

Purchase Contract

pursuant to Section 2079 et seq. of Act No. 89/2012 Coll., the Civil Code, as amended (hereinafter the "Civil Code")

I. THE PARTIES:

1. Buyer:

Fyzikální ústav AV ČR, v. v. i.

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

with its registered office at Praha 8, Na Slovance 2, PSČ 182 00

represented by: RNDr. Michael Prouza, Ph.D., the Director

Registered in the register of public research institutions of the Ministry of Education, Youth and Sports of the Czech Republic

Id. No.: 68378271

Tax Id. No.: CZ68378271

(hereinafter the "Buyer")

and

2. Seller:

APERTURE OPTICAL SCIENCES, INC.

with its registered office at 170 Pondview Drive, Meriden, CT 06450, United States

represented by: Flemming Tinker, President

Id. No. (if any): EIN# 27-2329965

(Hereinafter the "Seller"; the Buyer and the Seller are hereinafter jointly referred to as the "Parties" and each of them individually as a "Party").

enter, on the present day, month and year, into this Purchase Contract (hereinafter the "Contract")

II. Fundamental Provisions:

The Seller has been awarded the public contract entitled "High quality, large size, fs = 220 mm uncoated focussing optics for L3 in P3 TP22_033" (hereinafter the "Public Contract").

III. Subject of the Contract

3.1 Under this Contract, the Seller shall design, manufacture and deliver to the Buyer 1 piece of an OAP mirror as specified and under the conditions stipulated herein and in Annex No 1 hereto Requirements Specification Document (hereinafter the "Mirror" and "RSD").

The Mirror shall be manufactured from the material identified by the Seller in its bid submitted within the Public Contract awarding procedure. The Seller may use other material only if it conforms with the material specifications of Annex No 1 hereto and subject to prior written approval of the Buyer.

3.2 The Buyer shall take over the Mirror with all the required documentation and pay the Purchase Price for it to the Seller as specified in Art. V. hereof.

- 3.3 If anything in this Contract is subject to approval by the Buyer the Buyer must not refuse such approval unless technically substantiated grounds are stated.
- 3.4 If it is requested in the RSD that the Buyer exercise best efforts to achieve certain result they are obliged to exercise all due professional care (expectable from an excellent professional in the given field) to achieve the result. If the result is not achieved by the Seller they have to present to the Buyer which appropriate technical measures were taken to achieve it, mainly focused on the fact the Seller did not resign on achieving the result.

IV. Risk of Loss and Ownership Title

The risk of loss or damage to the Mirror shall pass to the Buyer upon its delivery to the place of delivery (art. 8.3 hereof).

The ownership title to the Mirror shall pass to the Buyer upon execution of the acceptance protocol (art. 8.4 hereof).

V. Purchase Price and Payment Terms

- 5.1 The purchase price for the Mirror is **100 000 USD excl. VAT** (hereinafter the “**Purchase Price**”).
- 5.2 All the prices set out in this Contract are exclusive of VAT paid in the Czech Republic which will be paid by the Buyer. The Seller, if applicable, is responsible for clearing the Mirror for export (export customs formalities and financial duties). The Buyer is responsible for clearing the Mirror for import (import customs formalities and financial duty if any).
- 5.3 The Purchase Price includes all the costs related to the performance of the subject of this Contract. The Purchase Price is the maximum permissible price. The Purchase Price is independent of the development of prices and currency exchange rates.
- 5.4 The Purchase Price shall be paid on the basis of tax documents – invoices, to the account of the Seller designated in the invoice.
- The Seller is entitled to invoice the Purchase Price as follows:
- 40 % of the Purchase Price after the approval of the Qualified Design,
 - 50 % of the Purchase Price after completion of verification of the manufactured Mirror,
 - 10 % of the Purchase Price after the signature of the acceptance protocol by the Buyer pursuant to this Contract.
- 5.5 Invoices shall be payable within thirty (30) days from their delivery to the Buyer (hereinafter the "Maturity Period"). If the Seller indicates any shorter Maturity Period in an invoice such other period is deemed irrelevant and the period set out herein applies. Payment of the invoiced amount is considered executed on the date of its remitting to the Seller's account. The tax documents – invoices shall have properties of a tax document according to applicable legal regulation. Furthermore, they must also be in conformity with any double taxation treaties applicable to the given case.
- The Buyer shall advise the Seller on the proper contents of invoices prior invoicing.
- 5.6 Invoices shall be submitted to the Buyer only in the electronic form on the email address: efaktury@fzu.cz
- 5.7 If the Seller performs the subject-matter hereof duly in line herewith without substantial breaches of the Contract and if there are no obvious reasons for doubts on continuing of the due performance hereof by the Seller, by taking into account the overall approach of the Seller to the Contract performance (presented particularly by due preparation for performance of follow-up activities), and if it might ease further performance hereof by the Seller, the Buyer reserves the right fully on its discretion to provide the Seller with the Purchase Price instalments sooner than scheduled hereunder or in higher amount than stipulated herein (i.e. any instalments might be increased with proportional decreasing of subsequent instalments). If the conditions stipulated above are met, the Buyer is entitled to modify the payment schedule stated herein anyhow in favour of the Seller and to provide it with any prepayment.

VI. Delivery Period

The Seller shall deliver the Mirror to the place of delivery within 9 months from the signature of this Contract.

VII. Place of delivery

The place of delivery shall be ELI Beamlines facility, Průmyslová 836, ZIP 252 41, Dolní Břežany, district Prague-west, the Czech Republic.

VIII. Delivery Phasing and Acceptance of the Mirror

Qualification of Design

8.1 The Seller shall submit to the Buyer manufacturing drawings and design supporting documentation in line with Annex No 1 hereto (RSD) for approval before manufacture of the Mirror.

The Buyer shall provide a statement (approval or any comments) on the manufacturing drawings and related documentation submitted by the Seller within 10 business days from receiving it. Potential necessity of implementation of any comments of the Buyer does not postpone the delivery deadline stipulated hereby if the above deadline is met by the Buyer. If the deadline for provision of the statement is not met by the Buyer the delivery deadline extends accordingly.

Manufacture, Verification and Delivery

8.2 The Seller shall carry out manufacture, factory testing and verification of the Mirror and transport the Mirror to the place of delivery in line with Annex No 1 hereto (RSD).

8.3 The Buyer shall confirm the delivery of the Mirror to the place of delivery to the Seller or to a carrier designated by the Seller.

8.4 The Mirror shall be accepted in the place of delivery on the basis of an acceptance protocol according to Annex No 1 hereto (RSD).

IX. Warranty and Claims Based on Defects of the Supply

9.1 The Seller provides the warranty of quality for the Mirror for a period of 6 months from the date of acceptance of the Mirror. The Buyer shall raise a warranty claim against the Seller without undue delay after ascertaining a defect, but not later than on the last day of the warranty period, by means of a written notice sent to the Seller's authorised representative for technical matters set out herein. A claim sent by the Buyer on the last day of the warranty period shall be deemed made in time.

9.2 The Seller agrees to remove the defect for which they are responsible free of charge.

9.3 The Seller undertakes to remove any defect within a commercially reasonable time.

9.4 The Parties shall execute a record on removal of the defect, in which they shall confirm that the defect has been removed.

9.5 The warranty shall not apply to defects caused by unprofessional handling, incorrect or unsuitable maintenance, non-compliance with written rules of operation and maintenance of the Mirror provided by the Seller or by environmental contamination. The warranty shall also not apply to defects caused by gross negligence or intentional conduct.

X. Penalties

10.1 If the Seller is in delay with the due delivery of the Mirror to the place of delivery, the Seller shall pay to the Buyer a contractual penalty in the amount of 0,1 % of the Purchase Price (without VAT) for every (even commenced) day of delay.

10.2 If the Mirror has to be remanufactured for a defect the time of the first remanufacture (limited to max. 4 months) shall not be penalised with the contractual penalty. In case of delay with delivery of the Mirror that must be remanufactured (including transport damage) the penalised period of delay stops on the date of delivery of the defective Mirror to the place of delivery or on the day on which the defect is ascertained during the manufacture and reported to the Buyer and the contractual penalty shall not accrue the next 4 months.

- 10.3 If the Seller is in delay with the removal of a defect, the Seller shall pay to the Buyer a contractual penalty in the amount of 0,02 % of the Purchase Price (without VAT) for every (even commenced) day of delay.
- 10.4 Should a delay of the Seller be caused by a documented impact of the Covid-19 pandemic or of the war in Ukraine on the course of performance of this Contract by the Seller (e.g. sick workers, sub-supplies delays or failures, etc.), the contractual penalties for delay above do not apply. The Seller shall in sufficient detail document when an obstacle occurred and how long it lasted. The penalties do not apply also in the case of such obstacle caused by Covid-19 pandemic or by the war in Ukraine, which could have been overcome but only with unreasonable efforts or disproportionate costs.
- 10.5 The Seller shall pay contractual penalties within fifteen (15) days from the day, on which the Buyer enumerated their claim. The payment of contractual penalties shall not affect the right of the Buyer to damages to the extent to which such damages exceed the contractual penalty.
- 10.6 Total amount of contractual penalties that the Buyer is entitled to claim shall not exceed 10 % of the Purchase Price without VAT.
- 10.7 The Buyer is entitled to unilaterally set off claims arising from the contractual penalties against the claim of the Seller for the payment of the Purchase Price.

XI. Termination of the Contract

- 11.1 This Contract may be terminated by agreement of the Parties or withdrawal from the Contract on the grounds stipulated by law or in the Contract.
- 11.2 The Buyer is entitled to withdraw from the Contract without any penalty from Seller in any of the following cases:
- i) material breach of the Contract is committed by the Seller;
 - ii) insolvency proceedings are initiated against the Seller's assets;
 - iii) the Seller is in delay with the delivery of the Mirror more than by 6 months.
- 11.3 The Seller is entitled to withdraw from the Contract without any penalty from Buyer in the event of material breach of the Contract by the Buyer.

XII. Representatives, Notices

- 12.1 The Seller has appointed the following authorised representative for communication with the Buyer in technical matters:
- Mr. Alberto Bodden
E-mail: [REDACTED]
- 12.2 The Buyer has appointed the following authorised representative for communication with the Seller in technical matters:
- Dr. Uddhab Chaulagain, e-mail: [REDACTED]
- 12.3 Unless this Contract stipulates otherwise, any and all notices that are to be or may be made between the Parties under this Contract must be made in writing and delivered to the other Party by an internationally renowned courier service (Federal Express, DHL, etc.), in person (with written confirmation of acceptance) or by registered post.

XIII. Choice of Law

- 13.1 This Contract and all the legal relationships arising out of it shall be governed by the laws of the Czech Republic.
- 13.2 The Parties acknowledge and note that the provisions of the Civil Code shall apply in matters that are not explicitly regulated by this Contract.

- 13.3 Any and all disputes arising out of this Contract or the legal relationships connected with the Contract shall be resolved by the Parties by mutual negotiations. In the event that any dispute cannot be resolved by negotiations within sixty (60) days the dispute shall be resolved by the competent court in the Czech Republic based on application of any of the Parties.

XIV. Export Control

Export law of US or other countries may require an end-user statement regarding use and may also require an export license. In the event that such items are required, the supply of the Mirror is subject to receipt of an end-user statement from the Buyer and approval of application for an export license. The resale of Mirror is subject to written approval of the Seller. Buyer shall not deliver the Mirror to countries, where such delivery would constitute a violation of US or any other country export regulations and/or laws.

XV. Social, Ecological and Innovative Aspects

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

- a) this Contract is fulfilled only by persons that are employed in accordance with the applicable legal regulations (no illegal or child workers);
- b) while performing this Contract, all applicable health and safety regulations and rules at work place are observed;
- c) all persons performing this Contract are employed under fair and non-discriminatory working conditions;
- d) if presented with different manners of fulfilling this Contract, the Seller shall select the solution/process that is in accordance with the principles governing nature conservation and nature protection, ecological sustainability and ecological waste management; and
- e) if presented with different manners of fulfilling this Contract, the Seller shall select the solution/process that is the most innovative.

XVI. Assignment

- 16.1 The Seller shall not be entitled to assign any rights or obligations arising in connection herewith to a third party.
- 16.2 The Buyer makes the Seller aware that the Buyer is going with anticipated effect as of 1.1.2023 to transfer the ELI Beamlines research facility (now owned and operated by the Buyer) for construction and operation of which is the supply under this Contract being agreed to to The Extreme Light Infrastructure ERIC (ELI ERIC). The ELI ERIC is a legal person set up under Regulation (EC) No 723/2009 and it is the future long term owner and operator of the ELI Beamlines facility. The Seller by entering this Contract agrees to the assignment of all rights and obligations from this Contract by the Buyer to ELI ERIC. The Buyer shall inform the Seller on the completed assignment without undue delay and the assignment shall become effective at the moment of its notification to the Seller. The supply supplied under this Contract will be used exclusively in the ELI Beamlines facility.

XVII. Final provisions

- 17.1 The Buyer hereby declares that it is not with respect to the subject hereof an entrepreneur and that the subject of the Contract doesn't fall within the scope of any of its entrepreneurial activities.
- 17.2 The Contract represents the entire and comprehensive agreement between the Buyer and the Seller.
- 17.3 In the event that any of the provisions of this contract shall later be shown or determined to be invalid, ineffective or unenforceable, then such invalidity, ineffectiveness or unenforceability shall not cause invalidity,

ineffectiveness or unenforceability of the Contract as a whole. In such event the Parties undertake without undue delay to replace after mutual agreement such invalid, ineffective or unenforceable provision of the Contract by a new provision, that in the extent permitted by the laws and regulations of the Czech Republic, relates as closely as possible to the intentions of the Parties to the Contract at the time of creation hereof.

- 17.4 This Contract shall be valid on the date of the signature of both Parties and effective on the day, on which it was published in the register of contracts within the meaning of the Act no. 340/2015 Coll., on the Register of Contracts.
- 17.5 This Contract may be changed or supplemented solely by means of numbered supplements in writing, furnished with the details of time and place and signed by duly authorised representatives of the Parties.
- 17.6 This Contract is executed only electronically. The following Annex is an integral part of the Contract:
Annex No. 1: Requirements Specification Document,
- 17.7 The Parties, manifesting their consent with its entire contents, affirm the Contract with their signature.

For: Fyzikální ústav AV ČR, v. v. i.

For: APERTURE OPTICAL SCIENCES, INC.

Name: RNDr. Michael Prouza, Ph.D.
Title: Director

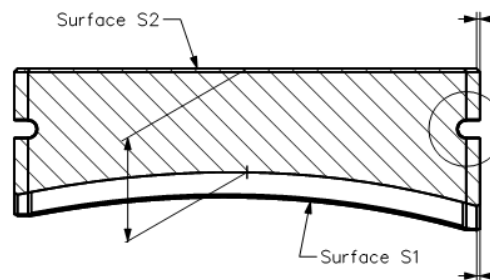
Name: Flemming Tinker
Title: President

Annex No. 1 Requirements Specification Document

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[RSD Product Category C]

High quality, large size, $f_s = 220$ mm uncoated focussing optics for L3 in P3 TP22_033



Keywords

Off-axis parabolic mirror, parameters, requirements, beam transport and focusing

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Stefan Weber	Head of Department of Plasma Physics and High Intensity Interaction	31.08.2022	Via TC

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1. Introduction

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints of the L3 target parabola for the Plasma Physics target chamber P3 of the ELI-Beamlines project. This can lead to the identification of product interfaces with the ELI science-based technology and ELI building facility. This RSD also acts as a parent document for technical requirements that need to be addressed in lower-level design description documents.

1.2. Scope

This RSD contains all of the technical requirements: functional, performance and design, delivery, safety and quality requirements for the following product (tender number - TP22_033): **High quality, large size uncoated fs = 220 mm off-axis parabolic mirror for L3 in P3** (further "OAP mirror").

The product is an integral part of the "P3 plasma physics platform" and will be located in the P3 vacuum target chamber in the E3 experimental hall after coating. This product is registered in the PBS software under the **E.E3.15.3.1** code.

1.3. Terms, Definitions and Abbreviations

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

Abbreviation	Meaning
A	Analysis (as a verification method)
CA	Contracting Authority (Institute of Physics AV CR, v. v. i.)
CAP	Clear Aperture
E3	Experimental hall 3
ELI	Extreme Light Infrastructure
I	Inspection (as a verification method)
OAP	Off-Axis Parabola
PD	Physical Dimension
PETG	Polyethylene Terephthalate Glycol
QR	Quality Report
R	Review of documentation (as a verification method)
RA5	Research activity 5
RH	Relative Humidity
RSD	Requirements Specification Document
SFL	Segment Focal Length
T	Test (as a verification method)
VCD	Verification Control Document

1.4. Reference documents

Number of doc.	Title of Document/File
RD-01	00329445-00-OAPSubstrate30Degree220mmFocus.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 the Supplier offers another equal solution and proves that the solution meets in an equivalent manner the requirements including references to standards or technical documents, the CA shall accept it.

2. General requirements

The requested OAP mirror will be coated and used as a final focusing element of the 10 Hz repetition rate 30 J, 30 fs, 810 nm 1 Petawatt L3 laser beam for high-intensity Plasma Physics Experiments.

REQ-034731/A

The Supplier shall provide **1 pc** of the uncoated OAP mirror in accordance with all requirements described in this RSD document and detailed in chapter 3.

NOTE: The following Table 1 provides numbering (and name) of the requested OAP mirror according to its basic specifications. This notation will be used when referring to the particular OAP mirror.

Verification method: R – review, I – inspection

OAP notation number (Name)	PD, SFL, off-axis angle	PBS database code (for the CA identification)
OAP (P3)	250x250 mm ² , 220 mm, 30°	E.E3.15.3.1

Table 1: The notification of OAP mirror according to its basic specifications (the detailed specifications are given in chapter 3)

3. Functional, Performance and Design requirements

3.1. Geometry and Substrate

REQ-034732/A

The substrate material of the OAP mirror shall be manufactured from Fused Silica KV without any bubbles or other defects on the polished surface or equivalent quality high-power laser grade fused silica.

NOTE: Zerodur and any other substrate materials, that are susceptible to ionizing radiation damage, are prohibited to use.

Verification method: R - review (QR III. - Substrate material report)

REQ-034733/A

The OAP mirror (along the beam) shall be rectangular in shape with the physical dimension of width x height: $(250+0-1) \times (250+0-1) \text{ mm}^2$ as shown in the drawing of **Figure 1**.

NOTE: The Supplier and the CA will agree during the design phase on the tolerance given in the manufacturing documents (REQ-034759/A).

*NOTE 2: The dimensions shall correspond to the requirements given in the reference drawing **RD-01** (see chapter 1.4; drawing N^o 00329445/00/01) which is an inseparable part of the OAP mirror requirements.*

Verification method: R - review, T - test (QR - IV. Dimensional report)

REQ-034734/A

The clear aperture of the OAP mirror (along the incoming collimated laser beam) shall be square (centre of the clear aperture is the mirror centre). The clear aperture shall be at least $225 \times 215 \text{ mm}^2$ and should have rounded corners. The radii of the rounded corners require the approval of the CA during the design phase.

Verification method: R - review, T - test

REQ-034735/A

The centre thickness of the OAP mirror shall be $(80 \pm 0.5) \text{ mm}$.

NOTE: The Supplier and the CA will agree during the design phase on the tolerance given in the manufacturing documents (REQ-034759/A).

Verification method: R - review, T - test (QR - IV. Dimensional report)

REQ-034736/A

The off-axis angle of the OAP mirror shall be $30.0 \pm 0.5^\circ$ (angle subtended between the segment axis and the segment focal length) as shown in the drawing of **Figure 1**.

NOTE: The Supplier and the CA will agree during the design phase on the tolerance given in the manufacturing documents (REQ-034759/A).

Verification method: R - review, T - test

REQ-034737/A

The off-axis distance (to the centre of the OAP mirror) shall be $(110 \pm 1.5) \text{ mm}$ as shown in the drawing of **Figure 1**.

NOTE: The Supplier and the CA will agree during the design phase on the tolerance given in the manufacturing documents (REQ-034759/A).

Verification method: R - review

REQ-034738/A

The segment focal length (vertex of the OAP mirror to the focal point) shall be $(220 \pm 10) \text{ mm}$ as shown in the drawing of **Figure 1**.

NOTE: The Supplier and the CA will agree during the design phase on the tolerance given in the manufacturing documents (REQ-034759/A).

Verification method: R - review, T - test

3.2. OAP mirror surface

REQ-034739/A

The RMS surface figure error of the OAP mirror shall be lower than 15 nm (best effort ≤ 10 nm) for spatial periods > 10 mm over the central 225×215 aperture to obtain a Strehl ratio $S = \exp[-2*(2*\pi*RMS \text{ (nm)}/\lambda \text{ (nm)})^2]$ of at least 0.95 over the central $225 \times 215 \text{ mm}^2$ aperture.

NOTE: The best commercially reasonable effort of the RMS surface figure error over central 225×215 aperture shall be equal to 10 nm or less.

Verification method: R - review, T - test (QR I. - Interferometric report)

REQ-034740/A

The RMS surface slope error of the OAP mirror shall not exceed $5 \mu\text{rad}$ (best effort $\leq 30 \text{ nm} / 1 \text{ cm}$, i.e. $\leq 3 \mu\text{rad}$) for spatial periods from 1 to 10 mm over the central $225 \times 215 \text{ mm}^2$ CAP.

Verification method: R - review, T - test (QR I. - Interferometric report)

REQ-034741/A

The surface roughness over the CAP of the OAP mirror shall be polished with a process to achieve $R_z < 5 \text{ nm}$, $R_a < 0.7 \text{ nm}$, R_q (RMS) $R_z < 0.9 \text{ nm}$.

Verification method: R - review (of the polishing process), T - test (QR I. - Interferometric report)

REQ-034742/A

The scratch/dig of the reflective surface of the OAP mirror shall be $\leq 40/20$ with a best effort to achieve $\leq 20/10$ S/D for full CAP according to the MIL-PRF-13830B standard.

Verification method: R - review, T - test (QR II. - Surface quality report)

REQ-034743/A

2 pcs with 2-inch diameter flat mirror substrates shall be manufactured from the exact same material and polished with the exact same surface finish as the OAP mirror as representative witness samples of the OAP for surface tests and further coating laser induced damage (LIDT) tests.

Verification method: R - review, I - inspection

3.3. Other requirements of the OAP mirror

REQ-034744/A

The OAP mirror shall be vacuum compatible. All specifications of this RSD document shall be met when the OAP mirror is exposed to a vacuum of 10^{-6} mbar. In this working environment, the OAP mirror shall also not outgas.

Verification method: R - review, A - analysis

REQ-034745/A

The back face of the OAP mirror shall be fine ground, without a wedge, parallel to the tangent of the OAP vertex.

Verification method: R - review, I - inspection (*including photo documentation*)

REQ-034746/A

The side face of the OAP mirror shall have a mark indicating the plane with the optical axis and the focal point.

Verification method: I - inspection (*including photo documentation*)

REQ-034747/A

The chamfers of the OAP mirror substrates shall comply with the reference drawing **RD-01** (Chapter 1.4 - drawing № 00329445/00).

Verification method: R - review, T - test (*QR IV. - Dimensional report*)

REQ-034748/A

The lateral side of the OAP mirror shall have the mounting interface in the form of a groove along 2 vertical sides as defined in the reference drawing **RD-01** (Chapter 1.4 - drawing № 00329445/00) which is an inseparable part of the OAP mirror requirements.

Verification method: R - review, T - test

REQ-034749/A

The OAP mirror shall have a pictogram specifying the off-axis angle with respect to the optical axes.

Verification method: I - inspection (*including photo documentation*)

REQ-034750/A

The OAP mirror shall have an OAP alignment feature on the rear surface of the OAP (~50 mm x 50 mm stripe) oriented perpendicular to the optical axis of the incoming parallel laser beam to allow the alignment of the parabola with the help of an autocollimator or similar metrology to the nominal tip and tilt angles of the parabola. The final design and location may differ from this concept and shall be part of a 1-week design phase followed by the final approval of the CA.

Verification method: I - inspection (*including photo documentation*)

REQ-034811/A

The OAP mirror shall have the following information engraved into the top of the substrate barrel:

**▽ ELI E3 L3 OAP 0810 PQQ30 220 250x250x080
00004 ▽**

NOTE 1: This engraved information denotes as follows:

- *ELI Beamlines,*
- *Experimental hall E3,*
- *L3 laser Off-Axis Parabolic mirror (OAP) @ 810 nm,*
- *p-polarization, material quality QQ, Off-axis angle of 30°,*
- *FFF = focal length = 220 mm.*
- *Substrate size,*
- *Serial number XXX,*
- *Triangles pointing to curved and to be HR coated side S1.*

Verification method: I - inspection

Requirement TC ID / Rev.	Parameter / Property of the OAP mirror	Specified value / Requirement	Quality report (see REQ-034757/A)	Verification Method
REQ-034732/A	Material	mirror grade fused silica KV without any bubbles or other defects on the polished surface (Zerodur material is prohibited)	<i>III. Substrate material report or certificate</i>	R - review
REQ-034733/A	OAP mirror shape (along the beam)	Squared in shape: (250+0-1) x (250+0-1) mm ²	<i>IV. Dimensional report</i>	R - review T - test
REQ-034734/A	Clear aperture (along the beam)	Squared with dimensions at least 225 x 215 mm ² and with rounded corners	—	R - review T - test
REQ-034735/A	Centre thickness	80 mm ± 0.5 mm	<i>IV. Dimensional report</i>	R - review T - test
REQ-034736/A	Off-axis angle	30.0 ± 0.5°	—	R - review T - test
REQ-034737/A	Off-axis distance from the vertex to the centre of the mirror	110 mm ± 1.5 mm	—	R - review
REQ-034738/A	Segment focal length (OAP vertex to the focal point)	220 mm ± 5 mm	—	R - review T - test
REQ-034739/A	RMS surface figure error	≤ 15 nm RMS (Power term removed) over 225 x 215 mm ² central aperture and to obtain the Strehl ratio $S = \exp[-2*(2*\pi*RMS (nm)/\lambda (nm))^2]$ of at least 0.95 over the central 225 x 215 mm ² aperture, best commercially reasonable effort to achieve: ≤ 10 nm RMS surface figure error	<i>I. Interferometric report</i>	R - review T - test
REQ-034740/A	RMS Surface slope error	≤ 5 μrad RMS, test wavelength (633±2) nm, Best effort: <3 μrad RMS	<i>I. Interferometric report</i>	R - review T - test
REQ-034742/A	Surface quality, Scratch/Dig (S/D)	≤ 40/20 with best effort to achieve ≤ 20/10 S/D per MIL-PRF-13830B	<i>II. Surface quality report</i>	R - review T - test
REQ-034741/A	Surface roughness/mid-spatial frequencies	Rz<5 nm, R _a <0.7 nm, R _q (RMS) Rz<0.9 nm	<i>I. Interferometric report</i>	R - review
REQ-034744/A	Operational conditions	Vacuum compatible under vacuum level up to 10 ⁻⁶ mbar without materials outgassing	—	R - review A - analysis
REQ-034745/A	Backface	Fine ground, no wedge, parallel to tangent in OAP vertex, Commercial polish	—	R - review I - inspection
REQ-034746/A	Side face	Marking the position of the OAP optical axis: OAP (P3): 250 x 250 mm ² , f _s = 220 mm, 30°	—	I - inspection
REQ-034747/A	Chamfers	According to the drawing number 00329445/00 (see RD-01; chapter 1.4)	<i>IV. Dimensional report</i>	R - review, T - test
REQ-034748/A	Lateral side	Mounting interface in the form of a groove along 2 vertical sides according to the drawing number 00329445/00 (see RD-01; chapter 1.4)	—	R - review T - test
REQ-034749/A	Pictogram	Specifying the off-axis angle with respect to the optical axes	—	I - inspection

Requirement TC ID / Rev.	Parameter / Property of the OAP mirror	Specified value / Requirement	Quality report (see REQ-034757/A)	Verification Method
REQ-034750/A	OAP tip/tilt rear surface alignment feature	on the rear surface of the OAP (~50 mm x 50 mm stripe) oriented perpendicular to the optical axis of the incoming parallel laser beam to allow the alignment of the parabola with the help of an autocollimator or similar metrology to the nominal tip and tilt angles of the parabola. The final design and location may differ from this concept and shall be approved by the CA after an 1 week design phase.	—	I – inspection

Table 2: Summary of the specifications for the OAP mirror

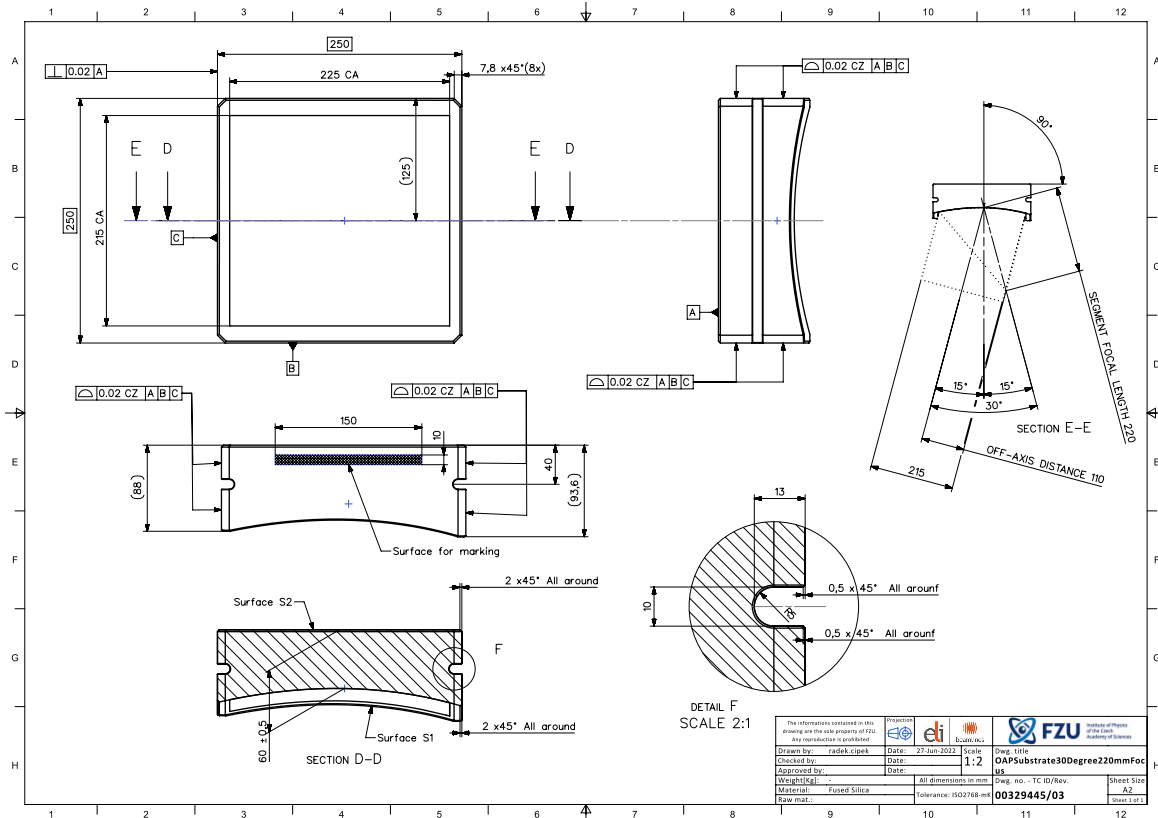


Figure 1: Overview of the OAP mirror drawing for P3 platform: PD = 250x250 mm², CAP= 225 x 215 mm², SFL=220 mm, off axis angle = 30° (see chapter 1.4; **RD-01**).

4. Environmental requirements

REQ-034751/A

The Supplier and the CA shall agree on the cleaning method to clean the OAP mirror without decreasing the mirror's properties and to avoid contamination of clean space.

NOTE: The cleaning methods may use high gas flow (dry and clean air or N₂) and specialized chemical cleaning liquids (alcohol, Isopropyl alcohol, deionized water).

Verification method: R - review

5. Delivery requirements

REQ-034752/A

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

NOTE: The Supplier is fully responsible for the delivery of undamaged mirror.

Verification method: I - inspection

REQ-034753/A

The OAP mirror shall be delivered in a protective ultra-low outgassing container – preferably a PETG container – that shall not contact side S1 of the OAP mirror which will be coated and prevent its damage, degradation and contamination. The container shall then be sealed with ultra-low outgassing clean room tape and wrapped into 2 aluminized clean room 100 (ISO class 5 according to ČSN EN ISO 14644, equivalent to EN ISO 14644) compatible polyethylene bags. Packaging shall be performed in a clean environment.

Verification method: I – inspection, R – review

REQ-034754/A

The Supplier shall provide an appropriate shipping crate with shock and tilt watch and packaging material compliant for overseas shipping.

Verification method: I – inspection

REQ-034755/A

The serial number shall be clearly marked on the outer layer of the outermost aluminized polyethylene bag as well as on the bubble wrap. The outermost aluminized bag shall have a label: "To be opened only in ISO class 6 clean room and by laser optics experts" as well as "FRAGILE – GLASS".

NOTE: The same labels should be applied on the outside of the shipping crate/box.

Verification method: I – inspection, R – review

6. Safety Requirements

REQ-034756/A

The Supplier shall demonstrate the conformity with the Act No. 102/2001 Coll. (EU Directive 2001/95/EC) on general product safety.

Verification method: I – inspection

7. Quality control

7.1. Quality Reports (QRs) before the OAP mirror coating

REQ-034757/A

The Supplier shall perform a factory verification of the substrate and provide the following **specific quality reports for meeting corresponding requirements (I - IV)**:

- I. **Interferometric report** of the OAP mirror surface with a map showing a departure from the ideal reflected wavefront in units of testing wavelength λ and in nm as well as wavefront RMS, gradient and mid spatial frequencies (REQ-034739/A, REQ-034740/A and REQ-034741/A). Interferometric data shall be provided as an image (e.g. jpg) as well as digitally in Zygo *.dat format.
- II. **Surface quality report** with scratch and dig map showing the locations of all defects (see REQ-034742/A).
- III. **Substrate material report** or certificate showing which material was used for the substrate and its properties (see REQ-034732/A).
- IV. **Dimensional report** providing information about a measured physical dimension of the manufactured product (see REQ-034733/A, REQ-034735/A and REQ-034747/A).

NOTE: The results of the factory verification of the substrate shall be provided to the CA in the corresponding specific QRs.

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

7.2. Documentation and data control

REQ-034758/A

The Supplier shall provide a report about the execution of outgoing check and compliance with technical requirements defined by this RSD and completeness of the product.

Verification method: I - inspection

REQ-034759/A

The Supplier shall supply the following relevant manufacturing documents (extent as stipulated in the contract):

- Full technical documentation of the uncoated OAP (e.g. storage, cleaning, operation and maintenance instructions);
- Final manufacturing drawings approved by the CA (see REQ-034767/A);
- Specific quality reports (see REQ-034757/A) that demonstrate fulfilment of all technical requirements described specifically in Chapter 3;
- All approved by the CA "requests for deviation/wavier from requirements described herein".

NOTE 1: Scope of the technical documentation and formats shall be agreed with the CA.

NOTE 2: The technical documentation including Quality Reports (see REQ-034757/A) shall be submitted electronically and on CD.

Verification method: R - review, I - inspection

REQ-034760/A

The manufacturing documents shall contain strictly the units which are used to define the requirements in Chapter 3.

Verification method: R - review

REQ-034761/A

The manufacturing documents shall include the accuracy of the manufacturing process. This accuracy shall be also included in the corresponding QRs (see REQ-034757/A).

Verification method: R - review

REQ-034762/A

The Supplier shall use following data formats:

- *.JPG, *.PNG, *.TIFF, *.PDF/A, *.HTML, *.doc, *.docx, *.xls, *.xlsx, *.ppt, *.pptx, OpenDocument Format;
- CAD 2D: *.dwg;
- CAD 3D: *.stp, *.ste, *.step or other 3D CAD formats agreed with the CA;
- interferometer *.dat files on a CD and via email or equivalent data transfer.
-

7.3. Nonconformity Control System

REQ-034763/A

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

8. Verification requirements for the Supplier

8.1. Verification methods

REQ-034764/A

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

1. **Review**; Verification via Review (**R**) shall consist of using approved records (examples of such approved records are design documents and reports, technical descriptions, and engineering drawings, manuals and accompanying operation documentation) or evidence that unambiguously shows that the requirement is met.
2. **Inspection**; Verification via Inspection (**I**) shall consist of a visual determination of physical characteristics including photographs taken by the Supplier and sent to the CA proving that the specific requirements have been met.
3. **Test**; Verification via Test (**T**) shall consist of measuring product performance and functions under realistic operating conditions.
4. **Analysis**; Verification via Analysis (**A**) shall consist of performing theoretical or empirical evaluations (e.g. mathematical models, calculations and etc.).

8.2. Verification Control Document (VCD)

Verification Control Document (**VCD**) is a living document which shall be used throughout the entire Contract delivery and its phases (see chapter 8.3 Phasing of the delivery). The **VCD** provides traceability during delivery phases (Qualification of Design, Manufacturing, Acceptance, etc.).

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

The **VCD** will be provided by the CA and it can be accommodated to the Supplier's needs.

REQ-034765/A

The Supplier shall provide a Verification Control Document (VCD) for the review as agreed with the CA.

NOTE 1: Guidelines for VCD preparation will be provided by the CA.

NOTE 2: The form of VCD will be agreed between the CA and the Supplier based on the best commercial praxis used by the Supplier.

NOTE 3: The form of VCD will be agreed before completion of the Qualification Design phase (see chapter 8.3.1).

*NOTE 4: The VCD specifies **HOW** and **WHEN** each requirement is planned to be verified by the Supplier, when it was actually verified.*

Verification method: R – review

8.3. Phasing of the delivery

This chapter is intended to briefly summarize basic milestones of the Contract delivery. These milestones represent gates (checkpoints) where the quality of the delivery is to be evaluated.

Delivery shall not proceed past these gates unless their satisfactory accomplishment is approved by the CA.

Delivery lifecycle shall contain at least the following phases (**quality gates**):

- **Qualification of Design;**
- **Manufacturing;**
- **Acceptance.**

8.3.1. Qualification of Design

Summary of what has to be provided by the Supplier in terms of documentation (QRs and manufacturing drawings) before starting the manufacturing. The goal is to verify the **manufacturing drawings and design supporting documentation**.

The output of this phase is **Qualified Design and agreed scope of technical documentation**.

REQ-034766/A

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

- structure and content of the Quality Reports (QRs, see REQ-034757/A);
- structure and content of the VCD ready to be implemented (see REQ-034765/A).

Verification method: R - review

REQ-034767/A

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

- final manufacturing drawings (see REQ-034759/A);
- detailed procedures related to the testing during Manufacturing phase (see chapter 8.3.2 Manufacturing);
- common nonconformity control system (see REQ-034763/A).

Verification method: R – review

8.3.2. Manufacturing

The goal is to demonstrate that the manufactured product meets the specified technical requirements (RSD) of the CA.

This quality gate concerns primarily:

- **Inspection of manufactured product;**
- **Testing at the Supplier's site** (factory testing);
- **Cleaning, Packaging and shipping.**

Output of this phase is the **Verified Final Product**.

REQ-034768/A

The results of the Manufacturing phase of verification shall be recorded by the Supplier in the appropriate **QRs** (or in other factory/quality reports, if not specified in chapter 7.1) and overall results (including review of documentation/reports and inspection of product) shall be recorded in the **VCD** (see chapters 8.2).

NOTE: The results of all the tests shall be given strictly in units which are used to define the requirements in chapter 3.

Verification method: R - review

REQ-034769/A

The final issue of the VCD shall be submitted to the CA after the approval of the last report, within the time frame agreed with the CA in the VCD (see chapter 8.2).

Verification method: R - review

8.3.3. Acceptance

The Acceptance phase shall demonstrate the following:

- Final product has been successfully verified and this process has been documented in an appropriate way through the QRs (see REQ-034757/A) and the VCD (see REQ-034765/A);
- All detected nonconformities have been solved in accordance with REQ-034763/A;
- Final product is free of fabrication errors.

The basis for acceptance will be completed VCD summarizing the overall verification results together with relevant documentation supporting the verification (i.e. QRs, approved manufacturing drawings, Declaration of conformity and etc.).

In case of successful acceptance phase, the CA will provide to the Supplier signed acceptance protocol. In case of unsuccessful acceptance stage, the CA will provide to the Supplier a Nonconformity Report (NCR) and process in accordance with REQ-034763/A shall be applied.

REQ-034770/A

The verification process shall be carried out by the Supplier and is successfully completed when the OAP mirror complies with all specifications and the results of this process are documented in an appropriate way through QRs (see REQ-034757/A) and the VCD (see REQ-034765/A).

NOTE: Acceptance will be carried out by the CA (or if required, representatives/contractors appointed by the CA) upon delivery of the OAP mirror not obviously damaged during transport.