



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) **Institute of Physics of the Academy of Sciences of the Czech Republic, public research institution**

with its registered office at: Na Slovance 2, Praha 8, PSČ: 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) **DELONG INSTRUMENTS a.s.**

with its registered office at: Palackého třída 3019/153b, Brno 616 00

registration No.: 46903879

enrolled in the commercial register kept by Krajský soud v Brně, item B 3738

represented by: Ing. Tomáš Papírek – Member of Board

("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 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 contracts awarding, as amended, and with binding rules of the Operational Program.
- (C) The Supplier's bid for the public contract titled "*Large Optomechanical Mirror Mounts and Electronic Controls for L4 10 PW Compressor*," whose purpose was to procure the Object of Purchase (hereinafter the "**Bid**" and "**Public Contract**"), was selected by the Client as the most suitable and relevant parts thereof describing the Object of Purchase (as defined below) and the course of its manufacture from the technical and quality perspective 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:

- develop (based on the detailed conceptual design provided by the Client) detailed design, manufacture, test and deliver to the Client **5 optomechanical mounts** of large laser mirrors (**identified as OM7, OM8, OM9, SPM1 and OOM1**)
- develop (based on the detailed conceptual design provided by the Client) detailed design of **the optomechanical mount** of a large laser mirror identified as **OM7.5**

Note: manufacturing, testing and delivery of the mount OM7.5 forms a contractual call in option (art. 1. 2 a) hereof)

- develop (based on the detailed conceptual design provided by the Client) detailed design, manufacture, test, deliver and install in the place of delivery the **optomechanical electronic controller**

as are the mounts and the controller specified herein, mainly in Annex 1 (*Summary of Deliverables, Time Schedule and Payments*), Annex 2 (*Detailed Technical Specifications*), Annex 3 (*Verification Control Document*) and Annex 5 (*Supplier's Bid*) to this Contract ("**Object of Purchase**") 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, testing and delivery of the optomechanical mount OM7.5 in accordance with this Contract and all its Annexes including Annex 1 (*Summary of Deliverables, Time Schedule and Payments*) (hereinafter "**Option 1**");
- b) optional provision of extra design works up to 40 man-days according to Annex 1 (*Summary of Deliverables, Time Schedule and Payments*);
- c) optional installation technical support up to 20 man-days according to Annex 1 (*Summary of Deliverables, Time Schedule and Payments*);

(all options are referred to hereinafter together as the "**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 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 are necessary other deliveries and activities not expressly mentioned in this Contract, 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 the performance of this Contract, the Client is entitled to further specify or clarify the requirements stipulated in Annex 2 (Detailed Technical Specification). Such further requirements can be requested by the Client no later than one month before the scheduled completion of the D2 Deliverable (for optomechanical mounts OM7, OM7.5, OM8, OM9 and SPM1 and for the motion control system MCTR) and of the D3 Deliverable for the optomechanical mount OOM1. 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). Should any request for change result in increase of Purchase Price such request is binding for the Supplier only if the Purchase Price modification is agreed between Parties and such modification is in accordance with the Act No. 134/2016 Coll., on public contracts awarding, and binding rules of the Operational Program.
- 1.5 The Object of Purchase and its components and parts shall be delivered new (i.e. not remanufactured).
- 1.6 The final cleaning of all components, testing and verification of performance of the integrated mounts and integration of all instrumentation with the control system (MCTR) 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 Supplier shall ensure that the Object of Purchase complies with all technical specifications and performance requirements stipulated in Annex 2 (Detailed Technical Specifications). The Supplier is responsible that the Object of Purchase and/or its subsystems 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 are in contradiction to the applicable law or this Contract. If the Supplier finds out or should have found out by exercising professional care that the instructions are inappropriate or contradicting valid law, Czech or EU standards or are in contradiction to this Contract, then the Supplier must notify the Client.

3. CLIENT'S CONFIDENTIAL INFORMATION

- 3.1 For the purposes of detailed design and manufacture of the Object of Purchase, the Client may provide to the Contractor conceptual drawings, 3D model, 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 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 only and solely for the purposes of the fulfilment of this Contract, i.e. for the manufacture and assembly of the Object of Purchase for the Client.

- 3.2 The Supplier must 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 third party and/or by any unauthorized person.
- 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 objects, 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 International Laser Research Facility ELI Beamlines shall pass on such third party. 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) 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) is entitled to grant 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. It is hereby explicitly agreed that 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 to the Client 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 upon mutual agreement replace meetings in person by other forms of communication, as long as they agree on such in writing. 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 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, the 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 the major subsystems of the Object of Purchase (i.e. of the optomechanical mounts and of the motion control system (MCTR)) at his premises (factory acceptance tests), in relation with Deliverables D3, D5 and Optional DA (if the Option 1 is activated), 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 **18 526 500,-** Czech Crowns (CZK) without value added tax ("**VAT**") ("**Purchase Price**"). The Purchase Price represents the Supplier's binding maximum price. The prices for performing Options are stipulated in Annex 4 (*Prices*) hereto. 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, delivery to ELI-Beamlines and installation (where applicable) of the Object of Purchase or its parts, costs of the Licence, insurance, warranty service and any other costs and expenses connected



with 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 Options may be changed only in accordance with the Act No. 134/2016 Coll., on public contracts awarding, 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 due performance hereof by the Supplier taking into account the overall approach of the Supplier to the Contract performance (presented particularly by due preparation for performance of activities that are to come) 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 Purchase Price partial instalments (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 future 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.
- 8.6 The Purchase Price and prices of Options shall be paid on the basis of 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 efakury@fzu.cz

- 8.8 The invoice issued by the Supplier as a tax document must contain all information required by the applicable laws of the Czech Republic. Invoices issued by the Supplier in accordance with this Contract shall contain in particular following information:
- a) name and registered office of the Client,
 - b) tax identification number of the Client,
 - c) name and registered office of the Supplier,
 - d) tax identification number of the Supplier,
 - e) registration number of the tax document,



- f) Quantity (extent) and nature of performance supplied or services rendered(including the reference to this Contract),
- g) the date of issue of the tax document,
- h) the date of the supply of goods or services or the date of the payment on account, whichever comes sooner, in so far as they differ from the date of issue of the tax document – invoice,
- i) due date,
- j) the price,
- k) registration number of this Contract, which the Client shall communicate to the Supplier based on Supplier's request before the issuance of the invoice,
- l) registration number and title of a Project if requested by the Client prior to invoicing,

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

- 8.9 In case that the invoice shall 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.

9. **ACCEPTANCE OF DELIVERABLES, HANDOVER OF INDIVIDUAL PARTS OF OBJECT OF PURCHASE, ACCEPTANCE OF COMPLETE 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 Should any Deliverable (other than D4, D6, and optional DA (if the Option 1 is activated)) be duly completed and comply with the requirements of the Client as set forth herein the Client shall issue to the Supplier, without undue delay, a confirmation on the due execution of the Deliverable (hereinafter the "**Deliverable Acceptance Protocol**"). Notwithstanding to it 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 and fabrication process. Acceptance of these individual Deliverables does not release the Supplier from his liability for the technical compliance and completeness of the entire Object of Purchase.



- 9.3 On-site acceptance and handover and takeover of individual parts of the Object of Purchase related to Deliverables D4, D6, and optional DA (if the Option 1 is activated) shall be realized on the basis of a final acceptance protocol (hereinafter the “**Final 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; and
 - e) date of the signature.
- 9.4 The Final Acceptance Protocol issued according to Art. 9.3 hereof 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, software codes and other contractually required information and documentation corresponding to the Deliverable.
- 9.5 In case of deficiencies (i.e. defects and backlogs) of the delivered subsystems related to Deliverables D4, D6 and optional DA (if the Option 1 is activated), mainly if the Supplier does not hand over to the Client all the above mentioned documents, or if the Deliverable does not meet the Requirements Specifications according to Annex 2 (*Detailed Technical Specifications*), 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 delivery of any 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 Object of Purchase. In such a case the Parties shall list the deficiencies in the Final Acceptance Protocol, including the manner and the date of their removal (remedy). If the Parties do not reach agreement in the protocol regarding the date of the removal, the Supplier shall remove the deficiencies within ten (10) working days. 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 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, corresponding to the Deliverables D4, D6 and optional DA (if the Option 1 is activated), shall pass to the Client upon their handover and acceptance confirmed by the signature of the Final 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 for the period of 24 months from execution of a Final Acceptance Protocol for the respective part of the Object of Purchase, except for the motion control system (MCTR) 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 Final Acceptance Protocol lists any deficiencies, the warranty period 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. 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: service@delong.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 defect removal with the Supplier if the Supplier submits evidence (e.g. subcontractors bid etc.) that 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 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. 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 shall be extended in case of defects preventing the Client from use of any component of the Object of Purchase for intended use by the period of time that elapses between the notification of the defect and its removal. The warranty period extension applies both on the defective component and all other (even non-defective) components that could not have been used for intended use due to operational dependence.
- 11.10 In case that the Supplier does not remove the defect within the stipulated or mutually agreed term or if the Supplier refuses to remove the defect, then 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 and D2 for more than one month, 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.
- 13.2 If the Supplier is in delay with the Deliverables D3, D4, D5 and D6, 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 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.
- 13.4 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, thus the Client shall be entitled to claim the exceeding damages.
- 13.5 Total amount of contractual penalties for delay with completion of Deliverables D3, D4, D5 and D6 shall not exceed 2% of the Purchase Price (excl. VAT) in relation to each Deliverable D3, D4, D5 and D6, i.e. in total 8 % of the Purchase Price.
- 13.6 The Client is entitled to unilaterally set off claims arising from the contractual penalties against the 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*);
 - e) the insolvency proceeding is initiated against the Supplier; or



- f) the Client ascertains that the Supplier provided in its Bid for the Public Procurement 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, which preceded the conclusion of this 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 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. **REPRESENTATIVES OF THE PARTIES**
- 16.1 The Supplier appoints the following representative for the communication with the Client:



In technical matters:

Name: Ing. Tomáš Bejdák

E-mail: tomas.bejdak@delong.cz

Tel.: 549 123 506

- 16.2 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

17. FINAL PROVISIONS

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

- 17.2 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.

- 17.3 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.

- 17.4 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.

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

- 17.6 If any of provisions of this Contract are invalid or ineffective, then such invalidity, ineffectiveness or unenforceability shall not cause the invalidity, ineffectiveness, or unenforceability hereof as a whole and the Parties are bound to 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.

- 17.7 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.

- 17.8 Integral parts of this Contract are:

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



Annex 2 (*Detailed Technical Specifications*)

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.

- 17.9 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: Ing. Tomáš Papírek

Position: Member of the board



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ANNEX 1

SUMMARY OF DELIVERABLES, TIME SCHEDULE AND PAYMENTS

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

Large optomechanical mirror mounts and electronic controls
for L4 10 PW compressor
[TP19-010]

TC ID/Revision: 00232443/A
 Confidentiality: BL - Restricted for internal use
 WBS code: 3.4 – L4 system
 PBS code: RA1.L4.CMP1.10PW.OM.LCMT

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%
D2	Detailed engineering design and resonance frequency analysis of OM7, OM7.5, OM8, OM9 and SPM1, detailed design of the motion control system (MCTR)	3 months from CD	30%
D3	Manufacture, assembly and factory testing of OM7, OM8 OM9 and SPM1, assembling and factory testing of the motion control system (MCTR)	8 months from CD	20%
	Detailed engineering design and resonance frequency analysis of OOM1		
D4	Delivery of OM7, OM8, OM9 and SPM1 to ELI-Beamlines, delivery and installation of the motion control system (MCTR) at ELI-Beamlines	9 months from CD	10%
D5	Manufacture, assembly and factory testing of OOM1	12 months from CD	20%
D6	Delivery of OOM1 to ELI-Beamlines	14 months from CD	10%

Optional manufacture of OM7.5

Deliverable	Description	Completion	Payment
Optional DA	Manufacture, assembly and factory testing of OM7.5, delivery of OM7.5 to ELI-Beamlines	6 months from the activation of the Option 1	Price of the Option

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 and resonance frequency analysis of OM7, OM7.5, OM8, OM9 and SPM1, detailed design of the optomechanical electronic controller (MCTR)

a) The Supplier shall develop detailed engineering 3D models of OM7, OM7.5, OM8, OM9 and SPM1, 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 next step (Deliverable D3) 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 D3).

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

- Lifting mechanism / lifting points (e.g. lifting eyes) for installation of the mounts
- Relief holes in the mounts to avoid trapped air pockets
- Connection to the internal (vacuum) and external (on the outer compressor chamber surface) cable trays
Note: The layout and location of the cable trays inside the compressor and on the compressor chamber will be specified by FZU.
- Determination of materials, configuration of motion elements, connections of the actuators and of positioning sensors, surface finishes and other similar matters necessary to optimize for fabrication

c) The Supplier shall verify the stiffness and vibrational properties of the developed detailed design of all the optomechanical mounts, by means of FEA (Finite Element Analysis) simulations. The acceptable limits of vibrational criteria are 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 requirements are 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.

f) The Supplier shall provide an updated detailed 3D model of the optomechanical mounts of OM7, OM7.5, OM8, OM9 and SPM1, showing the finally agreed configuration.

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

e) The Supplier shall develop detailed design of the compressor Motion Control System (MCTR), based on the architecture block scheme provided in Annex 2 (Requirements Specification Document). The designed system shall incorporate as minimum the control points specified in Annex 2, and may add additional control points so as to meet all other system requirements. The designed MCTR shall use the approved devices (hardware) from the list specified in Annex 2; the Supplier shall ask Client for approval if any devices not explicitly mentioned in Table 2 of Annex 2 are considered. The designed MCTR detailed scheme and associated documentation, including list of all devices to be used, shall be submitted by Supplier to Client for review. The accepted detailed scheme and list of devices developed in this Deliverable will be binding for the Supplier in the manufacturing phase (Deliverable D3).

The provided documentation shall be reviewed by Client by means of Critical Design Review (CDR) process 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 D3 and 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: 3 months after Commencement Day

3. Deliverable D3:

Manufacture, assembly and factory testing of OM7, OM8, OM9 and SPM1, assembling and factory testing of the optomechanical controller (MCTR)

Detailed engineering design and resonance frequency analysis of OOM1

The Supplier shall develop a full set of final production drawings of the individual optomechanics OM7, OM8, OM9 and SPM1, in line with the documentation produced within the D2 Deliverable.

The Supplier shall manufacture the mounts OM7, OM8, OM9 and SPM1. The Supplier shall install the integrated optomechanical components in an ISO Class 5 or better cleanroom at his premises, where all assembly operations and testing shall be made. The Supplier shall integrate the mechanical components of the mounts with the respective electrical actuators, position encoders, and other sensors. Upon integration with vacuum-compatible cabling and connectors, the mounts shall be connected to corresponding electronic drivers.

The Supplier shall build the electronic optomechanical controller (MCTR) according to approved documentation from Deliverable D2, and shall manufacture all cables necessary to connect MCTR to the optomechanical mounts. The Supplier shall test MCTR basic functionality before connecting the mounts.

The Supplier shall provide all equipment for the required testing of the optomechanical mounts and of MCTR.

The Supplier shall validate key performance parameters of the mounts OM7, OM8, OM9 and SPM1 at their works, namely:

- Demonstration of precision on individual movements of the mounts, achievement of required minimal step, demonstration of stability of each mount
- Functioning of MCTR with all electrical actuators
- Demonstration of individual states and transitions of MCTR machine state diagram

The verification of the optomechanical mounts OM7, OM8, OM9 and SPM1 and of the MCTR performance shall be made according to the Verification Plan. The results of this performance verification and testing will be a Protocol on Factory Testing of the OM7, OM8, OM9 and SPM1 optomechanical mounts.

The statuses of the requirements verified in this phase for OM7, OM8, OM9 and SPM1 shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of D3 related to OM7, OM8, OM9 and SPM1.

As part of D3 Deliverable, the Supplier shall also develop detailed engineering 3D model of the OOM1, optomechanical mount, based on the preliminary design drawings and 3D models supplied by the Client. The detailed engineering model produced by the Supplier will be used in Deliverable D5 to make production drawings and to manufacture the OOM1 mount. 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).

a) Included in this detailed 3D model of OOM1 will be elaboration of specific details, such as:

- Lifting mechanism / lifting points (e.g. lifting eyes) for installation of the mounts
- Relief holes in the mounts to avoid trapped air pockets
- Connection to the internal (vacuum) and external (on the outer compressor chamber surface) cable trays
Note: The layout and location of the cable trays inside the compressor and on the compressor chamber will be specified by FZU.
- Determination of materials, configuration of motion elements, connections of the actuators and of positioning sensors, surface finishes and other similar matters necessary to optimize for fabrication

b) The Supplier shall verify the stiffness and vibrational properties of the developed detailed design of the optomechanical mount OOM1, by means of FEA (Finite Element Analysis) simulations. The acceptable limits of vibrational criteria are included in the detailed specification of performance requirements in Annex 2 to this Contract. 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.

c) A brief technical report shall be provided by the Supplier that lists all the significant changes and enhancements between the FZU provided concept design of OOM1 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.

- d) The Supplier shall provide an updated detailed 3D model of OOM1, showing the finally agreed configuration
- e) Supplier shall provide final Quality and Verification Plan for all the main components of OOM1 and other documentation which will be reviewed by the Client.

The provided OOM1 documentation shall be reviewed by Client by means of Critical Design Review (CDR) process 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 D3 related to OOM1.

Completion: 8 months and after Commencement Day

4. Deliverable D4:

Delivery of OM7, OM8, OM9 and SPM1 to ELI-Beamlines, delivery and installation of the motion control system (MCTR) at ELI-Beamlines

The Supplier shall prepare for transport the OM7, OM8, OM9 and SPM1 mounts, and the electronic motion control system (MCTR) including all related equipment (wiring etc.). Each mount shall be packed separately.

For the duration of its transport the components shall be hermetically sealed under dry air or nitrogen. The initial wrapping of all parts shall be in multiple layers of plastic film (as sheet or bags) of type specifically for use in contamination controlled areas. 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 components 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 of the mounts at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, the mounts and other delivered components will be unpacked by Supplier in ISO Class 5 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

The Supplier shall install the electronic motion control system (MCTR) in the L4c laser hall, into the Rittal electrical cabinets provided by the Client (see Annex 2, Requirements Specification Document). The Supplier shall then test functioning of MCTR with all electrical actuators of OM7, OM8, OM9 and SPM1 mounts.

This inspection shall be the basis for acceptance of D4 related to OM7, OM8, OM9 and SPM1 mounts.

This inspection of delivered OM7, OM8, OM9 and SPM1 mounts and results of acceptance tests of MCTR according the Verification Control Document (VCD), Annex 3, shall be the basis for acceptance of D4.

Completion: 9 months after Commencement Day

5. Deliverable D5:

Manufacture, assembly and factory testing of OOM1

Based on the results of Deliverable D3 the Supplier shall develop a full set of final production drawings of the optomechanical mount OOM1.

The Supplier shall manufacture the OOM1 mount. The Supplier shall install the OOM1 components in an ISO Class 5 or better cleanroom at his premises, where all assembly operations and testing shall be made. The Supplier shall

integrate the mechanical components of OOM1 with the respective manual and electrical actuators, position encoders, and other sensors.

Upon integration with vacuum-compatible cabling and connectors, the OOM1 mount shall be connected to a Supplier-provided surrogate electronic driver, with the same functionality as the electronic motion control system (MCTR).

The Supplier shall validate key performance parameters of the OOM1 mounts at their works, namely:

- Demonstration of precision on individual movements of the mount, achievement of required minimal step, demonstration of stability
- Functioning of all electrical actuators
- Functioning of the mechanical actuators

The verification of the optomechanical mount OOM1 shall be made according to the Verification Plan. The results of this performance verification and testing will be a Protocol on Factory Testing of the OOM1 optomechanical mount.

The statuses of the requirements verified in this phase shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of D5.

Completion: 12 months and after Commencement Day

6. Deliverable D6: Delivery of OOM1 to ELI-Beamlines

The Supplier shall prepare for transport the OOM1 optomechanical mount, including all related equipment (wiring etc.).

For the duration of its transport the OOM1 shall be hermetically sealed under dry air or nitrogen. The initial wrapping of all parts shall be in multiple layers of plastic film (as sheet or bags) of type specifically for use in contamination controlled areas. 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 OOM1 and its components to the ELI-Beamlines facility and will remain responsible for them (with appropriate insurance cover) until up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading of the mounts at the ELI-Beamlines building entrance will be made by fork lift truck.

On the ELI-Beamlines site, the OOM1 mount and other delivered components will be unpacked by Supplier in ISO Class 5 cleanroom and will be inspected for absence of any damage due to transport, according to Annex 3, Verification Control Document (VCD).

This inspection shall be the basis for acceptance of D6.

Completion: 14 months after Commencement Day

II. Contractual options

Contractual Option 1: Manufacture, assembly and factory testing of OM7.5, delivery of OM7.5 to ELI-Beamlines

As part of this Deliverable the Supplier shall develop detailed engineering drawings of the optomechanical mount OM7.5, in line with the documentation produced within the D2 Deliverable.

The Supplier shall manufacture the OM7.5 mount. The Supplier shall install the integrated optomechanical mount in an ISO Class 5 or better cleanroom at his premises, where all assembly operations and testing shall be made. The Supplier shall integrate the mechanical components of the mount with the respective actuators.

The Supplier shall provide all equipment for the required testing of this OM7.5 optomechanical mount.

The Supplier shall validate key performance parameters of the OM7.5 mount at their works, namely demonstration of range of on individual movements and demonstration of stability of the mount.

The verification of OM7.5 mount performance shall be made according to the Verification Plan. The results of this performance verification and testing will be a Protocol on Factory Testing of the optomechanical mount OM7.5.

Upon completion of the factory testing the Supplier shall pack the OM7.5 mount and all related equipment. The mount shall be hermetically sealed under dry air or nitrogen.

The Supplier shall transport the OM7.5 optomechanical mount to the ELI-Beamlines facility.

On the ELI-Beamlines site, the mount will be unpacked by Supplier in ISO Class 5 cleanroom, and will be tested according to the Protocol on Reception Testing of the optomechanical mounts.

The status of requirements verified in this phase shall be tracked by the Verification Control Document (VCD), see Annex No. 3, and shall be the basis for acceptance of the Contractual Option 1.

The Client is entitled to activate this Option 1 with a written request no later than on the date of acceptance of Deliverable D6. The Supplier is entitled to invoice the Client with the price of Option 1 after its completion (i.e. upon acceptance of Deliverable DA).

The option might be activated by the Client if the process of designing and building of the Object of Purchase and the associated technology, for technical reasons, confirms the immediate need of manufacture and delivery of the OM7.5 mount.

Contractual Option 2: Optional design works

The following services are agreed as contractual option herewith. The Client is entitled to require provision of optional design works. 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 D6 Deliverable. The maximum extent of this contractual option is 40 man days. Detailed conditions of provision of the services (extent, subject matter of design works etc.) shall be agreed between Contractual parties. However, the Supplier will commence provision of the support no later than 10 working days after written request by the Client. The price of optional services (as man-day price) is stipulated by Annex 4 hereof and shall be paid if any optional services are provided after their due provision.

The services might be requested by the Client if there is a need of additional design works which exceeds the extent of design works that already form part of the subject matter hereof (i.e. are needed to perform and complete the subject matter of this contract as it is specified by this contract on the date of its conclusion), particularly if:

- a) the Client requests any modifications of the subject matter of the public contract (the Object of Purchase) or design of any additional parts of the Object of Purchase is needed, or

- b) the design works are needed to design any parts of technology needed to incorporate the Object of Purchase to the surrounding technology.

Contractual Option 3: Optional installation technical support

The following services are agreed as contractual option herewith. The Client is entitled to require provision of Supplier's technical support during installation of the optomechanics being subject of this contract. The Client is entitled (but has no duty to do so) to ask the Supplier for the support at its full discretion at any time starting by D4 and up to 2 months after D6. The maximum extent of this contractual option is 20 man days. Detailed conditions of provision of the support (extent, time of provision, profession of specialists etc.) shall be agreed between Contractual parties. However, the Supplier will commence provision of the support no later than 10 working days after written request by the Client. The price of optional support (as man-day price) is stipulated by Annex 4 hereof and shall be paid if any optional support is provided after its due provision.

The services might be requested by the Client if he realizes during his own works on installation of the mounts that installation support (advice and/ or hands on work) from the Supplier is needed for efficient installation of the mounts.



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ANNEX 2

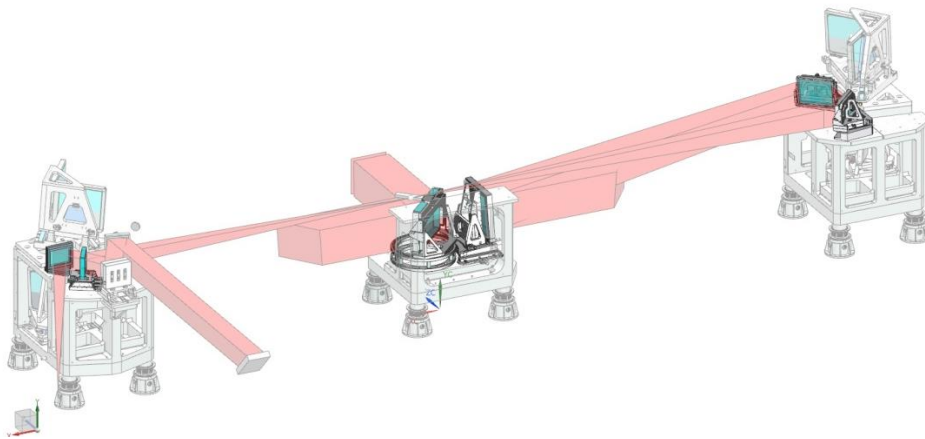
DETAILED TECHNICAL SPECIFICATIONS

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PBS code	RA1.L4.CMP1.10PW.OM.LCMT		
Project branch	<i>Engineering & Scientific documents (E&S)</i> Engineering & Scientific documents (E&S)		
Document Type	<i>Specification (SP)</i> Specification (SP)		

[RSD product category C]

Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor

TP19_010



Keywords

N/A

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Approved by

<i>Name (Approver)</i>	<i>Position</i>	<i>Date</i>	<i>Signature</i>
Bedřich Rus	Scientific Coordinator of Laser Technology (RP1)		

Change No.

<i>Change No.</i>	<i>Made by</i>	<i>Date</i>	<i>Change description, Pages, Chapters</i>	<i>TC rev.</i>
1	Bedřich Rus David Snopek Jack Naylon	12.06.2019	RSD draft creation	A
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1. Introduction

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints on a product related to the RA1 programme of the ELI Beamlines project. This can lead to identification of the 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 chapter 1.4).

1.2. Scope of work

This RSD states and describes the technical requirements for the assembly of large optomechanical vacuum mirror mounts and their electronic controls, which compose the final leg of the Compressor Image relay System (CIS). This part of CIS optical beam transport is located inside the large vacuum L4 10PW compressor (In-compressor CIS, I-CIS) and is an integral part of the overall L4 laser system of ELI Beamlines. It is registered in the PBS database under the following PBS code: *RA1.L4.CMP1.10PW.OM.LCMT*.

This RSD contains all of the technical requirements: functional, performance and design, delivery, safety and quality requirements for the following product (tender number: TP19_010): Large Optomechanical Mirror Mounts and electronic controls for L4 10 PW Compressor ("Mounts" in further text). In addition to the requirements specified hereinafter, all parts of the Mounts shall fully comply with the drawings provided in the Reference Documents (see below RD-01, chapter 1.4).

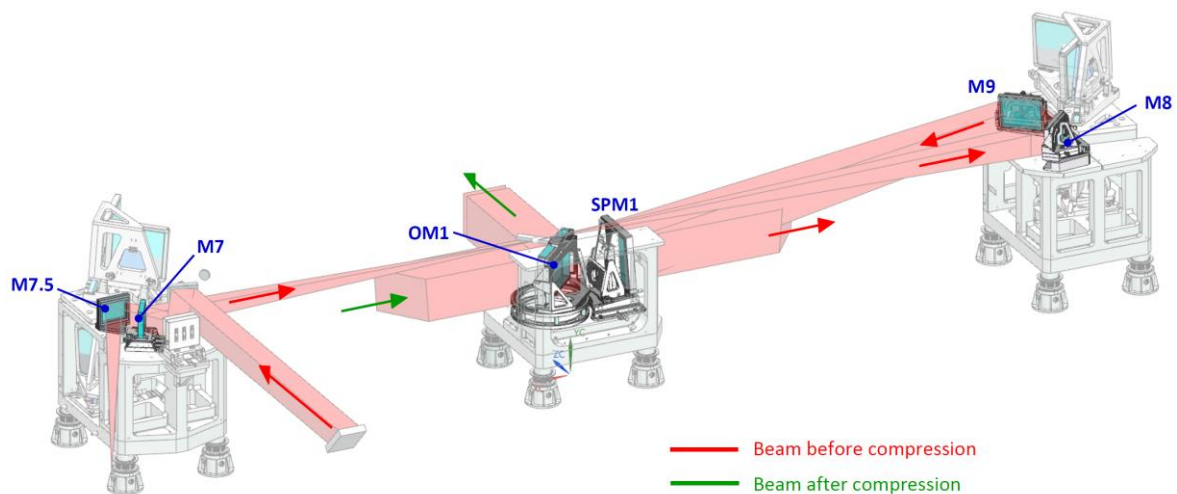


Figure 1: Overall layout of the In-Compressor Image relay System (I-CIS), showing location of all optomechanical mounts required within this contract (OM7, OM7.5, OM8, OM9, SPM1, and OOM1) and the optical path of the incoming laser beam reflected by mirrors M7-M8-M9-SPM1; mirror M7.5 serves to send the low-intensity beam transmitted through M7 to outside of the compressor. The M7, M7.5, M8 and M9 are planar mirrors; the SPM1 is a spherical mirror. A part of the required supply is also manufacture of the optomechanical mount for the compressor output mirror OM1 serving to send the compressed 10PW laser beam out of the compressor. The mounts will operate in high cleanliness vacuum environment and will be attached to the supporting chassis in each tower of the L4 compressor.

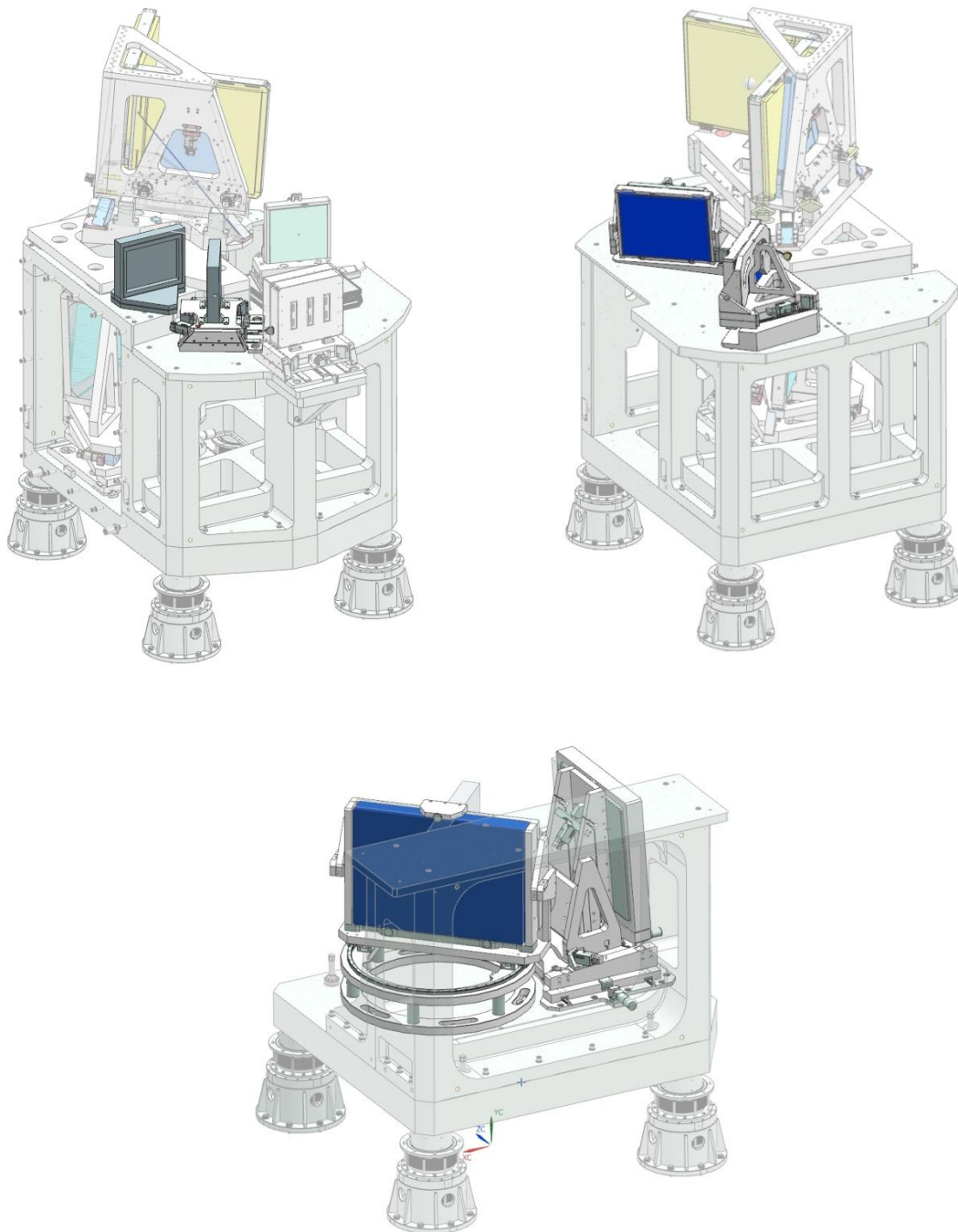


Figure 2: Location of the individual optomechanical mounts on the North (upper left), South (upper right), and central (bottom) chassis of the L4 vacuum compressor, indicating some spatial constraints. The mirrors M7 and M7.5 sitting on the North chassis shall have compact bases in order to fit environment of the surrounding systems. Design of the mount of mirror M9, sitting on the South chassis, shall be adapted to strongly limited height available above the local optical table on which this mount is attached. The mounts of mirrors SMP1 and OM1, both sitting on the central chassis, shall be designed with respect to close distance of these two mirrors.

Required part of the supply is manufacture of six optomechanical mounts of large laser mirrors which form the final leg of the CIS, or I-CIS, beam transport system from the L4 laser chain output to the L4 10PW compressor gratings. The overall layout of these mirrors and their mounts, sitting inside the L4 vacuum compressor, is shown in Figure 1. The mounts are located in all three compressor towers and are supported by rigid semi-monolithic chassis in each tower. The chassis are in turn mounted on monolithic isolation platforms which are mechanically de-coupled from the vacuum chamber body by means of bellow units integrated into the supporting legs.

The In-Compressor Imaging System (I-CIS) is located inside the compressor chamber and provides the following functions:

1. Transports the collimated laser beam from the input of the compressor chamber in vacuum, along the required geometric path, to reach the first diffraction grating
2. Expands the beam size from approximately 320x320 mm at the input of the compressor to approximately 650x650 mm on the first diffraction grating.
3. Forms part of the full optical image relay system between the L4 laser chain output and the final (fourth) grating in the compressor.

All the mounts required within this supply will be operating in high-cleanliness vacuum, at nominal pressure 10^{-7} mbar. The detailed design of the mounts as well as choice of the material and of components of the electronic controls shall be fully compatible with operation in high-cleanliness environment. For instance, all holes made in the mounts shall be vented and, as a rule, use of lubricants is not allowed. If local application of a lubricant is unavoidable, the only permitted are Krytox™ LVP and Braycote Micronic 601EF which are UHV compatible lubricants and are known to be proven for the intended purpose in high-precision vacuum optomechanical applications. However, amounts as minimum as possible shall be used, and any specific application of the lubricant shall be approved by CA.

The following tables provide a summary of the contractual requirements. The total scope of the contract comprises all the requirements stated or implied in the foregoing text, whether or not included in this summary.

1.3. Terms, Definitions and Abbreviations

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

Abbreviation	Meaning
API	Application Programming Interface
BiSS	Bidirectional / Serial / Synchronous
CA	Contracting Authority (Client)
CIS	Compressor Image relay System
D-SUB	Subminiature D-type connector according to specification MIL-DTL-24308
DIN	Deutsches Institut für Normung / German institute for standardisation
ELI	Extreme Light Infrastructure
EMI	ElectroMagnetic Interference
EMP	ElectroMagnetic Pulse
FEM	Finite Element Method
FLT	Fork Lift Truck
FMEA	Failure Mode and Effects Analysis
FPGA	Field Programmable Gate Array
GUI	Graphical User Interface
I-CIS	In-Compressor Image relay System
L x W x H	Length x Width x Height
L4c	Identification code of hall
MCTR	Motion Control System
MSS	Machine Safety System
NI	National Instruments
OM	Optomechanics
PLC	Programmable Logic Controller
RA1	Research activity 1
RGA	Residual Gas Analyzer
RIO	Reconfigurable I/O
RMC	Rack Mount Controller
RS-422	Recommended Standard for serial communication ANSI/TIA/EIA-422-B
RS-485	Recommended Standard for serial communication ANSI/TIA/EIA-485-A
RSD	Requirements Specification Document
RTD	Resistive Temperature Detector
RTS	Real-Time Server
SCADA	Supervisory Control and Data Acquisition system
TVS	Transient Voltage suppression Diode

Abbreviation	Meaning
TC ID	Team Center Identifier (unique identifier number)
UHV	Ultra High Vacuum
VCD	Verification Control Document

1.4. Reference Documents

Number of document	Title of Document/ File
RD-01	00230601/A_Drawing_package-Large optomechanical mounts for L4 10 PW compressor_TP19_010.zip

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

Drawing No	Filename	Sheets	File format
00197367/00	OM7	1	PDF
00222423/00	OM7.5	1	PDF
00197941/00	OM8	1	PDF
00197387/00	OM9	1	PDF
00212422/00	SPM1	1	PDF
00198749/00	OOM1	1	PDF

1.5. 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 the requirements including references to standards or technical documents.

2. Technical description

2.1. Scope of Work

Within this procurement the following scope of work is required:

- A. Final production design of six large optomechanical mounts OM7, OM7.5, OM8, OM9, SPM1 and OOM1, based on the detailed conceptual design provided by CA.

The Supplier is specifically required to:

- a) Develop detailed design of the individual mounts, based on the provided conceptual drawings, and perform FEM simulations of the final design to demonstrate rigidity and required vibration resonance properties
 - b) Identify and implement suitable actuators meeting the positioning and cleanliness requirements
 - c) Develop design of rigid frames in which the mirrors will be mounted and which will interface with the respective mounts; the frames shall be designed so that they do not produce any optically significant deformations to the mirrors
 - d) Develop design of attachment of the optomechanics to the respective optical support chassis; the solution should ideally use brackets not extending the optomechanics' footprint on the chassis
- B. Manufacture of the six optomechanical mounts OM7, OM7.5, OM8, OM9, SPM1 and OOM1.
 - C. Design, supply, installation and testing of the optomechanical system controller including all actuators and associated devices, according to the functional specification supplied by CA (see Section 2.3).
 - D. Design and supply of all cabling, cable management and vacuum feedthroughs (without vacuum flanges) for all electrical components of the mounts.
 - E. Final cleaning, trial assembly and functional testing of each optomechanical mount, at the supplier's works.
 - F. Packaging for transport and delivery of all the mounts to the ELI-Beamlines facility.

Installation of the mounts and final integration of the controls in the L4c hall of ELI-Beamlines is not required within this nominal procurement package but may be called in as contractual option.

The supply of the mirrors is not part of the scope of supply.

2.2. Optomechanical Mounts

The outline technical requirements of all required optomechanical mounts are given in

Table 1. The mounts are fitted with actuators that allow a fine adjustment of yaw and pitch by operation of stepper motor from the external control system.

Additionally to yaw and pitch, the mirrors M7, M8, and M9 are equipped by linear translation that allows for ± 12.5 mm axial translation. The SPM1 mount shall allow for ± 50 mm axial translation and also ± 25 mm lateral and ± 25 mm vertical translation. The OOM1 mirror mount shall be equipped by a rotation stage for 95° manual rotation and not precluding future implementation of stepper motor making it possible for operation from the external control system.

The mirrors will be mounted in frames which will be installed into the supplied optomechanical mounts and shall thus interface with these mounts.

Whenever indicated the axes shall be equipped by encoders making it possible absolute position knowledge by the encoder readout. The encoders shall provide this absolute position capability even after encoder switch on, without homing of the movement.

Table 1 provides a summary of functional requirements for all the optomechanical mounts that form part of this supply. While the individual parameters in Table 1 are binding the Supplier is entitled to select appropriate type of vacuum-compatible electrical actuator for each mount /axis. If needed, CA can provide Newport VHRU and/or LTA vacuum actuators including position encoders but the Supplier shall provide full integration of these actuators into the optomechanics and into the control system.

Table 1: In-compressor L4 CIS optomechanics
 (note: the individual optomechanics OMx correspond to the respective mirrors Mx).

Optomechanical mount No.	Range	Resolution ¹	Accuracy ²	Actuator type	Encoder
OM7					
Yaw	±0.5°	1 μrad	2 μrad.	Stepper motor	Y
Pitch	±0.5°	1 μrad	2 μrad	Stepper motor	Y
Translation	±12.5 mm	5 μm	10 μm	Stepper motor	Y
OM7.5					
Yaw	±1°	N.A.	N.A.	Manual	-
Pitch	±1°	N.A.	N.A.	Manual	-
Translation	±12.5 mm	N.A.	N.A.	Manual	-
OM8					
Yaw	±0.5°	1 μrad	2 μrad.	Stepper motor	Y
Pitch	±0.5°	1 μrad	2 μrad	Stepper motor	Y
Axial translation	±12.5 mm	5 μm	10 μm	Stepper motor	Y
OM9					
Yaw	±1°	1 μrad	2 μrad	Stepper motor	Y
Pitch	±1°	1 μrad	2 μrad	Stepper motor	Y
Axial translation	±12.5 mm	5 μm	10 μm	Stepper motor	Y
SPM1					
Yaw	±0.5°	1 μrad	2 μrad	Stepper motor	Y
Pitch	±0.5°	1 μrad	2 μrad	Stepper motor	Y
Axial translation	±50 mm	5 μm	10 μm	Stepper + ball screw	Y
Lateral translation	±25 mm	5 μm	10 μm	Stepper + ball screw	Y
Height	±25 mm	5 μm	10 μm	Stepper + ball screw	Y
OM1					
Pitch	±0.5°	1 μrad	5 μrad	Stepper motor	Y
Yaw (fine)	±1°	1 μrad	N.A.	2x stepper motor	-
Rotation (flip)	±45°	N.A.	N.A.	Manual	End positions detection

¹ One incremental step of motorized actuator without microstepping; one graduation of fine adjustment scale for micrometric screw

² Absolute position knowledge by encoder readout, bidirectional repeatability for motions without encoder

³ Design of the mount should enable implementation of a stepper motor in the future

Yaw: rotation around the vertical axis

Pitch: rotation around the horizontal axis parallel to the mirror surface

Roll: rotation around the horizontal axis perpendicular to the mirror surface

All mirrors will be mounted in frames. All mirrors have a groove around the entire edge (see Figure 3 below) to allow mounting the mirrors into the frame; the width of the groove is 10 mm for the mirrors M7, M7.5, M8 and M9, and 20 mm for the mirrors SPM1 and OM1. The supplier is asked to develop a 3-point design of the mounting elements, which shall not produce any consequential optical deformations of the front surface, specifically deformation produced by the mounting across the entire surface of the mirror shall not exceed 100 nm (or $\lambda/10$, where $\lambda = 1 \mu\text{m}$). Fulfilment of this criterion shall be substantiated by detailed FEM analysis. The solution of the mounting system provided in the CA drawings is only indicative as it does not employ the edge groove.

The frames shall be inserted and attached to the optomechanical mounts. Dimensions of the individual mirrors and of their mounting frames are shown below in Table 2.

The frames will be supplied by CA according to the design developed by the supplier.

Mirror	Substrate size			Frame size (outside dimensions)		
	Width (mm)	Height (mm)	Thickness (mm)	Width (mm)	Height (mm)	Thickness (mm)
M7	360	320	60	430	390	50
M7.5	370	320	60	430	390	50
M8	600	450	80	660	510	70
M9	600	450	80	660	510	70
SPM1	710	710	120	820	820	110
OM1	1000	710	120	1100	800 *	110

* Upper part of the OM1 frame consists only from central brace so as to leave maximum space for the laser beams propagating above the OOM1 mount

Table 2: Size of the in-compressor CIS mirrors and of the mounting frames (manufacture of M7.5 is not part of the nominal supply). The indicated thickness of the spherical mirror SPM1 relates to thickness at edges of this mirror.

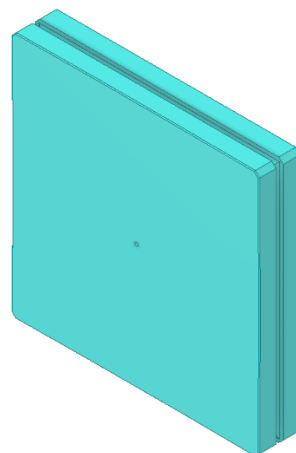


Figure 3: Schematic indication of the mounting groove around edge of all in-compressor CIS mirrors. The width of the groove is 10 mm for mirrors M7, M7.5, M8 and M9, and 20 mm for SPM1 and OM1; the groove depth is respectively 20 mm and 30 mm.

2.2.1. Optomechanical mount OM7

The conceptual design of the OM7 optomechanical mount is indicated in Figure 4 and, in more detail, in the drawing package in Chapter 5. The mirror has size 360 x 320 x 60 mm. The conceptual design is based on use of flexible joints for yaw and pitch movements. The mount has also to allow linear translation of the mirror by +/-12.5 mm.

The OM7 mount and the mirror frame shall not obstruct the back side of the mirror, thus following the conceptual design provided by CA. Furthermore, the OM7 will be mounted on the North chassis in space constrained environment and therefore its size resulting from the detailed design to be developed by the Supplier shall not exceed the dimensions of the conceptual design.

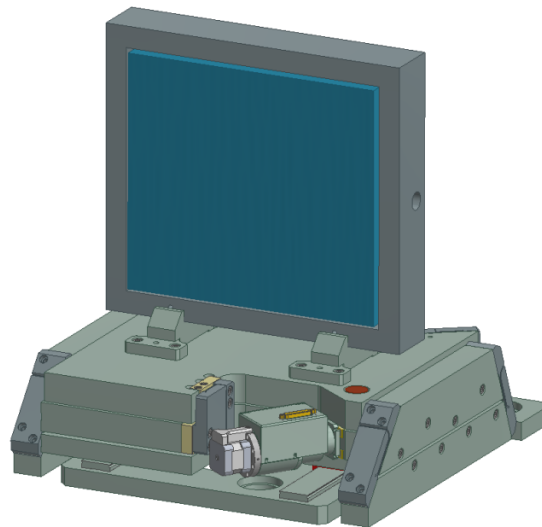


Figure 4: Conceptual design of the OM7 optomechanical mount. The mount shall allow accurate yaw and pitch alignment as well as linear motorized horizontal translation along a direction which is at 30 degrees with respect to the mirror surface.

2.2.2. Optomechanical mount OM7.5

The conceptual design of the OM7.5 optomechanical mount is indicated in Figure 5 and, in more detail, in the drawing package in Chapter 5. The mirror has size 360 x 320 x 60 mm. The conceptual design is based on use of flexible joints for yaw and pitch movements. The mount shall also make it possible linear horizontal movement by +/- 12.5 mm.

Manufacture of this mount OM7.5 constitutes an option of the contract.

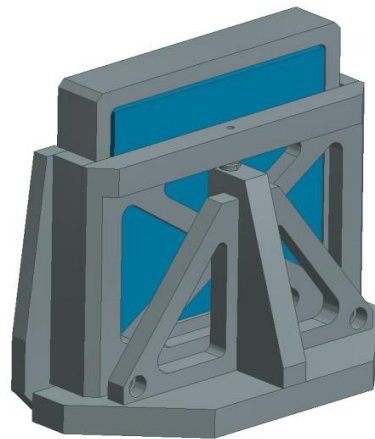


Figure 5: Conceptual design of the OM7.5 optomechanical mount. The mount shall allow accurate yaw and pitch alignment, as well as linear translation along an axis oriented at 60 degrees with respect to the mirror surface.

2.2.3. Optomechanical mount OM8

The conceptual design of the OM8 optomechanical mount is indicated in Figure 6 and, in more detail, in the drawing package in Chapter 5. The mirror has size 600 x 450 x 80 mm. The conceptual design is based on use of flexible joints for yaw and pitch movements. The linear movement along a horizontal direction shall allow for +/- 12.5 mm displacements.

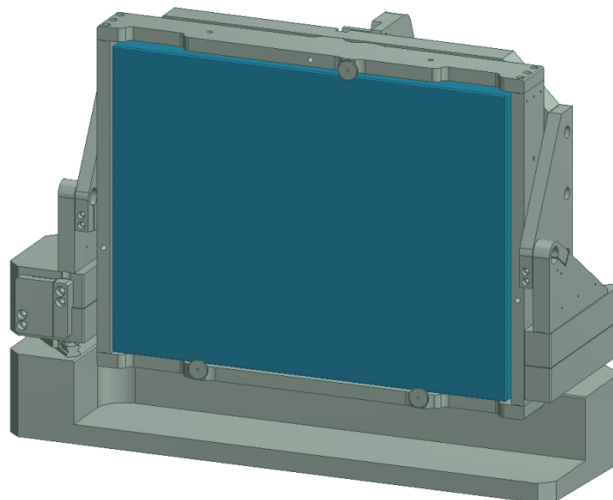


Figure 6: Conceptual design of the OM8 optomechanical mount. The mount shall allow accurate yaw and pitch alignment. The mount is also equipped by horizontal linear motorized translation along direction of approximately 45° with respect to the surface of the mirror.

2.2.4. Optomechanical mount OM9

The conceptual design of the OM9 optomechanical mount is indicated in Figure 7 and, in more detail, in the drawing package in Chapter 5. The mirror has size 600 x 450 x 80 mm. The conceptual design is based on use of flexible joints for yaw and pitch movements. The mount has also to make it possible linear translation of the mirror by +/- 12.5 mm.

The M9 mount shall be designed with respect to strongly restricted space between the bottom side of the mirror and the supporting optical table.

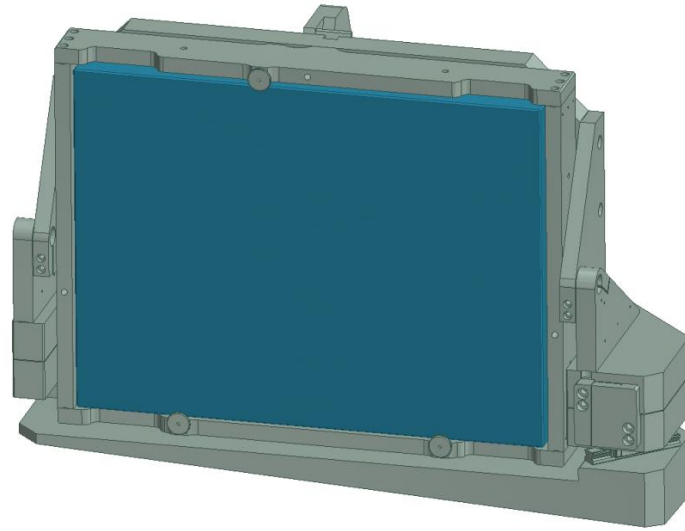


Figure 7: Conceptual design of the OM9 optomechanical mount. The mount shall allow accurate yaw and pitch alignment. The mount is also equipped by horizontal linear motorized translation along direction of approximately 45° with respect to the surface of the mirror.

2.2.5. Optomechanical mount SPM1

The conceptual design of the SPM1 optomechanical mount is indicated in Figure 8 and, in more detail, in the drawing package in Chapter 5. The mirror has size 710 x 710 x 120 mm. The SPM1 mount constitutes a 5-axis positioning assembly and is thus the most complex from all mounts required within this contract. The conceptual design is based on use of flexible joints for yaw and pitch movements, around a point located in the center of the front surface. The mount has also to make it possible x-y (axial and transverse direction, respectively) linear translations and also vertical translation by +/-25 mm, along an axis inclined by 3.25° with respect to vertical direction (this is due to the geometry of the optical beam path defined by the mirrors). Furthermore, the detailed design shall not exceed in dimensions the conceptual design provided by CA, as the SPM1 mount will operate in space-constrained arrangement, next to the OOM1 mount (see Figure 2).

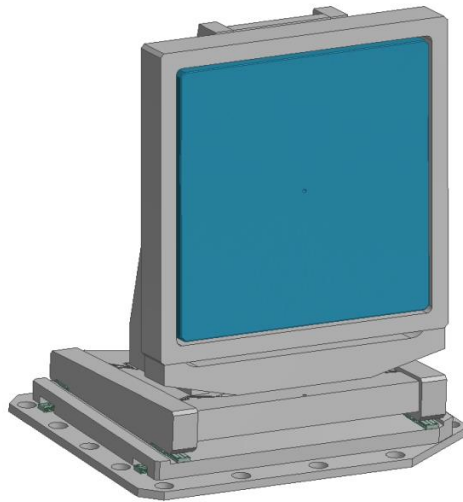


Figure 8: Conceptual design of the SPM1 optomechanical mount. The mount shall allow accurate yaw and pitch alignment around the center of the front surface. The mount shall also be equipped by motorized x-y-z linear translations where the z axis shall be inclined by 3.25° with respect to vertical direction.

2.2.6. Optomechanical mount OOM1

The conceptual design of the OOM1 optomechanical mount is indicated in Figure 9 and, in more detail, in the drawing package in Chapter 5. The mirror has size 1000 x 710 x 120 mm. The mount exploits flexible joints for the pitch movement. The OOM1 system shall be capable of motorized fine yaw movement but also shall allow for manually rotating (re-configuring) the mirror by 90° . This rotation is produced in the conceptual design by rotation motion guides (i.e., rails and caged ball guides).

The OOM1 mount and the mirror frame shall be designed with respect to limited space above the mirror, in order not to obstruct propagation of the laser beam in the compressor. The overall height of OOM1 thus shall not exceed that of the conceptual model supplied by CA.

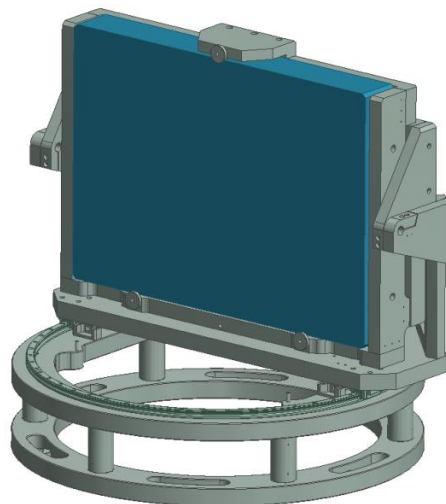


Figure 9: Conceptual design of the OOM1 optomechanical mount. Additionally to accurate yaw and pitch movements the mount shall allow rotation by 90° , to reconfigure output of the L4 compressor and to re-direct the output laser beam to the direction opposite to nominal configuration.

2.3. Motion Control System

The compressor Motion Control System (MCTR) is dedicated to precision closed-loop motion control and monitoring of all optomechanical systems within the L4 compressor. The MCTR shall integrate 41 stepper motors, 53 absolute encoders, 84 limit switches, 24 RTDs, 4 clinometers and 4 triaxial accelerometers.

A significant part of the MCTR consists of the integration of the grating optomechanical systems (G1, G2, G3 and G4). These systems shall be supplied by the CA on-site at the time of installation only. The grating optomechanics, actuators, cabling, feedthroughs and connectors are not in Supplier scope of supply. The Supplier shall supply the physical interfaces and control system integration as part of the MCTR for the grating systems (specified in the documentation provided), ready to be connected at the time of delivery. There are no specific performance requirements associated with the grating motion axes. The Supplier shall demonstrate the basic functionality of every control point, including those of the grating systems, as part of delivery acceptance unless the CA makes a specific exception.

In order to make the motion controls fully compatible with the control system of the L4 laser the low-level integration controls shall be based on the RIO platform that leverages FPGA-based feedback and distributed control architecture. RIO modules are available with comprehensive software development kits to interface, e.g., absolute position encoders via the BiSS open source protocol. Motor interface shall utilise universal step-direction control to allow stepper power drives to be easily exchanged for alternatives if required. Due to interlock requirements, the stepper drives cannot use microstepping to increase static positioning precision, as a continuous holding current cannot be assumed (*i.e.*, whole-step movements shall be made). All motor drives shall be deactivated before a laser shot via the interlock interface and the position of all axes shall remain static to within the specified axis position accuracy.

The MCTR shall be designed to the specified state machine scheme so that the state of the system is deterministic at all times. The MCTR shall interface to the external machine safety system (MSS) and be designed to comply reliably with the permissive signals provided and reliably output status and fault signals to this system as specified. The MCTR shall also export process variables to the L4 laser SCADA interface using the Real-Time Server (RTS) and software libraries that will be provided by the CA.

The MCTR shall be completely integrated using a RTS of type RMC-8354 and programmed in LabVIEW (for reasons of compatibility with the overall L4 control system based on LabVIEW) for real-time targets. The RTS, a DIN-mount Ethernet switch, software implementation templates for the RTS and for the FPGA controllers, and 1-2 days' training on the use of these shall be provided by the CA on the Supplier's request and delivered to the Supplier no more than 3 months after the start of the contract.

The Supplier shall provide a basic demonstration graphical user interface (GUI), LabVIEW-based, displaying actuator and system states and allowing operators to move axes for alignment when in the appropriate state. It shall be possible for operators to read the position of all axes and encoders both in raw and real-world units, with all necessary unit conversions being performed on the RTS directly. The coordinate transformations required for real-world conversion of the grating tripod mount axes are not in the scope of delivery.

The RIO(s) shall be closely integrated with machine protection functions and shall perform consistency checks on all drive faults and temperature thresholds for the in-vacuum RTDs. RIOs shall also react to alarms and faults and signal this to the external MSS which will shut down the laser. This MSS interface shall be based on 24V dry-contact signals and is specified in the documentation provided. A state machine regulating all motion activity shall be implemented on the RIO(s). It shall be regulated by a permission signal provided by the MSS and its status shall be signaled to the MSS as specified in the documentation provided. Devices

that are not allowed to operate in particular states shall be reliably prevented from activating. Unexpected removal of the permissive is an external interlock and the MCTR shall immediately stop any motion and deactivate any active drives.

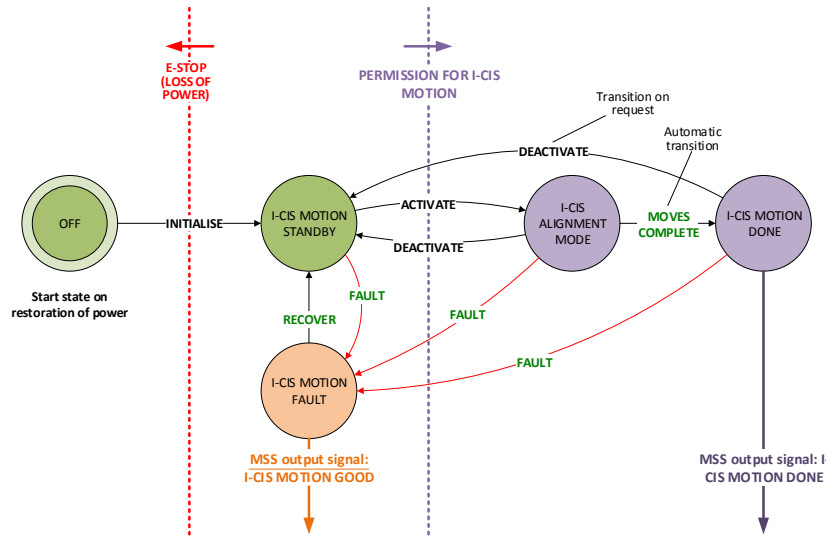
All motion control electronics represented between the blue dashed and red dashed lines shall be mounted in no more than two electrical cabinets which shall be provided by the CA. On the Supplier's request the CA shall provide the mounting panels from these cabinets to allow for off-site assembly of the controls electronics by the Supplier. Cabinets will be depth 0.5m, width 1.2m and height 2m (Rittal VX 8205.000) and will be located in an aisle close to the north wall of the L4c laser hall. Cabinets will be fitted with a plinth of height 200 mm for cable routing along the base. All cabling between the chambers and the cabinet shall be via floor channel and/or raised floor (provided by the CA at the time of installation) and via metal cable trays on the chamber vessel (provided by the CA).

Cable lengths between the chamber vessel and the control cabinets will be significant (30+ meters in some cases) so the Supplier shall ensure that all sensors and actuators are carefully chosen and cable type is properly specified for the lengths required. All sections of cable and pipe of length exceeding 50 cm will be supported or routed in closed metal cable trays which will be supplied by the CA. Cables and wires shall have an appropriate jacket colour – black, grey or white for general signals, blue for MSS signals, yellow or orange for personnel safety signals; earth, mains voltages and neutral per the usual standards. Pipes for compressed air shall be blue or stainless steel; cooling water supply shall be black (supply), red (return) or stainless steel. All cables and wires shall be labelled with a unique identifier and supplied with a cable schedule and/or wiring diagram from which the precise source and destination endpoints can be identified.

Special consideration shall be given to the influence of electromagnetic pulse (EMP) energy on all elements of the motion control system. This is primarily ensured by providing sufficient electrical shielding of the in-vacuum components, as the EMP source is within the chamber. Cables external to the control cabinet should be shielded to a minimum of 93% coverage and should be routed in closed metal cable trays. Wherever feasible, the Supplier should not preclude galvanic isolation and/or fast-acting surge protection (e.g., TVS diodes) for all connections to devices mounted in or on the chambers. In addition the supplier may wish to follow one or more of the following recommendations, at their discretion: use of RS-422 isolators for BiSS-C signals; use of EMI filtered D-SUB connectors on vacuum feedthroughs; use of double-shielded vacuum cables; use of ferrite common mode chokes on cables; use of EMI filters on mains power supplies. The final delivery acceptance of the MCTR shall include a functional demonstration.

The MCTR solution shall comply with the following diagrams. They show the required control system architecture and required control points (as a minimum – the Supplier may add control points so as to meet all other system requirements). Other implementation requirements are given in text notes in the diagram.

Many control system hardware items in the diagram are required to be chosen from the Requested Devices list (Table 3), for reasons of compatibility with the devices used in the L4 laser control system as well with the devices used in other major laser equipment of ELI-Beamlines.. The exact number of RIOs, terminals, interfaces and Ethernet ports used is not important as long as all minimum and any additional control points are fully integrated and all other requirements are satisfied.



In normal operation to begin alignment, MSS will grant the PERMISSION FOR I-CIS MOTION. This will also prevent the laser from firing. The L4 control system will then call the ACTIVATE transition, followed by the sequence of moves. When any drives are moving, I-CIS MOTION DONE is de-asserted by the motion controllers

In normal operation once the moves are complete, I-CIS motion goes to MOTION DONE state. If no more alignment is required, the L4 control system will then call the DEACTIVATE transition. MSS will then remove PERMISSION FOR I-CIS MOTION once verifying I-CIS MOTION DONE is asserted. After this the laser may fire.

Figure 10: State diagram for compliance of the MCTR with the concept of operations. Primary states are denoted by circles, allowed transitions by arrows and dashed lines represent permissives from safety systems.

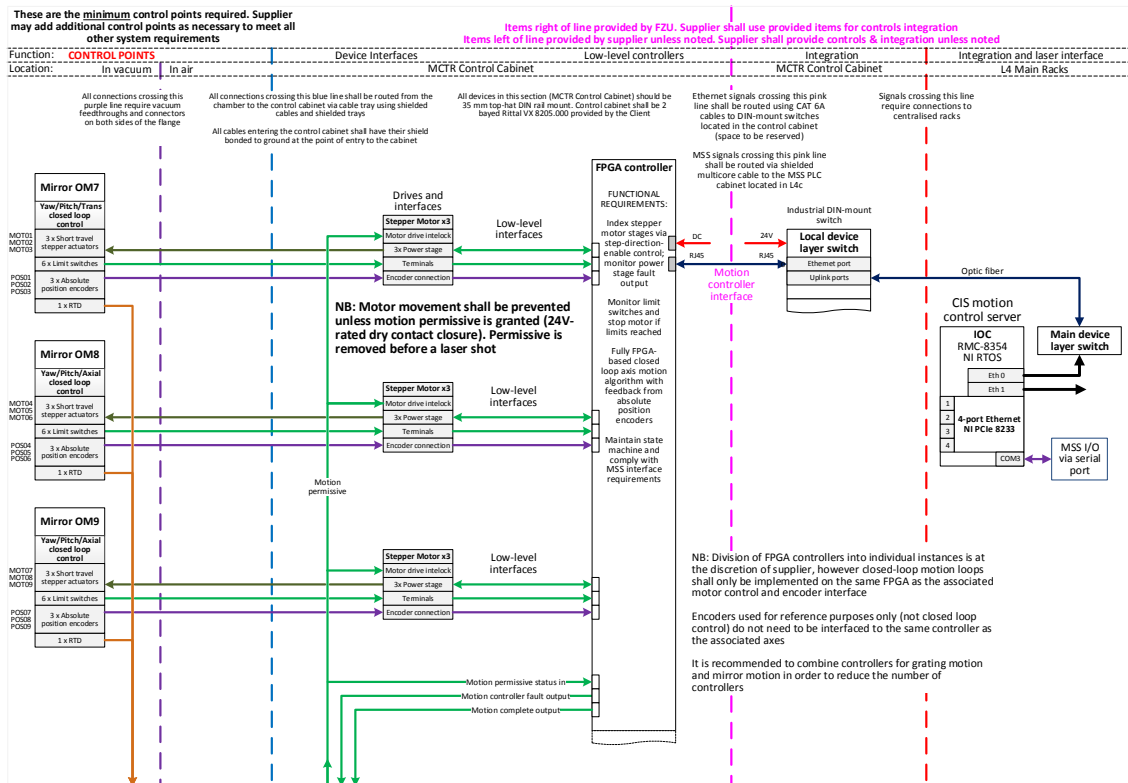
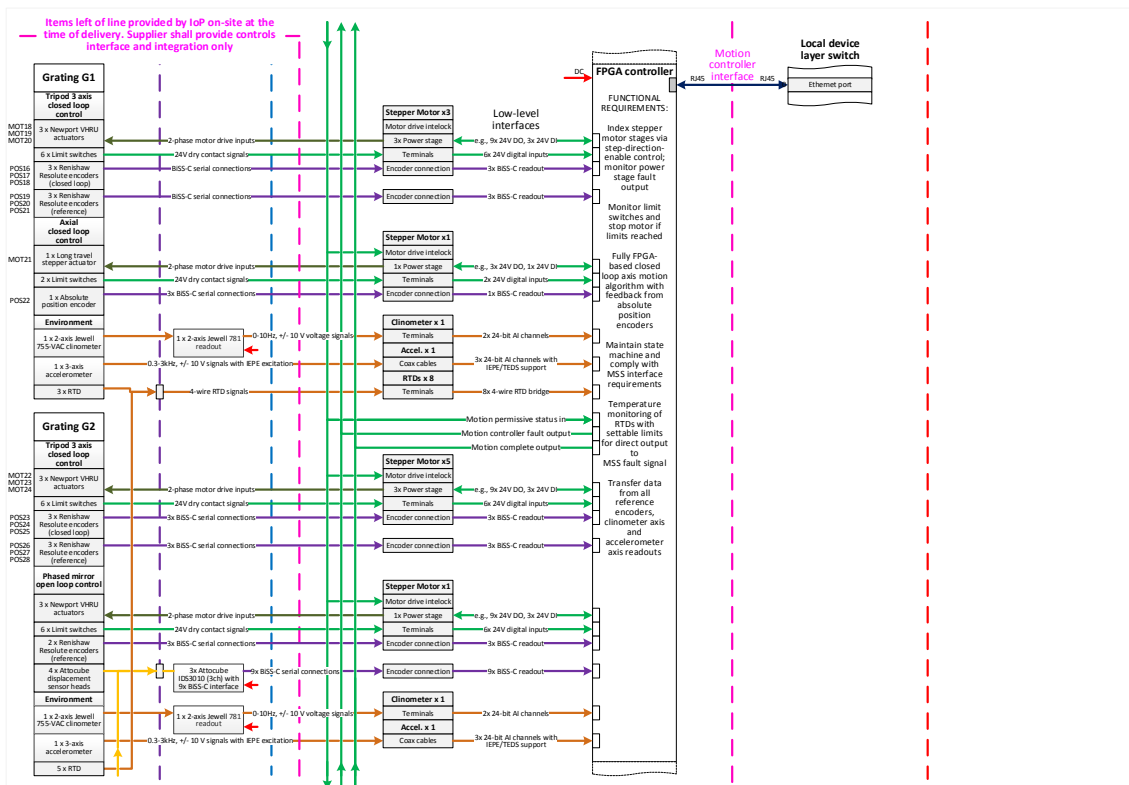
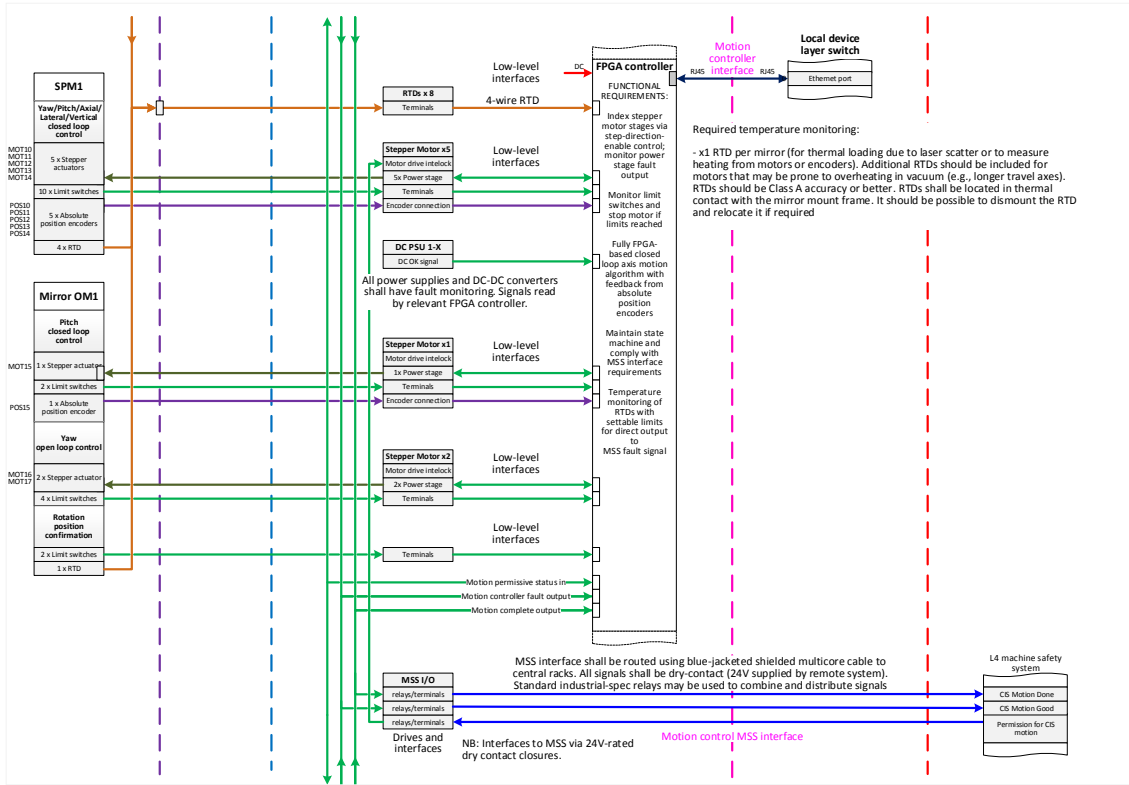


Figure 11: MCTR architecture and implementation compliance diagram to be followed by the Supplier. Figure continued on the following pages



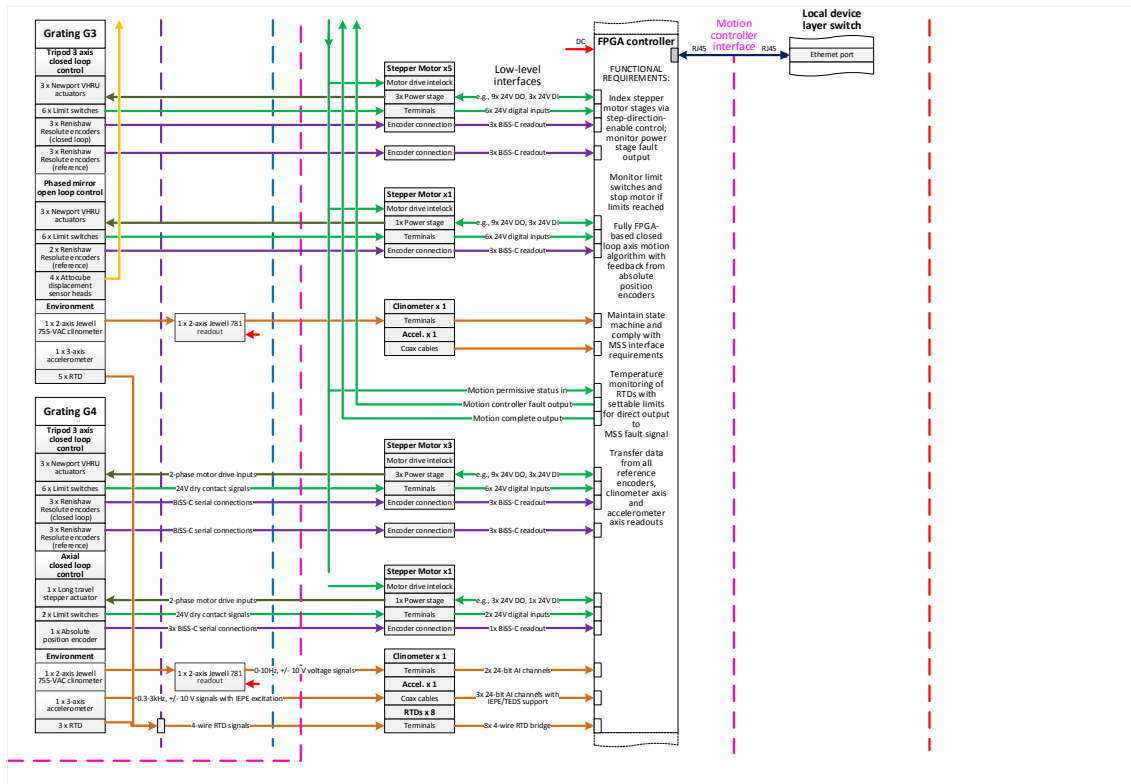


Table 2: Requested devices (hardware) list (motion controller)

The requested devices are those for which compatibility and operation with the existing laser equipment is proven. The necessity for a specific implementation is compatibility with the rest of the L4 laser control systems, compatibility with the control systems of other major laser equipment of ELI-Beamlines, and for maintainability assurance. Using the requested devices ensures that:

- Device has been tested by the CA and is known to be proven for its intended purpose and the requirements, thus reducing development risks and ensuring operational reliability;
- Device is already used in other parts of the L4 laser, minimizing risks of integration with the L4 laser control system and ensuring that spare parts and know-how are available at the CA;
- Device is known to be compatible with the CA's systems and to satisfy the CA's interface requirements, reducing the integration risks to ELI-Beamlines facility.

Device types not mentioned in this list may be freely selected by the Supplier as necessary to satisfy all other requirements.

Device type	Requested device
FPGA controller	NI 9149, NI 9147
FPGA BiSS-C input	SEA 9521
FPGA analogue input	NI 9239, NI 9234, NI 9220
FPGA RTD input	4-wire: NI 9216
FPGA digital I/O	NI 9423, NI 9474, NI 9477, NI 9476, NI 9425, NI 9426
FPGA motor interface	Digital I/O modules, SISU-1004
Other FPGA I/O	Any NI-listed C-series module
Stepper motor (short travel, high load)	Newport VHRU-10V9, -Newport LTA-HL V9
Stepper motor (long travel for ball screw)	Phytron VSS series
Stepper motor (short travel, low load)	NSA12V6 or NSA12V9
Stepper motor (rotation)	Newport RVU series
Absolute position encoder	Renishaw Resolute series with BiSS-C interface
Stepper motor power stage	Phytron MCD+ series; other Phytron drives
Serial device server	Moxa IA5450A
Precision limit switch	Metrol GN
Protection limit switch	Allectra 363 or similar construction
In-vacuum RTD	Allectra 343-PT100-C1
Accelerometer	PCB 356M98

2.4. General Requirements for Manufacture, Testing, and Packaging

2.4.1. Cleaning Procedure

1. Physical pre-cleaning
 - a. Prior to cleaning, all components shall be examined.
 - b. All surfaces shall be inspected one by one and shall be free of scratches, rolling, cracks, scale, or other defects.
 - c. All swarf, burrs, etc. from the machined surfaces shall be physically removed. The procedures may include high pressure air blasting, water jet, scraping, swabbing etc.
 - d. Gross contaminations from the manufacturing process shall be removed by washing or rinsing with suitable general purpose solvent.
2. Cleaning / washing
 - a. All components shall be cleaned separately. Cleaning of assembled components and systems is not allowed.
 - b. All components to be cleaned shall be thoroughly inspected. Areas or re-entrant volumes which may trap cleaning agents or may have deposits from the fabrication process shall be identified and closely followed during the whole cleaning process.
 - c. Degrease using detergent and town water, using a mild alkaline non-etch environment with a pH <11. If local regulation permits it is advised to use as an alternative trichloroethylene or perchloroethylene. Allowed procedures include rinsing, immersion and swabbing. Use of high pressure hot water jet (>100 bar), using 2% solution of Brulin 1990GD at 65-70°C is recommended.
 - d. Application of vapour degreasing process additionally to c) is recommended.
 - e. Immediately after c), without letting the surface dry, wash thoroughly with town water, without detergent. Recommended is use of high pressure hot water jet at temperatures around 80° C or higher. Pay particular attention to any trapped volumes.
 - f. Wash with clean demineralised water (minimum resistivity = 10^6 Ohm/cm). Allowed procedures include immersion and rinsing; use of high pressure hot water jet (temperature 60-80° C) is recommended.
 - g. Step f) should be ideally done by using ultrasonic bath. Use of ultrasonic bath for all small to medium size components and complex-shape components in step f) is mandatory.
 - h. All bolts shall be cleaned in ultrasonic bath with 2% solution of Brulin 816GD. Subsequently the bolts shall be cleaned by ultrasonic bath of clean acetone or isopropyl.
 - i. Ideally all components should be baked out at temperatures 200 to 300° C in a vacuum oven at a pressure <1 mbar, to achieve vacuum surfaces low in hydrocarbons. While application of this technique for the largest components of the mounts (e.g. mount bases) may be limited in terms of size, its use is mandatory for all optomechanics.

2.4.2. General rules for assembling

- Any use of grease shall be avoided unless absolutely necessary.
- The only UHV compatible approved lubricants are Krytox™ LVP and Braycote Micronic 601EF
- The mounts shall be assembled in clean space with cleanliness Class 5 according to ČSN EN ISO 14644 standard (equivalent to ISO 14644), or better.

2.4.3. Testing and inspection

- The assembled mounts shall be tested in clean space or clean flowbox with cleanliness Class 5 according to ČSN EN ISO 14644 standard (equivalent to ISO 14644), or better.
- Prior to installation into the mounts, all actuators and components of linear translations shall be tested at works for vacuum cleanliness at vacuum pressures $1 \cdot 10^{-7}$ mbar. The tests will require the quadrupole mass spectrometer (or RGA, residual gas analyzer) to prove that the residual gas mass spectrum of each actuator is free of peaks due to high-mass species beyond mass number 44 (corresponding to residual CO₂ molecules).
- The mounts shall be thoroughly tested at works for functionality (resolution / range / accuracy / encoder readings / integration with the electronic controller) with mass simulators corresponding to the aggregated mass of the corresponding mirror and its frame.

2.4.4. Packaging

- Each movement or movable part of the optomechanical mounts shall be firmly locked before packaging to avoid damage during transport, by means of a securing bracket.
- Each mount shall be packed separately.
- A multi-layer wrapping protocol shall be applied to preserve Class 5 level of cleanliness (according to ČSN EN ISO 14644 standard (equivalent to ISO 14644), or better) during shipping.
- The interior of the package container shall be filled with clean dry air or nitrogen.
- Each mount shall be triple bagged, with two layers of polyethylene cleanroom film (e.g. UltraLOPlus™ or equivalent) and then one layer of a vapour barrier material such as foil. Seams shall be taped or heat sealed. Excess air between wrappings shall be evacuated and the bags sealed with desiccant packs inside.

3. Functional, Performance and Design requirements

3.1. General

REQ-027384/A

R1-00 - The detailed 3D engineering model and/or detailed drawings submitted by the Supplier shall be approved by the Client prior to proceeding to elaboration of the production (manufacture) drawings.

Verification method: R - review of related drawings and CA approval

3.2. Optomechanical mounts

REQ-027264/A

R1-01 - The optomechanical mounts shall be designed to support the respective optical components with dimensions as given in Table 2. The nominal position and orientation of the optical components in space shall be as in the 3D model. The required extent of movements shall be as in Table 1.

NOTE: The 3D model of the mounts will be provided to the Supplier after the contract signature.

Verification method: R - review of design, T – test

REQ-027265/A

R1-02 - The optomechanical mounts shall be attachable to the optical support chassis and shall be able to be pre-positioned (without engaging the actuators) with precision of ± 1 mm.

NOTE: The 3D model of the chassis will be provided to the Supplier after the contract signature.

Verification method: R - review of design, T – test

REQ-027266/A

R1-03 - Each individual optomechanical mount shall provide short-term and long-term angular mechanical stability (drift) of the optical element better than $1 \mu\text{rad}$ (in a thermally stabilized environment).

Verification method: T - test

REQ-027267/A

R1-04 - FEM resonant frequency analysis of the optomechanical mounts shall be carried out by the Supplier.

Verification method: A – analysis

REQ-027268/A

R1-05 - The mounts shall not exhibit any resonant frequency below 35 Hz, and also shall not have resonant frequency close to 50 Hz.

Verification method: A – analysis

REQ-027269/A

R1-06 - The principal material of the optomechanical mounts shall be aluminium. The Supplier shall provide Certificate of Origin specifying manufacturer, composition of the alloy, for each aluminum blank used.

Verification method: R - review of material certificates

REQ-027270/A

R1-07 - The mirrors shall be mounted in frames separable from the positioning parts of the optomechanical mounts.

Verification method: R - review of design

REQ-027271/A

R1-08 - The design of the frames shall incorporate a 3-point fitting scheme for the mirrors, which shall not produce deformation across the entire surface higher than 100 nm.

Verification method: R - review of design

REQ-027272/A

R1-09 - The mounts design shall feature integration of electrical actuator including wirings for electrical actuators.

Verification method: R - review of design

REQ-027273/A

R1-10 - The detailed design of the mounts and any other components shall avoid any trapped volumes of air, e.g. the mounting holes shall not be blind tapped.

Verification method: R - review of design

REQ-027274/A

R1-11 - All actuators used in the optomechanics shall be certified for vacuum at least $1 \cdot 10^{-8}$ mbar.

Verification method: R - review of documentation

REQ-027275/A

R1-12 - All outer surfaces shall be machined resulting in surface quality of Ra 0.8 μm or better.

Verification method: I – inspection, T – Test

REQ-027276/A

R1-13 - All edges of the optomechanical mounts shall be chamfered.

Verification method: R - review of design, I – inspection

REQ-027277/A

R1-14 - All cables for electrical actuators shall be organized into cable trays both inside the compressor vacuum chamber and on the chamber exterior.

NOTE 1: Layout and location of the cable trays will be specified by the CA.

NOTE 2: The 3D model of the compressor will be provided to the Supplier after the contract signature.

Verification method: R - review of design, I – inspection

REQ-027278/A

R1-15 - Cable from each electrical actuator shall be led to the exterior by no more than one electrical vacuum feedthrough.

Verification method: R - review of design, I – inspection

REQ-027279/A

R1-16 - Best practice shall be followed in the design, type choice and implementation of the vacuum electrical feedthroughs.

Verification method: R - review of design, I – inspection

3.3. Control system

REQ-027280/A

R2-01 - Actuators, encoders, sensors and other instrumentation shall be delivered with control systems, power and utilities connections as necessary for correct and safe operation of the in-compressor CIS assembly, and with full English-language documentation.

Verification method: R - review of design, I – inspection

REQ-027281/A

R2-02 - All control systems hardware (device) shall be selected from the Requested Hardware (device) List to be compatible with the hardware used for the L4 laser controls. Use of custom-made hardware or devices shall be justified by the Supplier and approved by the CA on a case-by-case basis.

NOTE: This list contains off-the-shelf control system devices that are compatible with the L4 system controls, have been verified by the CA and for which spares are maintained.

Verification method: R - review of design, I – inspection

REQ-027282/A

R2-03 - All actuators, sensors and other instrumentation which has a computer interface such as RS-485 or Ethernet shall be provided with LabVIEW drivers and/or API and a basic demonstrative graphical user interface (GUI). All drivers shall follow the National Instruments' Instrument Driver Guidelines, and shall be verified as compatible with the National Instruments Real-Time operating system (NI ETS 2016) on the RMC-8354 real-time server computer, to ensure compatibility with the existing integration platform of the CA for the L4 laser and for other major laser equipment of ELI-Beamlines.

NOTE: The control system of the L4 laser into which the controls will be integrated is based on LabVIEW 2016 SP1.

Verification method: R - review of design, I – inspection, FD – functional demonstration

REQ-027283/A

R2-04 - All software forming part of the control system, including but not limited to drivers (see REQ-027282/A) and FPGA firmware, shall be provided fully open-source in LabVIEW, and use only National Instruments' distributed libraries and those by 3rd parties in wide circulation via the VI Package Manager. No DLLs, .COM or .NET objects or any other mechanisms for calling closed-source external code shall be used. All software shall have full English-language documentation and comments.

Verification method: R - review of design, I – inspection, FD – functional demonstration

REQ-027284/A

R2-05 - All critical control systems software shall run on embedded real-time computing hardware chosen from the Requested Hardware (device) List (Table 3).

NOTE: Basic GUIs and non-critical software that are not essential for correct and safe operation of the CIS may run on Windows (or equivalent) or Linux (or equivalent) PCs, as necessary.

Verification method: R - review of design, FD – functional demonstration

REQ-027285/A

R2-06 - A complete set of wiring diagrams and full bill of materials shall be provided for the control system

Verification method: CA review

3.4. Packaging and Transportation requirements

REQ-027286/A

R3-01 - For the duration of its transport the individual optomechanical mounts shall be sealed under dry air or nitrogen. The initial wrapping of all parts shall be in multiple layers of ultra-low outgassing plastic film (as sheet or bags) of type specifically for use in contamination controlled areas. This 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.

Verification method: I – inspection

REQ-027287/A

R3-02 - The Supplier shall transport the components to the ELI-Beamlines facility and shall remain responsible (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading of the components at the building entrance will be carried out by the CA by fork lift truck (FLT) so the packages shall be palletized to suit FLT handling.

Verification method: I – inspection

REQ-027288/A

R3-03 - In order to fit in the lift the maximum dimensions of any component transport package shall not exceed 5.5 x 5.1 x 2.95 m³.

Verification method: I – inspection

3.5. Testing, inspection and documentation

REQ-027289/A

R4-01 - All optomechanical mounts shall be cleaned and tested at the manufacturer's works prior to acceptance for transport to ELI-Beamlines.

NOTE: CA will carry out its own spot check tests to confirm vacuum cleanliness of each of the mounts using its own test method.

Verification method: T – test

REQ-027290/A

R4-02 - Vacuum pumping tests shall prove that the actuators and the components of linear translations are compatible with a vacuum pressure $1 \cdot 10^{-7}$ mbar and using the quadrupole mass spectrometer (Residual Gas Analyzer) it shall be demonstrated that partial pressure of volatile organic compounds (VOCs) and other impurities with atomic mass >44 are less than 1/80 of partial pressure of residual CO₂ molecules (atomic mass = 44) after no more than 12 hours of pumping.

Verification method: T – test

REQ-027291/A

R4-03 - The Supplier shall allow the CA supervising the activities related to the cleaning, testing, packaging and 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: N/A

REQ-027292/A

R4-04 - Only new materials and equipment with manufacturer's full warranty shall be used for the entire scope of supply.

Verification method: I – inspection

REQ-027293/A

R4-06 - The mounts shall be delivered with fully detailed installation and operational manuals, certification and technical documentation, in English language.

Verification method: CA review of the installation and operation manual/s

3.6. Safety Requirements

3.6.1. General Safety Requirements

REQ-027294/A

R5-01 - 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 Device sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.

Verification method: CA review

REQ-027295/A

R5-02 - The Declaration of Conformity shall contain at least the following regulations:

- ČSN EN 61010-1 ed. 2 Safety requirements for electrical equipment for measurement, control, and laboratory use (equivalent to EN 61010-1)

Verification method: CA review

3.6.2. Personal and Machine safety

REQ-027296/A

R8-03 - A risk-assessment and failure mode and effects analysis (FMEA), to agreed template, shall be conducted by the manufacturer for the control systems in their scope of supply. Hazards to persons and the environment, and failures exceeding €10k damages or requiring more than 8 hours down-time shall be identified and considered.

Verification method: CA review

4. Quality requirements

4.1. Documentation and data control

REQ-027297/A

The Supplier shall supply the following relevant manufacturing documents:

- all manufacturing design, 3D model and design supporting documentation approved by the CA (see REQ-027303/A);
- full technical documentation on the delivered Product (e.g. installation, safe operation and maintenance instructions);
- all “requests for deviation/waiver from requirements described herein” approved by the CA (see REQ-027300/A).

Verification method: R – review, I - inspection

REQ-027298/A

The Supplier shall use following data formats:

- *.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: Not To Be Tracked within VCD

REQ-027299/A

Documentation (e.g. reports, protocols, certificates, instructions, manuals, etc.) shall be supplied in PDF format.

Verification method: Not To Be Tracked within VCD

4.2. Nonconformity control system

REQ-027300/A

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

4.3. 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 that the result of verification was OK.

4.3.1. 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 fulfills 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 fulfillment (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).

4.3.2. 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 fulfillment of the basic purpose of the VCD – to document and demonstrate the verification of fulfillment of CA requirements

REQ-027301/A

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. But different mounts and the MCTR might have different time schedule of Deliverables.

Verification method: The CA will review and agree the VCD and issue Acceptance protocol for the Supplier at the acceptance of the related Phase of delivery

REQ-027302/A

Before completion of the detailed engineering documentation 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.;
- structure and content of the VCD if it was modified by the Supplier.

Verification method: The CA shall agree the related documentation and issue Acceptance protocol for the Supplier at the acceptance of the related Phase of delivery.

REQ-027303/A

Before completion of the detailed engineering documentation 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-027300/A).

Verification method: The CA shall agree the related documentation and issue Acceptance protocol for the Supplier at the acceptance of the related Phase of delivery.

4.3.3. Acceptance

Acceptance will be carried out by the CA upon completion of each Phase of delivery. In case of successful acceptance phase the CA will provide to the Supplier signed acceptance protocol for each Phase of delivery. In case of unsuccessful acceptance stage the CA will provide to the Supplier Nonconformity Report (NCR) and process in accordance with REQ-027300/A shall be applied.

The final acceptance will be executed by the CA by verifying all criteria stated in REQ- 027304/A

The Acceptance phase shall demonstrate the following:

- The final product has been successfully verified and this process has been documented in an appropriate way;
- All detected nonconformities have been solved in accordance with REQ-027300/A;
- The final product is free of fabrication errors, is not damaged during transport and is ready for the intended operational use.

REQ-027304/A

The Acceptance phase shall demonstrate the following:

- All finished parts of the mirror mounts and electronic controls 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-027300/A;

Verification method: The CA shall verify all the related documentation and issue Final Acceptance protocol for the Supplier

5. Reference drawings and diagrams

The overview drawings related to this RSD and included within the **RD-01** archive (see chapter 1.4) are shown below in sections 5.2 to 5.7.

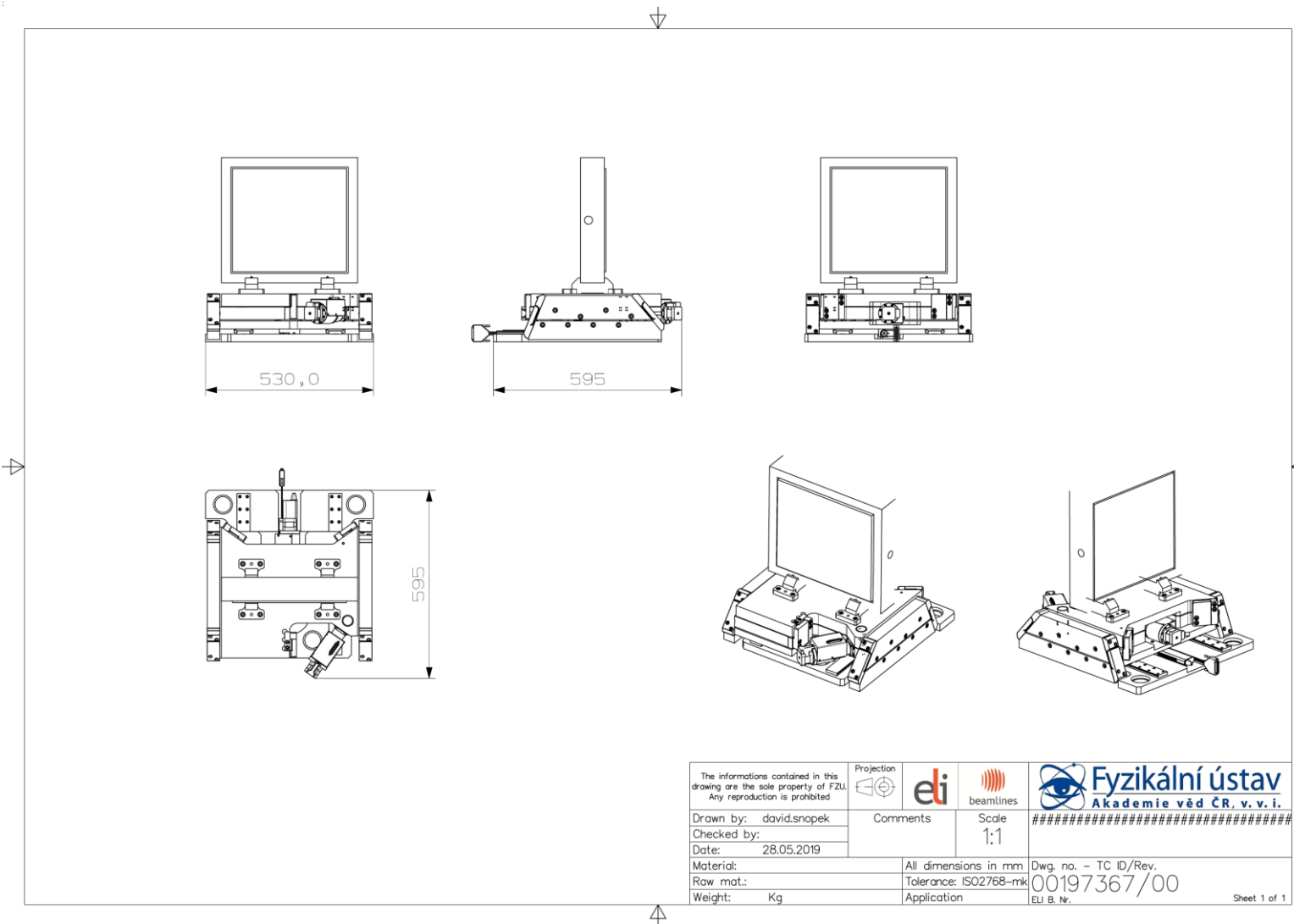
TC ID No.	Title of document / File	Description
00230603/A	MCTR_Simplified_Motion_Controls_29-May-2019.pdf	
00230601/A	Large optomechanical mounts for L4 10 PW compressor_TP19_010.zip	Drawing package (see below)

5.1. Drawing Package

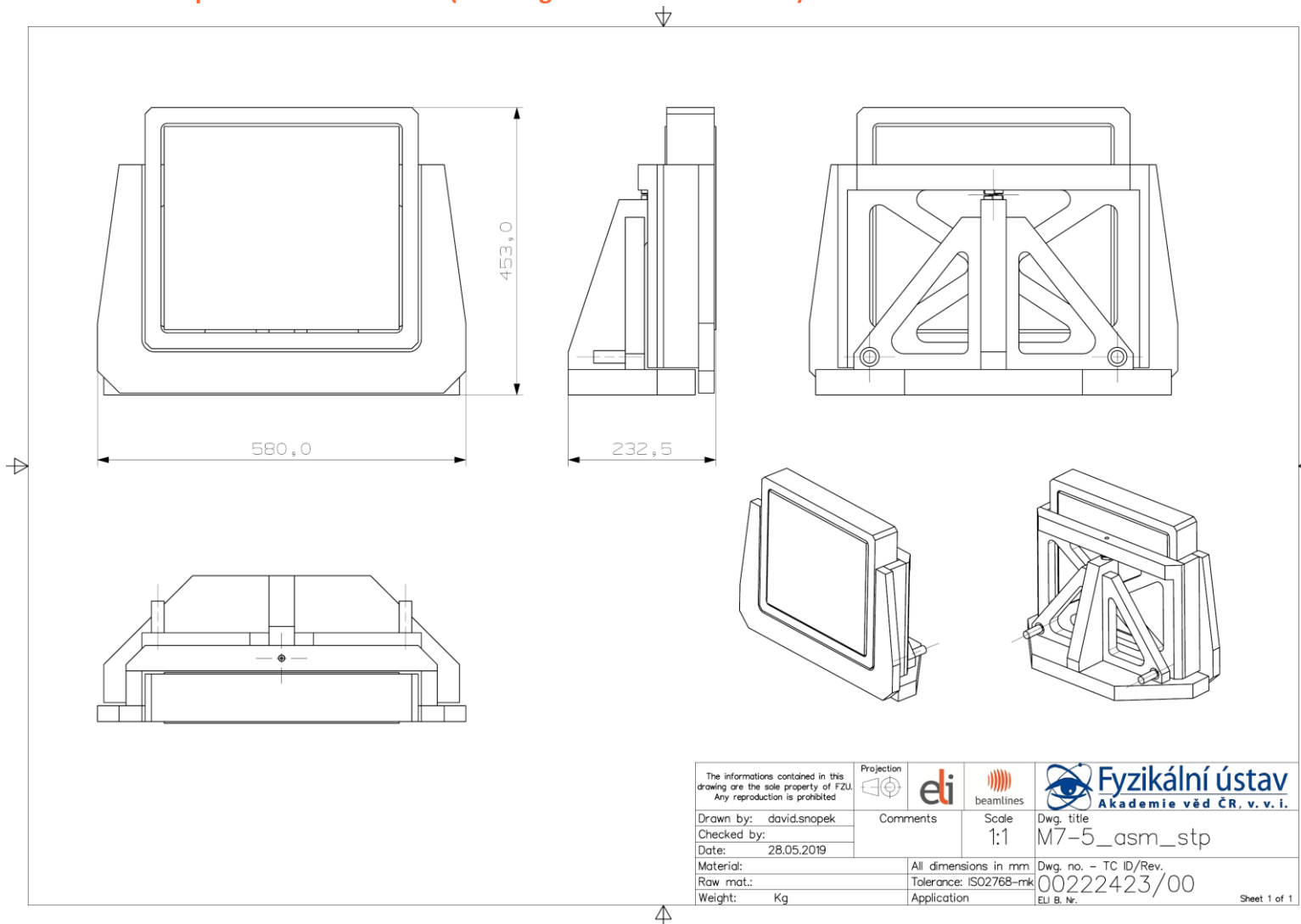
Detailed list of drawings included within “*Drawing_package-Large optomechanical mounts for L4 10 PW compressor_TP19_010.pdf*” file:

No.	TC ID No.	No. of sheets	Drawing Title	Description
1	00197367/A	1	M7	OM7 optomechanical mount
2	00222423/A	1	M7.5	OM7.5 optomechanical mount
3	00197941/A	1	M8	OM8 optomechanical mount
4	00197387/A	1	M9	OM9 optomechanical mount
5	00212422/A	1	SPM1	SPM1 optomechanical mount
6	00198749/A	1	OOM1	OOM1 optomechanical mount

5.2. OM7 optomechanical mount (Drawing No 00197367 Rev. 01)

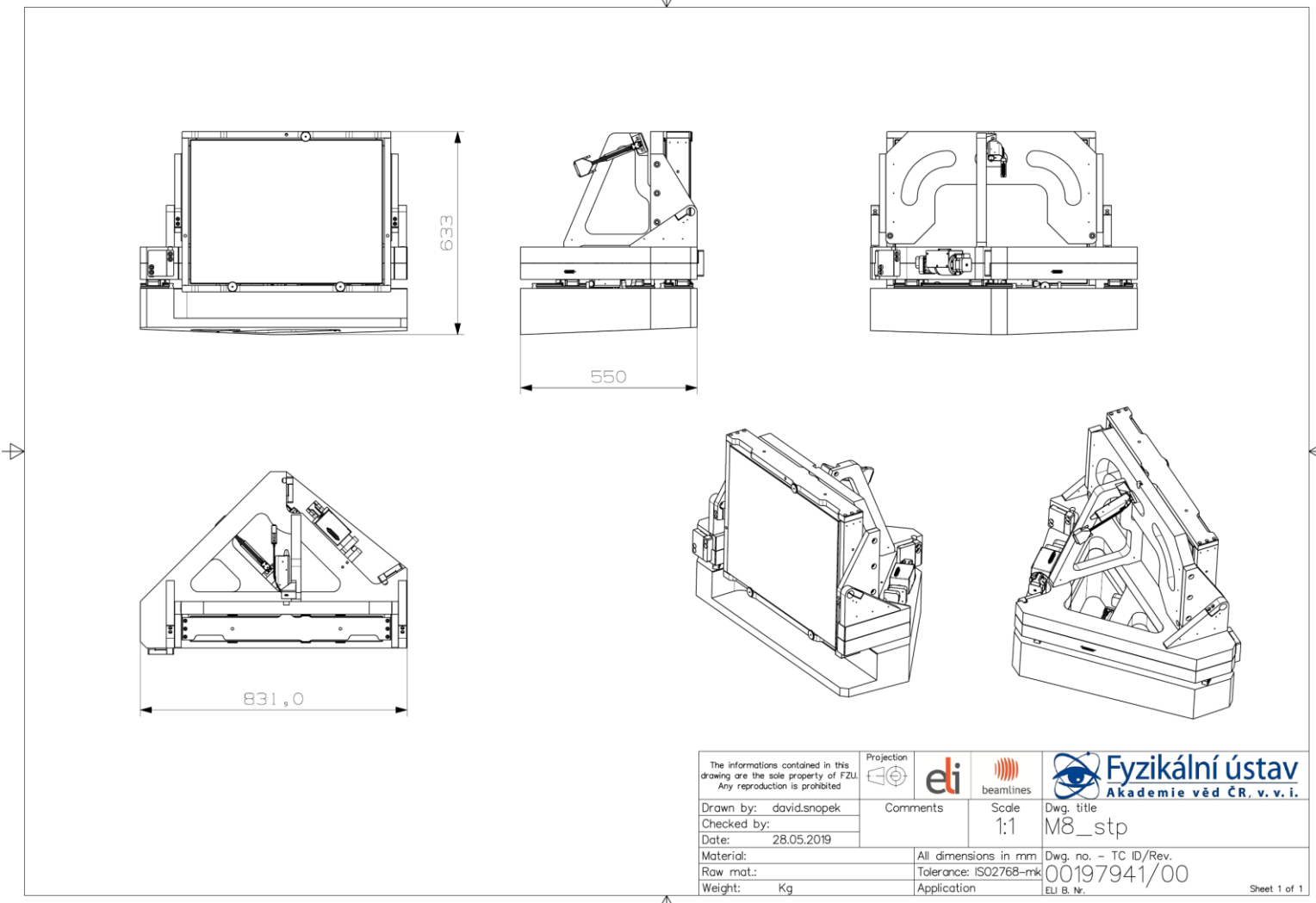


5.3. OM7.5 optomechanical mount (Drawing No 00222423 Rev. 01)



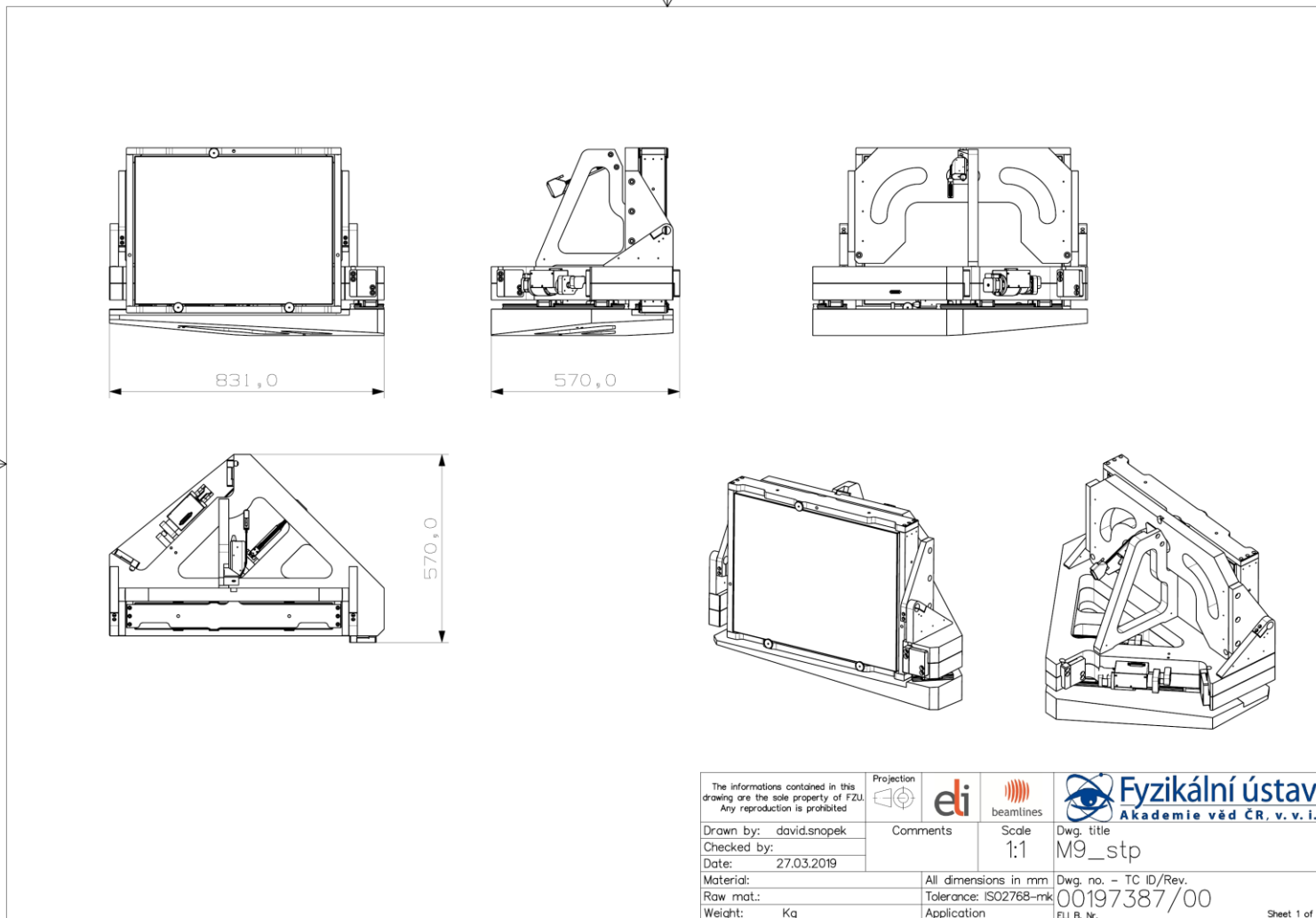
The informations contained in this drawing are the sole property of FZU. Any reproduction is prohibited	Projection	eli beamlines	Fyzikální ústav Akademie věd ČR, v. v. i.
	Comments		
Drawn by: david.snopek	Date: 28.05.2019	All dimensions in mm Tolerance: ISO2768-mk Application	Dwg. no. - TC ID/Rev. 00222423/00 ELI B. N.
Checked by:			
Material:			
Raw mat.:			Sheet 1 of 1
Weight: Kg			

5.4. OM8 optomechanical mount (Drawing No 00197941 Rev. 01)



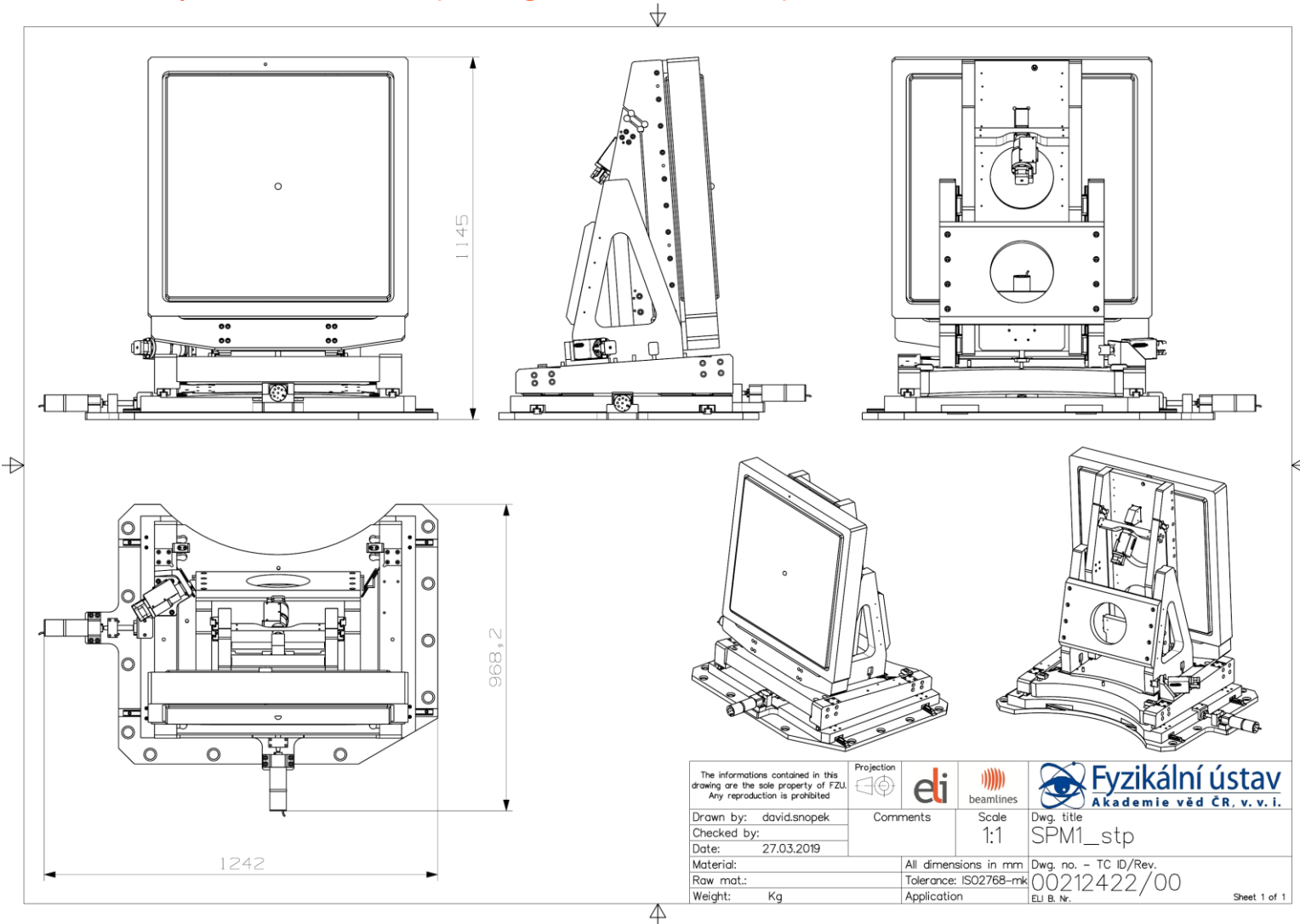
The informations contained in this drawing are the sole property of FZU. Any reproduction is prohibited.		Projection	eli	beamlines	Fyzikální ústav Akademie věd ČR, v. v. i.
Drawn by: david.snopek	Comments	Scale	Dwg. title		
Checked by:		1:1	M8_stp		
Date: 28.05.2019			Dwg. no. - TC ID/Rev.		
Material:	All dimensions in mm	00197941/00			
Raw mat.:	Tolerance: ISO2768-mk	ELI B. N.			
Weight: Kg	Application	Sheet 1 of 1			

5.5. OM9 optomechanical mount (Drawing No 00197387 Rev. 01)

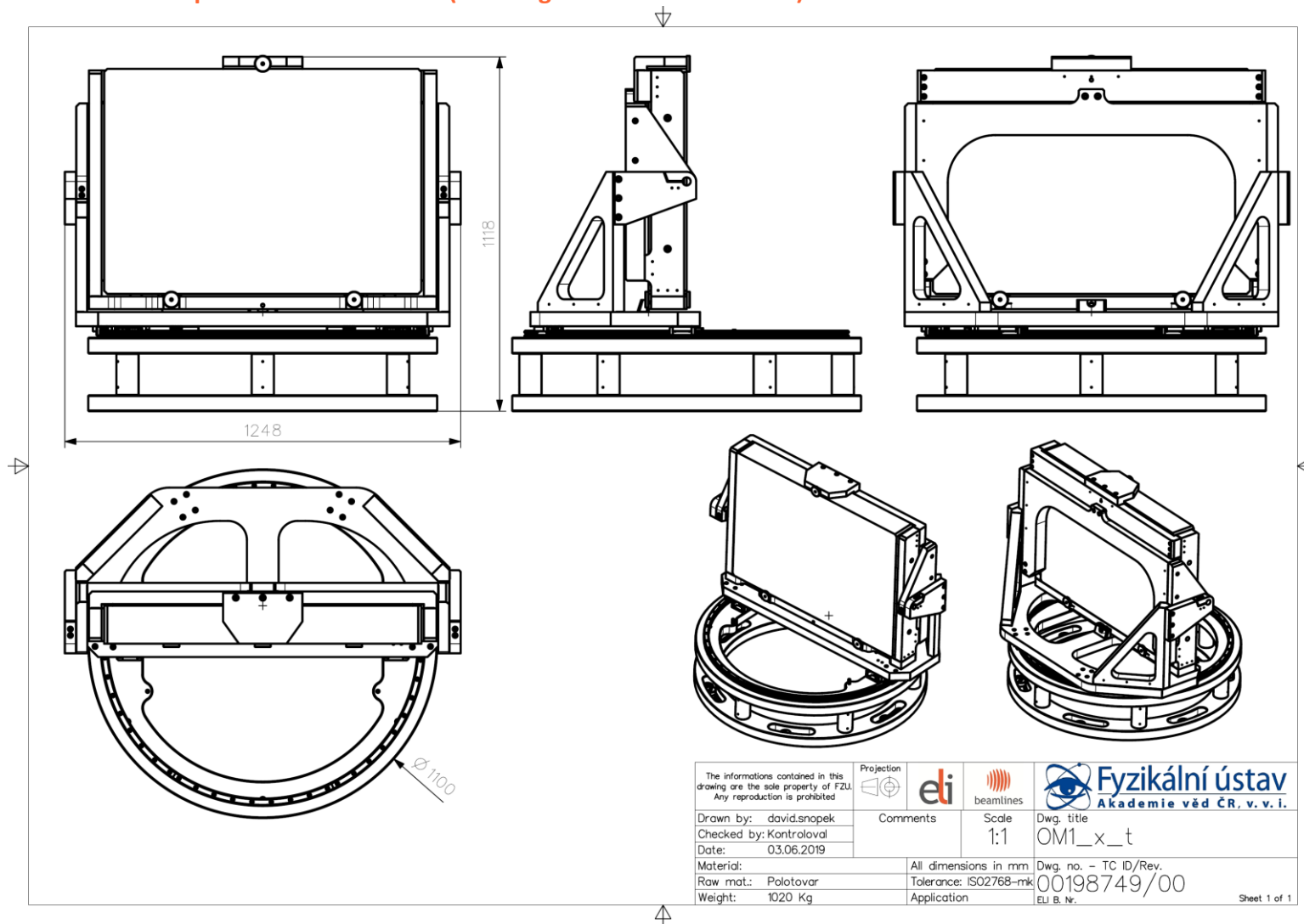


The informations contained in this drawing are the sole property of FZU. Any reproduction is prohibited.		Projection	eli	beamlines	Fyzikální ústav Akademie věd ČR, v. v. i.
Drawn by: david.snopek	Comments	Scale	Dwg. title		
Checked by:		1:1	M9_stp		
Date: 27.03.2019			Dwg. no. - TC ID/Rev.		
Material:	All dimensions in mm	00197387/00			
Raw mat.:	Tolerance: ISO2768-mk	ELI B. Nr.			
Weight: Kg	Application	Sheet 1 of 1			

5.6. SPM1 optomechanical mount (Drawing No 00212422 Rev. 01)



5.7. OOM1 optomechanical mount (Drawing No 00198749 Rev. 01)





EUROPEAN UNION
European Structural and Investing Funds
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ANNEX 3

VERIFICATION CONTROL DOCUMENT

Program: [3.4 - L4 system]
Subject: [Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010]. Verification Control Document (VCD)
Specification: [00230599/B - RSD (L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010]

E&S requirement ID	Requirement TC ID	chapter	sub chapter	Requirement text	Verified by	Verification Method	Close-out		Expected documentation	Delivered documentation (incl. TC ID)	Comments
							Yes	No			
019293/A;(L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010											
R1-00	REQ-027384/A	3. Functional, Performance and Design requirements	3.1. General	The detailed 3D engineering model and/or detailed drawings submitted by the Supplier shall be approved by the Client prior to proceeding to elaboration of the production (manufacture) drawings.	Supplier	R - review of related drawings and CA approval			No verification document supposed		
R1-01	REQ-027264/A		3.2. Optomechanical mounts	The optomechanical mounts shall be designed to support the respective optical components with dimensions as given in Table 2. The nominal position and orientation of the optical components in space shall be as in the 3D model. The required extent of movements shall be as in Table 1. NOTE: The 3D model of the mounts will be provided to the Supplier after the contract signature.	Supplier	R - review of design, T - test					
R1-02	REQ-027265/A			The optomechanical mounts shall be attachable to the optical support chassis and shall be able to be pre-positioned (without engaging the actuators) with precision of ±1 mm. NOTE: The 3D model of the chassis will be provided to the Supplier after the contract signature.	Supplier	R - review of design, T - test			Common Design review and test report		
R1-03	REQ-027266/A			Each individual optomechanical mount shall provide short-term and long-term angular mechanical stability (drift) of the optical element better than 1 μrad (in a thermally stabilized environment).	Supplier	T - test					
R1-04	REQ-027267/A			FEM resonant frequency analysis of the optomechanical mounts shall be carried out by the Supplier.	Supplier	A - analysis			Report from FEM analysis		
R1-05	REQ-027268/A			The mounts shall not exhibit any resonant frequency below 35 Hz, and also shall not have resonant frequency close to 50 Hz.	Supplier	A - analysis					
R1-06	REQ-027269/A			The principal material of the optomechanical mounts shall be aluminium. The Supplier shall provide Certificate of Origin specifying manufacturer, composition of the alloy, for each aluminum blank used.	Supplier	R - review of material certificates			Material certificates		
R1-07	REQ-027270/A			The mirrors shall be mounted in frames separable from the positioning parts of the optomechanical mounts.	Supplier	R - review of design			Common Design review and test report		
R1-08	REQ-027271/A			The design of the frames shall incorporate a 3-point fitting scheme for the mirrors, which shall not produce deformation across the entire surface higher than 100 nm.	Supplier	R - review of design					
R1-09	REQ-027272/A			The mounts design shall feature integration of electrical actuator including wirings for electrical actuators.	Supplier	R - review of design					
R1-10	REQ-027273/A			The detailed design of the mounts and any other components shall avoid any trapped volumes of air, e.g. the mounting holes shall not be blind tapped.	Supplier	R - review of design					
R1-11	REQ-027274/A			All actuators used in the optomechanics shall be certified for vacuum at least 1*10 ⁻⁸ mbar.	Supplier	R - review of documentation			<ul style="list-style-type: none"> • Common review and test report • Certificate for each actuator 		
R1-12	REQ-027275/A			All outer surfaces shall be machined resulting in surface quality of Ra 0.8 μm or better.	Supplier	I - inspection, T - test					
R1-13	REQ-027276/A			All edges of the optomechanical mounts shall be chamfered.	Supplier	R - review of design, I - inspection					

E&S requirement ID	Requirement TC ID	chapter	sub chapter	Requirement text	Verified by	Verification Method	Close-out		Expected documentation	Delivered documentation (incl. TC ID)	Comments
							Yes	No			
019293/A;(L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010											
R1-14	REQ-027277/A	Performance and Design requirements		All cables for electrical actuators shall be organized into cable trays both inside the compressor vacuum chamber and on the chamber exterior. NOTE 1: Layout and location of the cable trays will be specified by the CA. NOTE 2: The 3D model of the compressor will be provided to the Supplier after the contract signature.	Supplier	R - review of design, I - inspection			<ul style="list-style-type: none"> Common Design review and test report Common inspection and test report 		
R1-15	REQ-027278/A			Cable from each electrical actuator shall be led to the exterior by no more than one electrical vacuum feedthrough.	Supplier	R - review of design, I - inspection					
R1-16	REQ-027279/A			Best practice shall be followed in the design, type choice and implementation of the vacuum electrical feedthroughs.	Supplier	R - review of design, I - inspection					
R2-01	REQ-027280/A		Actuators, encoders, sensors and other instrumentation shall be delivered with control systems, power and utilities connections as necessary for correct and safe operation of the in-compressor CIS assembly, and with full English-language documentation.	Supplier	R - review of design, I - inspection						
R2-02	REQ-027281/A		All control systems hardware (device) shall be selected from the Requested Hardware Device List, in order to be compatible with the hardware used for the L4 laser controls. Use of custom-made hardware or devices shall be justified by the Supplier and approved by the CA on a case-by-case basis. NOTE: This list contains off-the-shelf control system devices that are compatible with the L4 system controls, have been verified by the CA and for which spares are maintained.	Supplier	R - review of design, I - inspection						
R2-03	REQ-027282/A		All actuators, sensors and other instrumentation which has a computer interface such as RS-485 or Ethernet shall be provided with LabVIEW drivers and/or API and a basic demonstrative graphical user interface (GUI). All drivers shall follow the National Instruments' Instrument Driver Guidelines, and shall be verified as compatible with the National Instruments Real-Time operating system (NI ETS 2016) on the RMC-8354 real-time server computer, to ensure compatibility with the existing integration platform of the CA for the L4 laser and for other major laser equipment of ELI-Beamlines. NOTE: The control system of the L4 laser into which the controls will be integrated is based on LabVIEW 2016 SP1.	Supplier	R - review of design, I - inspection, FD - functional demonstration			<ul style="list-style-type: none"> Common Design review and test report Common inspection and test report Functional demonstration protocol 			
R2-04	REQ-027283/A		All software forming part of the control system, including but not limited to drivers (see REQ-027282/A) and FPGA firmware, shall be provided fully open-source in LabVIEW, and use only National Instruments' distributed libraries and those by 3rd parties in wide circulation via the VI Package Manager. No DLLs, .COM or .NET objects or any other mechanisms for calling closed-source external code shall be used. All software shall have full English-language documentation and comments.	Supplier	R - review of design, I - inspection, FD - functional demonstration						

Program: [3.4 - L4 system]
Subject: [Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010]. Verification Control Document (VCD)
Specification: [00230599/B - RSD (L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010]

E&S requirement ID	Requirement TC ID	chapter	sub chapter	Requirement text	Verified by	Verification Method	Close-out		Expected documentation	Delivered documentation (incl. TC ID)	Comments
							Yes	No			
019293/A;(L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010											
R2-05	REQ-027284/A	3. Functional, Perfor		All critical control systems software shall run on embedded real-time computing hardware chosen from the Requested Hardware Device List (Table 2). NOTE: Basic GUIs and non-critical software that are not essential for correct and safe operation of the CIS may run on Windows (or equivalent) or Linux (or equivalent) PCs, as necessary.	Supplier	R - review of design, FD - functional demonstration					
R2-06	REQ-027285/A			A complete set of wiring diagrams and full bill of materials shall be provided for the control system	CA	CA review			Phase of delivery Acceptance protocol/s		
R3-01	REQ-027286/A	3.4. Packaging and Transportation requirements		For the duration of its transport the individual optomechanical mounts shall be sealed under dry air or nitrogen. The initial wrapping of all parts shall be in multiple layers of ultra-low outgassing plastic film (as sheet or bags) of type specifically for use in contamination controlled areas. This 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.	Supplier	I - inspection			No verification document supposed		
R3-02	REQ-027287/A			The Supplier shall transport the components to the ELI-Beamlines facility and shall remain responsible (with appropriate insurance cover) up to the start of offloading at the ELI-Beamlines Facility loading ramp. Offloading of the components at the building entrance will be carried out by the CA by fork lift truck (FLT) so the packages shall be palletized to suit FLT handling.	Supplier	I - inspection					
R3-03	REQ-027288/A			In order to fit in the lift the maximum dimensions of any component transport package shall not exceed 5.5 x 5.1 x 2.95 m3.	Supplier	I - inspection					
R4-01	REQ-027289/A	3.5. Testing, inspection and documentation		All optomechanical mounts shall be cleaned and tested at the manufacturer's works prior to acceptance for transport to ELI-Beamlines. NOTE: CA will carry out its own spot check tests to confirm vacuum cleanliness of each of the mounts using its own test method.	Supplier	T - test			Common Test report with results for all tested parts		
R4-02	REQ-027290/A			Vacuum pumping tests shall prove that the actuators and the components of linear translations are compatible with a vacuum pressure 1*10 ⁻⁷ mbar and using the quadrupole mass spectrometer (Residual Gas Analyzer) it shall be demonstrated that partial pressure of volatile organic compounds (VOCs) and other impurities with atomic mass >44 are less than 1/80 of partial pressure of residual CO2 molecules (atomic mass = 44) after no more than 12 hours of pumping.	Supplier	T - test					
R4-03	REQ-027291/A			The Supplier shall allow the CA supervising the activities related to the cleaning, testing, packaging and 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.	Supplier	N/A			N/A		
R4-04	REQ-027292/A			Only new materials and equipment with manufacturer's full warranty shall be used for the entire scope of supply.	Supplier	I - inspection			No verification document supposed		
R4-06	REQ-027293/A			The mounts shall be delivered with fully detailed installation and operational manuals, certification and technical documentation, in English language.	CA	CA review of the installation and operation manual/s			Installation and operation manual/s		

E&S requirement ID	Requirement TC ID	chapter	sub chapter	Requirement text	Verified by	Verification Method	Close-out		Expected documentation	Delivered documentation (incl. TC ID)	Comments	
							Yes	No				
019293/A;(L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010												
R5-01	REQ-027294/A	3. Functional, Performance	3.6. Safety Requirements	The Supplier shall supply a Declaration of Conformity or any other equivalent document legally recognized and accepted in the Czech Republic for each product type if the appropriate legislation determines the Supplier's obligation to have a Declaration of Conformity (or the equivalent document) for the purposes of a Device sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.	CA	CA review			Declaration of conformity/ies			
R5-02	REQ-027295/A			The Declaration of Conformity shall contain at least the following regulations: <ul style="list-style-type: none"> • ČSN EN 61010-1 ed. 2 Safety requirements for electrical equipment for measurement, control, and laboratory use (equivalent to EN 61010-1) 	CA	CA review						
R8-03	REQ-027296/A			A risk-assessment and failure mode and effects analysis (FMEA), to agreed template, shall be conducted by the manufacturer for the control systems in their scope of supply. Hazards to persons and the environment, and failures exceeding €10k damages or requiring more than 8 hours down-time shall be identified and considered.	CA	CA review			FMEA			
Q1	REQ-027297/A	Quality requirements	4.1. Documentation and data control	The Supplier shall supply the following relevant manufacturing documents: <ul style="list-style-type: none"> • all manufacturing design, 3D model and design supporting documentation approved by the CA (see REQ-027303/A); • full technical documentation on the delivered Product (e.g. installation, safe operation and maintenance instructions); • all "requests for deviation/waiver from requirements described herein" approved by the CA (see REQ-027300/A). 	Supplier	R - review, I - inspection			No verification document supposed			
Q2	REQ-027298/A			The Supplier shall use following data formats: <ul style="list-style-type: none"> • *.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 	N/A	N/A	N/A	N/A	N/A	N/A		
Q3	REQ-027299/A			Documentation (e.g. reports, protocols, certificates, instructions, manuals, etc.) shall be supplied in PDF format.	N/A	N/A	N/A	N/A	N/A	N/A		
Q4	REQ-027300/A			4.2. Nonconformity control system	The Supplier shall establish and maintain a nonconformity control system compatible with ČSN EN ISO 9001 (or equivalent, e.g. EN ISO 9001).	N/A	N/A	N/A	N/A	N/A	N/A	referenced REQ*
Q5	REQ-027301/A			4.3. Verification	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. But different mounts and the MCTR might have different time schedule of Deliverables.	CA	The CA will review and agree the VCD			<ul style="list-style-type: none"> • Phase of delivery Acceptance protocol/s • Final Acceptance protocol 		

E&S requirement ID	Requirement TC ID	chapter	sub chapter	Requirement text	Verified by	Verification Method	Close-out		Expected documentation	Delivered documentation (incl. TC ID)	Comments
							Yes	No			
019293/A;(L4) Large optomechanical mirror mounts and electronic controls for L4 10 PW compressor TP19_010											
Q6	REQ-027302/A	4. C	4.3.2. Verification Control Document	Before completion of the detailed engineering documentation phase the Supplier shall provide following information that shall be agreed by the CA: 1. - structure and content of the Test protocols, Analysis reports, Review reports etc.; 2. - structure and content of the VCD if it was modified by the Supplier.	Supplier + CA	The Supplier + CA shall agree the related documentation			Phase of delivery Acceptance protocol/s		
Q7	REQ-027303/A			Before completion of the detailed engineering documentation phase the Supplier and the CA shall agree on: 1. - final detailed engineering drawings provided by the Supplier; 2. - detailed procedures related to the testing, cleaning and packaging during Manufacturing phase; 3. - common nonconformity control system (see REQ-027300/A).	Supplier + CA	The Supplier + CA shall agree the related documentation			Phase of delivery Acceptance protocol/s		
Q8	REQ-027304/A		4.3.3. Acceptance	The Acceptance phase shall demonstrate the following: 1. - All finished parts of the mirror mounts and electronic controls have been successfully verified by the Supplier and the results of this process have been documented in VCD (The completed VCD is submitted); 2. - All previous Phases of delivery were accepted by CA and confirmed by the related Acceptance protocol (All the Acceptance protocols are submitted); 3. - All detected nonconformities have been solved in accordance with REQ-027300/A.	CA	Final CA verification			Related documentation IDs: (of all documentation above)	Verification date:	Name of the CA representative and Signature:



ANNEX 4

PRICES

Item No.	Item	Price CZK excl. VAT			
1	Purchase Price according to art. 8.1 of the Purchase Contract	18 526 500,00			
2	Option 1: Manufacture, testing and delivery of the optomechanical mount OM7.5	724 000,00			
		Unit	Number	Price CZK excl. VAT per unit	Price CZK excl. VAT per item
3	Option 2: Optional design works	man day	40	10 000,00	400 000,00
4	Option 3: Optional installation technical support	man day (including travel)	20	12 000,00	240 000,00



ANNEX 5

SUPPLIER'S BID

A) Warranty period on the motion control system (Remaining warranty on the MCTR)

The Supplier provides a warranty of quality on the motion control system (MCTR) of the Object of Purchase for the period of 30 months.

B) Qualification prerequisites

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

A cleanroom space of Class 5 or better with minimum surface 20 m² for assembling and testing of optomechanical units:

Class 5 - 50 m² – with surface dimension 10 x 5 m

- for assembling optomechanics and UHV vacuum units

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
Senior optomechanical designer	Ing. Tomáš Bejdák
Junior optomechanical designer	Ing. Michal Andrys
Junior optomechanical designer	Ing. Petr Brabenec
Senior electronic engineer	Ing. Jan Robotka
Junior electronic engineer	Ing. Petr Dobiáš

The Supplier is allowed to use another person only if it proves that such person possesses qualification and abilities conforming with requirements for each relevant position listed in the procurement documentation issued for purposes of Public Contract award.