-03**

The CH5 chamber shall be transported with the top lids, side doors, DN1000 ISO-F (or equivalent) flanges, and the flanges for the optomechanical legs on the underside of the chamber sealed by metal blanks cleaned to the same standard as the chamber. All other circular ISO flanges smaller than DN1000 will be mounted.

Verification method: I – Inspection

REQ-032739/A **R3-04**

The vacuum tubing segments shall be prepared for transport with the DN1000 ISO-F (or equivalent) flanges sealed by metal blanks which will be cleaned to the same standard as the segments.

Verification method: I – Inspection

REQ-032740/A **R3-05**

The cleaned chambers and tubing segments shall be wrapped in two layers of ultra-low outgassing polyethylene film (as sheet or bags) with thickness of at least 100 µm, with NVR (non-volatile residue) better than 0.15 µg/cm^2 and very low particle generation. Alternatively, UHV compatible aluminum foil approved by CA can be used. The clean conditions wrapping shall be further enclosed in robust outer packaging and transport crates as necessary for protection and handling during shipping to the ELI-Beamlines site.

NOTE: CA can recommend to the Supplier appropriate low-outgassing polyethylene-base foils brands if required.

Verification method: R – Review, I – Inspection

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

REQ-032741/A **R3-06**

The vacuum chambers and the detachable components of the legs and of the positioning system shall be packed separately for transport.

Verification method: I – Inspection

REQ-032742/A **R3-07**

The supplier shall transport the completed and tested components to the ELI Beamlines site.

NOTE: The bid price will be considered by the CA as the final price, including transportation costs.

Verification method: R – Review, I – Inspection

REQ-032743/A **R3-08**

The transportation procedure shall be reviewed and agreed by the CA.

Verification method: R - Review

REQ-032744/A **R3-09**

The Supplier shall allow supervision by the CA of the activities related to the transportation.

NOTE: Any acts of supervision shall not mean that the CA assumes additional liability of any kind exceeding its liabilities according to the contract.

Verification method: R - Review

REQ-032745/A **R3-10**

The flanges of the chamber shall remain sealed during transport.

Verification method: R - Review, I – Inspection

5. Safety Requirements

REQ-032749/A **R4-01**

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 Product sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.

Verification method: R – Review

REQ-033010/A **R4-02**

The Supplier shall perform risk assessment of the delivered products in order to ensure safe transportation, installation and their further use for the assembly of the entire system. The results of the risk assessment shall be reflected in the technical documentation (REQ-032753/A and “REQ-032754/A).

Verification method: R – Review

FZU Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

6. Quality requirements

6.1. Documentation and data control

REQ-032753/A **R5-01**

The Supplier shall supply the following relevant manufacturing documents:

- all manufacturing design, 3D model and design supporting documentation approved by the CA (see REQ-032764/A);
- full technical documentation on the delivered Product (e.g. storage, installation, safe operation and maintenance instructions);
- all "requests for deviation/waiver from requirements described herein" approved by the CA (see REQ-032757/A).
- Documentation (e.g. reports, protocols, certificates, instructions, manuals, etc.)

*NOTE: Following data formats can be used: JPG, *.PNG, *.TIFF, *.PDF/A, *.HTML; CAD 2D: *.dwg; CAD 3D: *.stp; *.ste; *.step or other 3D CAD formats agreed with the CA; text processors *.doc, *.docx, OpenDocument Format; spreadsheet processors *.xls, *.xlsx, OpenDocument Format; presentations *.ppt, *.pptx; OpenDocument Format.*

Verification method: R – Review, I – Inspection

REQ-032754/A **R5-02**

The Supplier shall provide the **Product Manual** as part of the delivered System. Completeness of the Manual shall be approved by the CA. The Manual shall include the instructions and descriptions regarding the following procedures:

- transport, handling, storage, disassembling and cleaning;
- installation
- safe operation, maintenance and disposal procedures;
- factory test reports

NOTE: The manual can be supplied in the hardcopy or PDF formats.

Verification method: R – Review

6.2. Nonconformity control system

REQ-032757/A **R6-01**

The Supplier shall establish and maintain a nonconformity control system compatible with ČSN EN ISO 9001 (or equivalent, e.g. EN ISO 9001).

Verification method: Not To Be Tracked within VCD

7. Verification requirements for the Supplier

The verification process will be performed mostly by the Supplier. The VCD draft provided by CA will specify exactly what is required to be verified by whom as well as the CA proposal how.

The VCD serves for gradual recording of executed verifications by the Supplier during the Contract realization. The records usually consist of date (time) when the verification was executed, by whom, the result (OK/NOK) and usually also reference to the related document as evidence of the result of verification.

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

7.1. Verification Control Document (VCD)

The CA requires that the Supplier will use the VCD document provided by the CA. Supplier can extend and adapt the VCD document for better reflection to the real condition and fulfilment of the basic purpose of the VCD – to document and demonstrate the verification of fulfilment of CA requirements

REQ-032776/A **R7-01**

The Supplier shall gradually execute the verification as required within this RSD as well as within the VCD draft provided by CA and record the results in to the VCD.

NOTE: Phases of delivery are called Deliverables in the Purchase contract.

Verification method: R - Review

7.2. Recommended verification methods

The verification process shall be accomplished by the Supplier through one or more of the following verification methods recommended by the CA:

1. Test – real verification that the subject of delivery fulfils required parameters usually carried out under controlled conditions, as close as possible to real operation. The Test protocols with test results or the complete Test report usually serve as the documented evidence. (Test - T) e.g.:
   a. Test at the Supplier (Factory Acceptance Test – FAT);
   b. Test at the CA (Site Acceptance Test – SAT);
   c. Functional Demonstration at the Supplier or at the CA but always with CA attendance (Functional Demonstration – FD);
   d. Measuring – specific type of Test - physical verification that the real measured value complies with the required value in the same units and standardized measuring conditions. The measurement protocol or report can serve as the documented evidence. The CA can also ask for the calibration protocol of used gauge or similar documentation. (Measuring – M).
2. Review – verification that the Documentation meet the requirements or the Documentation demonstrate the requirements fulfilment (Review – R).
3. Inspection – visual check or evaluation physical characteristics of the subject whether meet the requirements (Inspection – I).
4. Analysis - performing of theoretical or empirical evaluations of meeting the requirements by using defined methods (Analysis - A).

7.3. Qualification of Design

This chapter describes summary of what has to be provided by the Supplier in terms of documentation (detailed engineering documentation including technical documentation and design supporting documentation) before starting the manufacturing.

Output of this phase is **Final set of detailed engineering documentation, approved by the CA**.

REQ-032763/A **R7-02**

Before completion of the Qualification of Design phase the Supplier shall provide following information that shall be agreed by the CA:

- structure and content of the Test protocols, Analysis reports, Review reports etc. (if applicable);
- structure and content of the VCD if it was modified by the Supplier.

NOTE: Phases of delivery are called Deliverables in the Purchase contract.

Verification method: R - Review.

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

REQ-032764/A **R7-03**

Before completion of the Qualification of Design phase the Supplier and the CA shall agree on:

- final detailed engineering drawings provided by the Supplier;
- detailed procedures related to the testing, cleaning and packaging during Manufacturing phase;
- common nonconformity control system (see REQ-032757/A).

NOTE: Phases of delivery are called Deliverables in the Purchase contract.

Verification method: R - Review.

7.4. Manufacturing and delivery

The goal is to demonstrate that all the manufactured and delivered parts of the contract meet all requirements specified herein.

Output of this phase is the **Verified all parts of the contract**.

REQ-032766/A **R7-04**

The results of the verification during the Manufacturing phase shall be recorded by the Supplier (including review of documentation/reports and inspection of all the manufactured and delivered parts) in the VCD (see Annex III).

NOTE: Phases of delivery are called Deliverables in the Purchase contract.

Verification method: R - Review

REQ-032767/A **R7-05**

The final issue of the VCD shall be submitted to the CA after the approval of the last report before delivery.

Verification method: R – Review

7.5. Acceptance

Acceptance will be carried out by the CA upon completion of each Phase of delivery (Deliverable). In case of successful acceptance phase the CA will provide to the Supplier signed acceptance protocol for each Phase of delivery (Deliverable). In case of unsuccessful acceptance stage the CA will provide to the Supplier Nonconformity Report (NCR) and process in accordance with REQ-032757/A shall be applied.

The final acceptance will be executed by the CA by verifying all criteria stated in REQ- 032769/A

The Acceptance phase shall demonstrate the following:

- The final product(s) has (have) been successfully verified and this process has been documented in an appropriate way;
- All detected nonconformities have been solved in accordance with REQ-032757/A;
- The final product(s) is (are) free of fabrication errors, is (are) not damaged during transport and is (are) ready for the intended operational use.

REQ-032769/A **R7-06**

The Acceptance phase shall demonstrate the following:

- All finished parts of the contract have been successfully verified by the Supplier and the results of this process have been documented in VCD (The completed VCD is submitted);
- All previous Phases of delivery were accepted by CA and confirmed by the related Acceptance protocol (All the Acceptance protocols are submitted);
- All detected nonconformities have been solved in accordance with REQ-032757/A;

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

8. ANNEX: Drawings

8.1. RD-01 Drawing package L4 10PW Laser Beam Distribution Vacuum Infrastructure

Electronic format of the drawing package, compressed into *.rar archive

Fyzikální ústav Akademie věd České republiky
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

ANNEX 3

VERIFICATION CONTROL DOCUMENT

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

Confidentiality:	*BL - Restricted for internal use*	**TC ID/Revision**:	00309997/A
WBS code:	4.3 – Beam Transport	**PBS code**:	*SE.BDS.BT.L4BT.E34F.VCH*
Doc Status:	*DocReleased*	**Doc Type**:	*Specification (SP)*
Project Branch:	*Engineering & Scientific documents (E&S)*		

Table of Content

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

1. Quality Requirements for Supplier

1.1. General Quality Requirements

N°	TC N°		Requirement	Verification by
QR1-01	REQ-022310	A	The Supplier shall identify a Quality Manager for the project, responsible for implementing and performing management and other Quality disciplines and functions.	R - review
QR1-02	REQ-022311	A	If the Supplier delegates the quality assurance tasks to other organization it shall be done in a documented and controlled way monitored by the Supplier.	Not To Be Tracked within VCD
QR1-03	REQ-022312	A	The Supplier shall prepare, maintain and implement a Quality Plan for the product development and manufacturing to ensure that the product quality is in compliance with intended use and in conformity with requirements. *NOTE: The Client reserves the right to provide basic requirements for the Quality Plan.*	R - review
QR1-04	REQ-022313	A	The Quality Plan shall be submitted according to provisions of Annex 1.	R - review

1.2. Nonconformity Control System

N°	TC N°		Requirement	Verification by
QR1-05	REQ-022314	A	The Supplier shall establish and maintain a nonconformity control system compatible with ČSN EN ISO 9001 (equivalent to EN ISO 9001).	Not To Be Tracked within VCD

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

1.3. Documentation and data control

N°	TC N°		Requirement	Verification by
QR1-06	REQ-022315	A	The Supplier shall supply the following relevant manufacturing documents: • Full technical documentation (including manufacturing drawings) • Breakdown list as built • Handling, installation and maintenance manuals • All approved "requests for deviation/waiver" (see REQ-022314; QR1-05).	I – inspection
QR1-07	REQ-022316	A	All documentation shall be supplied in both hardcopy and PDF/A.	I – inspection
QR1-08	REQ-022317	A	The Supplier shall provide the following types of technical documentation: • Final 3D model (if available) • Final 2D drawings.	R - review
QR1-09	REQ-022318	A	The Supplier shall use the following data formats: • *.JPG, *.PNG, *.PDF/A, *.HTML • CAD 2D: *.dwg • CAD 3D: *.stp; *.ste; *.step, *.x_t; *.x_b, or other 3D CAD formats agreed with the Client • Text processors *.doc, *.docx, OpenDocument Format • Spreadsheet processors *.xls, *.xlsx, OpenDocument Format • Presentations *.ppt, *.pptx; OpenDocument Format.	Not To Be Tracked within VCD

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

2. Verification Requirements for Supplier

2.1. General requirements

N°	TC N°		Requirement	Verification by
QR2-01	REQ-022319	A	The verification process shall be managed by the Supplier and shall proceed according to the Verification Plan (VP), see provisions of Annex 1. The verification process shall include the following activities: 1. **Verification planning** (see section 2.3 below) 2. **Verification execution and reporting** (see section 2.4 below) 3. **Verification control and close-out** (see sections 2.5 and 2.6 below).	Not To Be Tracked within VCD
QR2-02	REQ-022320	A	The Supplier shall assign clear responsibility for the implementation of the verification process including the activities defined in QR2-01 (REQ-022319).	R - review

2.2. Verification Documentation

N°	TC N°		Requirement	Verification by
QR2-03	REQ-022335	A	The Supplier shall establish and maintain the system of verification process documentation.	Not To Be Tracked within VCD
QR2-04	REQ-022336	A	Verification documentation shall consist of following basic types of documents: • **VP, Verification Plan** (see section 2.3) • **Verification Reports** including: CDR Report, Tests, Inspection and Analyses reports (see section 2.4) • **VCD, Verification Control Document** (see section 2.5).	Not To Be Tracked within VCD
QR2-05	REQ-022337	A	The verification report shall be submitted to the Client for the review as agreed with the Client after corresponding verification activity completion, within the time frame agreed with the Client. *NOTE: Verification activity can be design review and analysis during the development, test and inspection of all System Components.*	R - review

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

2.3. Verification Planning

N°	TC N°		Requirement	Verification by
QR2-06	REQ-022321	A	The Supplier shall define the verification approach in a Verification Plan (VP) for approval by the Client prior to implementation.	Not To Be Tracked within VCD
QR2-07	REQ-022322	A	The Verification Plan (VP) shall describe **HOW** and **WHEN** each of the technical requirements will be verified: *NOTE 1: The Client reserves the right to provide binding guidelines for establishing the VP, within 15 working days from the Commencement Day of the contract.* *NOTE 2: Guidelines for VP preparation can be provided by the Client.*	R – review

2.4. Verification execution

N°	TC N°		Requirement	Verification by
QR2-08	REQ-022323	A	The verification execution process shall consist of following stages according to the phasing of the contract execution: • **Critical design review (CDR**); • **Verification of all components of the System Components** (testing and inspection at Supplier's site)**;** • **Acceptance by the Client at customer site**. *NOTE 1: The CDR is intended to verify that the design meets corresponding requirements (could be accepted) and/or identify required corrective actions needed to accept the design and start manufacturing phase of the contract.* *NOTE 2: Verification of all System Components is executed at the end of each corresponding manufacturing phase by inspection and tests. The purpose of this verification is checking the product readiness for shipment to the Client.* *NOTE 3: In the acceptance stage the verification shall demonstrate that the product meets the specifications (see Annex 2 of the Contract) and that it is free of fabrication defects and is ready for the intended operational use.*	Not To Be Tracked within VCD
QR2-09	REQ-022324	A	Acceptance shall be carried out on final hardware and software. *NOTE 1: Output of this verification stage is Verified System.* *NOTE 2: The results of acceptance stage shall be recorded by the Client within VCD (see section 2.6).*	Not To Be Tracked within VCD

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

QR2-10	REQ-022325	A	Verification shall be accomplished by the Supplier through one or several of the following methods: 1. **Review of design**; Verification by Review (**R**) shall consist of using official project documentation (e.g. design and technical documentation, numerical analysis reports, engineering drawings, manuals and operation documentation) that unambiguously shows that the requirement is met. 2. **Inspection**; Verification by Inspection (**I**) shall consist of visual examination of the manufactured and/or assembled product. 3. **Test** (including functional demonstration); Verification by Test (**T**) shall consist of quantitatively measuring performance of the product and of its functions in a defined operating regime. 4. **Analysis**; Verification by Analysis (**A**) shall consist of performing numerical or empirical performance evaluation of the product using a technique defined in the VP (see QR2-06; REQ-022321).	Not To Be Tracked within VCD
QR2-11	REQ-022326	A	The results of a review of design shall be documented in the Critical Design Review Report (**CDRR**) and tracked in the VCD. *NOTE: The Client can provide to the Supplier the template of CDRR.*	R – review
QR2-12	REQ-022330	A	The results of a review of analysis shall be documented in the appropriate Analysis Report (**AR**) and tracked in the VCD.	R – review
QR2-13	REQ-022327	A	The results of the inspection shall be documented in the appropriate Inspection Report (**IR**) and tracked in the VCD.	R – review
QR2-14	REQ-022328	A	The results of the test shall be documented in the appropriate Test Report (**TR**) and tracked in the VCD.	R – review
QR2-15	REQ-022329	A	The parts of the VCD related to the Design of all System Components shall be accepted by the Client before manufacturing of the System starts.	Not To Be Tracked within VCD

2.5. Verification Control Document (VCD)

The Verification Control Document (VCD) lists the requirements to be verified with the selected methods at the defined levels. The VCD is a living document and provides traceability during contract phases (design, manufacturing, testing and deployment) how each requirement is planned to be verified and is actually verified.

The VCD represents a formal tool of communication between the Supplier and the Client (formal record, reporting tool).

N°	TC N°		Requirement	Verification by
QR2-16	REQ-022338	A	The Supplier shall provide the first version of the Verification Control Document (VCD) as a part of the D1 Deliverable. *NOTE: Binding guidelines for VCD preparation will be provided by the Client within 15 working days from the Commencement Day of the contract.*	R - review

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

2.6. Verification close out

Acceptance will be carried out on the System Components after their delivery.

In case of successful acceptance phase the Client shall provide to the Supplier signed acceptance protocol. In case of unsuccessful acceptance phase the Client shall provide to the Supplier Nonconformity Report (NCR) and process in accordance with QR1-05 (see REQ-022314) shall be applied.

N°	TC N°		Requirement	Verification by
QR2-17	REQ-022421/A	A	Upon delivery of the System Components in appropriate and undamaged packaging the Client shall provide to the Supplier with Handover/takeover protocol.	Not To Be Tracked within VCD
QR2-18	REQ-022332	A	The verification process shall be considered complete for a given project phase (contractual Deliverables) when the Client approves all corresponding items in the VCD by confirming that: 1. All specified requirements for a given project phase (contractual Deliverable) have successfully been verified by the Supplier and results of this verification process has been approved by the Client; 2. All detected nonconformities have been solved in accordance with QR1-05 (REQ-022314); 3. Documented evidence is recorded in the VCD. *NOTE: In the acceptance phase, the verification of the delivered System Components and required documentation will be carried out and tracked by the Client in the final version of the VCD.*	Not To Be Tracked within VCD

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

3. Quality & Verification Plan

The table in Section 3.2 below summarizes the compulsory Quality and Verification activities of design, manufacturing, testing and delivery. These activities must be included in the detailed Quality and Verification Plan developed by the Supplier.

3.1 Abbreviations

Abbreviation	Meaning	Note
I	Inspection	As verification methods; Further details see QR2-10 (REQ-022325)
RoD	Review of Design	
T	Test	
A	Analysis	
FD	Functional Demonstration	
R	Review	Relevant official project documents for a given activity shall be reviewed, and a review report issued, by a responsible person at the Client.
H	Hold point	Progress shall not be made to the next sequenced activity until the Requirements of the Hold Point Activity have been met
W	Witness point	The activity shall be witnessed in person with appropriate advance notice having been given.
QR	Quality Report	All items from the Quality Plan, see QR1-03 (REQ-022312), corresponding to the given activity, must be documented
AR	Analysis Report	Documented results of corresponding verification activities shall be submitted to the Client (see section 2.4)
IR	Inspection Report	
TR	Test Report	
n/a	not applicable	
CDR	Critical Design Review	Details see in QR2-08 (REQ-022323)
CDRR	CDR Report	Details see in QR2-11 (REQ-022326)
VP	Verification Plan	Details see in section 2.3
VCD	Verification Control Document	Details see QR2-16 (REQ-022338)
ELI-BL	ELI-Beamlines	-

FZU Institute of Physics of the Czech Academy of Sciences
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

3.2 List of compulsory Quality and Verification activities

Seq. No	Activity	Input Requirement / Specifications	Place	Quality process		Verification process		Contractor		ELI-BL	
				Input	Output	Input	Output	Quality	Verification	Quality	Verification
1	**Detailed project schedule, detailed engineering design (Deliverables D1, D2, D3)**										
1.1	Contract kick-off and planning meeting	Kick off meeting agenda	ELI-BL or Contractor	n/a	Minutes	n/a	n/a	R	n/a	R	n/a
1.2	Design of specific components, drawings and schemes	Detailed concept design and 3D models, detailed engineering drawings for components and subsystems	ELI-BL or Contractor	Engineering drawings and schemes	Critical Design Review Report (CDRR), QR (Quality Report)	Engineering drawings and schemes	CDRR VP VCD (Annex 3 of the Contract)	n/a	RoD	H	RoD
1.3	Design of routing of primary backing vacuum, utilities, and electrical cables	3D concept design, detailed technical specifications (Annex 2 of the contract)	ELI-BL or Contractor	Engineering drawings and schemes	Critical Design Review Report (CDRR)	Engineering drawings and schemes	CDRR	n/a	RoD	H	RoD
1.4	Review of the contractor qualifications and procedures before launching fabrication	Contractor qualifications and procedures	Contractor	Contractor qualifications and procedures	Inspection report	n/a	n/a	n/a	n/a	W	I
1.5	Failure Mode and Effect Analysis (FMEA)	Detailed technical specifications (Annex 2 of the contract)	ELI-BL or Contractor	Detailed technical specifications	Analysis Report (AR)	n/a	n/a	AR/H	A	R	RoD

FZÚ
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

Seq. No	Activity	Input Requirement / Specifications	Place	Quality process		Verification process		Contractor		ELI-BL	
				Input	Output	Input	Output	Quality	Verification	Quality	Verification
2	**Manufacture, factory testing, and delivery to ELI-Beamlines (Deliverables D4 and D5)**										
2.1	Welding coordination tasks and responsibilities	ČSN EN ISO 14731 * (equivalent to EN ISO 14731 *)	Contractor	ČSN EN ISO 14731 * (equivalent to EN ISO 14731 *)	Certificates	n/a	n/a	H	I	R	I
2.2	Welding personnel qualifications	ČSN EN ISO 9606 *, ČSN EN ISO 14732 * or relevant (equivalents to EN ISO 9606*, EN ISO 14732 *)	Contractor	ČSN EN ISO 9606 *, ČSN EN ISO 14732 * or relevant (equivalents to EN ISO 9606*, EN ISO 14732 *)	Certificates	n/a	n/a	H	I	R	I
2.3	Inspection of the new material and components, traceability	Raw material certificates and contractor traceability procedures	Contractor	Raw material certificates and contractor traceability procedures	Certificates and procedures	n/a	n/a	H	I	R	I
2.4	Welding inspection	Production drawings (D2A and D2B Deliverables), welding procedures, welding sequence plan	Contractor	Production drawings, welding procedures, welding sequence plan	Inspection report	n/a	n/a	H	n/a	W	n/a
2.5	NDT inspection of the vacuum chambers	NDT procedures	Contractor	NDT procedures	Inspection report	NDT specifications	Test / Inspection report	H	T, I	R	R, I
2.5a	Visual inspection 100% EN ISO 17637 *	ČSN EN ISO 5817 * (equivalent to EN ISO 5817 *), evaluation group B	Contractor	Criteria according to ČSN EN ISO 5817 * (equivalent to EN ISO 5817 *), evaluation group B, product to be verified	Inspection report	Criteria according to ČSN EN ISO 5817 * (equivalent to EN ISO 5817 *), evaluation group B, product to be verified	Inspection report	H	I	W	R, I
2.5b	Surface crack test /PT/ of all load bearing parts and vacuum welds EN ISO 17637 *	ČSN EN ISO 23277 * (equivalent to EN ISO 23277 *), evaluation group 1	Contractor	Criteria according to ČSN EN ISO 23277 * (equivalent to EN ISO 23277 *), evaluation group 1, product to be verified	Inspection report	Test specifications	Test / Inspection report	H	T, I	W	R, I

** Regarding the referred standards or standardized/ standardizing technical documents the Client allows also another equivalent solution to be offered.*

FZÚ
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research, Development and Education
MINISTRY OF EDUCATION YOUTH AND SPORTS

ANNEX NO. 3

VERIFICATION CONTROL DOCUMENT

L4 10 PW Laser Beam Distribution Vacuum Infrastructure TP 20_040

TC ID/Revision: *00309997/A* ***Confidentiality:*** *BL - Restricted for internal use*

Seq. No	Activity	Input Requirement / Specifications	Place	Quality process		Verification process		Contractor		ELI-BL	
				Input	Output	Input	Output	Quality	Verification	Quality	Verification
2.6	Inspection of the finished chamber structure including visual inspection, surface and dimensional control	Production drawings Detailed Technical Specifications (Annex 2 of the Contract)	Contractor	Production drawings, Detailed Technical Specifications	Inspection control report	Production drawings, Detailed Technical Specifications	Inspection and dimensional control report	H	T, I	W	R, I
2.7	Measurement of deformations of the vacuum chambers walls upon pump down	Production drawings Detailed Technical Specifications (Annex 2 of the Contract)	Contractor	Production drawings, Detailed Technical Specifications	Quality report	Test specifications	Test report	H	T, I	W	R, I
2.8	Inspection of the cleaned vacuum chambers, vacuum leak and vacuum cleanliness tests	Manufacturing requirements including the cleaning procedure Vacuum test requirements	Contractor	Manufacturing requirements including cleaning procedure Vacuum test requirements	Quality report	Manufacturing requirements including cleaning procedure Vacuum test requirements	Test report	H	T, I	W	R, I
2.9	Acceptance of each of the vacuum chambers vacuum tested	Detailed technical specifications (Annex 2 of the contract)	Contractor	Detailed technical specs (Annex 2 of the contract)	Inspection and Test report	Detailed technical specs (Annex 2 of the contract)	Test report	H	T, I	W	R, I
2.10	Packaging for transport	Packaging for transport	Part list Shipping specifications	Contractor	Part list Shipping specifications	Shipping list	n/a	n/a	H	I	W
2.11	Shipping and reception at ELI-Beamlines	Shipping and reception specifications	ELI-BL	Shipping and reception specifications	Reception report	n/a	n/a	W	I	H	I
2.12	Unpacking and inspection	Unpacking and storage specifications Manual / specifications for installation	ELI-BL	Unpacking and storage specifications Manual /specifications for installation	Reception report	n/a	n/a	n/a	n/aI	H	I

Note: Regarding the referred standards or standardized/ standardizing technical documents throughout this document, the Client allows also another equivalent solution to be offered.

FZÚ
EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research,
Development and Education
MINISTRY OF EDUCATION
YOUTH AND SPORTS

ANNEX 4

PRICES

Item	Units (pieces/ hours/ flanges	Price (CZK excl. VAT) per unit	Price (CZK excl. VAT) per item
Purchase Price (according to art. 8.1 of the Purchase Contract, i.e. the total price for the firm scope excl. options):	1	**30 430 000,00**	**30 430 000,00**
Options:			
OD1 - Manufacture and factory testing of CH6, delivery to ELI-Beamlines	1	**3 340 000,00**	**3 340 000,00**
OD2 - Manufacture and factory testing of CH5, of the tubing segment TS2A and of its support, of TS2B and TS5, delivery to ELI-Beamlines	1	**12 810 000,00**	**12 810 000,00**
OD3 (L4c - Installation of chambers only) - Transport of the vacuum components (chambers CH1, CH2 and CH-DT, tubing segments TS0, TS1, and TSDT, and the tubing segment supports TSS1 and TSDT) to the final location in the L4c laser hall and installation of the chambers only	1	**320 000,00**	**320 000,00**
OD3 (L4c - Installation of remaining components) - Installation of tubing segments TS0, TS1 andTSDT and of the tubing segment supports TSS1 and TSDT in L4c	1	**110 000,00**	**110 000,00**
OD3 (E3 - Installation of chambers only) - Transport of the vacuum components (CH3 and CH4, tubing segments TS2C, TS3, and TS4, and tubing segment supports TSS3 and TSS4) to the final location in the E3 laser hall and installation of the chambers only	1	**200 000,00**	**200 000,00**
OD3 (E3 - Installation of remaining components) - Installation of tubing segments TS2C, TS3, and TS4, and tubing segment supports TSS3 and TSS4 in E3	1	**110 000,00**	**110 000,00**
OD4 - Technical installation works on primary vacuum piping and /or on utilities (cooling water, compressed dry air) - **1 hour**	160	**1 200,00**	**192 000,00**

OD5 - Manufacture of up to 3 DN1000 ribbed aluminium flanges - **1 flange**	3	**98 000,00**	**294 000,00**
Total Bid Price = Purchase Price + price of all options:			**47 806 000,00**

ANNEX 5

SUPPLIER'S BID

A) Precision of manufacture of large flanges ISO1000 above Tolerance Grade "A" specifications

The large flanges ISO1000 shall be manufactured with the following precision: +/- 0.3 mm

B) Warranty periods

The Supplier provides a warranty of quality on all the chambers and on all the tubing segments for the period of 36 months.

C) Qualification prerequisites

The Supplier shall carry out assembly and testing works hereunder in the cleanroom space described within the Bid as follows:

Brief description of the cleanroom space in terms of dimensions of the area and cleanliness class specification:
STREICHER has around 1,700 m3 of clean room of **ISO Class 6** according to EN ISO 14644-1 with a vast **6.6 m ceiling** height **for final cleaning, assembling and testing of large vacuum units**. **The footprint** of ISO Class 6 clean room **is 14,6 m x 9 m**. These dimensions allow to fit up assembly groups of up to 10 tons by using a gantry crane. The clean room comprises two separate rooms, grey room for pre-cleaning and a gowning area.

The Supplier shall use the following persons it identified within its Bid for performing this Contract while carrying out all the relevant activities hereunder:

Team member position	**Name**	**Internal staff**
Senior optomechanical designer	Libor Kepka	YES
Junior optomechanical designer (3 designers)	Emil Černý	YES
	Tomáš Holeček	YES
	Václav Krch	YES

Welding coordination supervisor	Petr Vítek	YES
Qualified welders (3 welders)	Jan Landkamr	YES
	Ondřej Šindelář	YES
	Miroslav Strnad	YES

The Supplier is allowed to use another cleanroom space or another persons only if it proves that such spaces or persons meet the requirements for the cleanroom space or team members stated in the procurement documentation issued for the purposes of the Public Contract award.