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# Introduction

## Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints on products applying in RA2 program of ELI project. This leads to the identification of interfaces with the ELI science-based technology. This RSD also acts as the parent document for the technical requirements that need to be addressed in lower level design description documents.

## Scope

This RSD contains all of the technical requirements: functional, performance and design, delivery, safety and quality requirements for the following product (tender number – TP20\_110): **UHV grade linear actuators for E2 Experimental hall**(further “**actuators**”). The products will be located in the E2 experimental hall and registered in PBS under following PBS code: E.E2.BETA.BT.1.1.

## Terms, Definitions and Abbreviations

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

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning** |
| CA | Contracting Authority (Institute of Physics AV CR, v. v. i.) |
| E2 | Experimental hall 2 |
| ELI | Extreme Light Infrastructure |
| NCR | Nonconformity Report |
| QR | Quality Report |
| RSD | Requirements Specification Document |
| RGA | Residual gas analysis  |
| SN | Serial number |
| UHV | Ultrahigh Vacuum |

## Reference documents

|  |  |
| --- | --- |
| **Number of doc.** | **Title of Document/File** |
| *RD-01* | 00272111\_00\_Linear\_actuator\_A.pdf |
| *RD-02* | 00272099\_00\_Linear\_actuator\_B.pdf |

## 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.

# Functional, Performance and Design requirements

Functional, performance and design requirements for the **actuators** are summarized within reference drawing **RD-01** and **RD -02** (see chapter 1.4).

## General requirements

REQ-029979/A

The Supplier shall produce **12 pcs** of the **Linear actuators** for E2 hall in accordance with the requirements given in the reference drawing **RD-01 or** **RD -02** (see chapter 1.4) and more up to the financial limit stipulated by the contract.

REQ-029980/A

The parameters of each **Linear actuator** shall correspond to the requirements given in the reference drawing **RD-01** or **RD -02** (see chapter 1.4).

REQ-029981/A

The **Linear actuators** shall have maximum dimensions according to the attached drawing package and the 3D CAD file (*see chapter 1.4;* *list of drawings within* ***RD-01*** *and* ***RD-02).***

*NOTE 1: Drawings shows only maximum boundary box, with in which delivered actuators shall fit in. Boundary box dimensions are marked with tolerance designation “MAX”. Other dimension without or with other tolerances shall be respected, as they are interface of the actuator to the other systems, where the actuators will be used.*

*NOTE 2: Supplier shall provide simplified 3D model and drawing showing actual outside dimensions for each actuator* *type.*

REQ-029982/A

Cables of linear actuators shall be radiation-resistant twisted pair cable, screened with outer insulation***.*** Actuator shall be equipped with one cable with two twisted pairs (1x4 conductors) or two cables with one twisted pair each (2x2 conductors).

Cable shall have these parameters:

Conductor: Silver-plated copper, multi strand

Number of conductors: 1 x 4 or 2 x 2

Conductor: 24 AWG 19/36 (19 x 0.127mm)

Conductor diameter: 0.64 mm

Conductor area: 0.24 mm2

Resistivity at 20 °C: 79.70 Ohm/km

Insulation: Kapton

Overall cable diameter: 3.45 mm

Diameter without screen: 2.90 mm

Voltage rating: >10 kV DC (in vacuum)

Maximum temperature: 300 °C

Weight: ~19.2 g/m

Vacuum leak rate: <5x10-10 mbar.l/s

Current at room temperature: ~2.50 A

Current up to 250 °C: ~2.30 A

## Cleaning and outgassing

REQ-029984/A

Actuator and its parts shall be cleaned to meet a **particle cleanliness** level of **100** with **best effort** and a particle level 160 **guaranteed** per MIL–STD-1246C (or equivalent standard) superseded by IEST-STD-CC1246D for particles with size > 5 μm.

*NOTE 1: The table below shows the particle cleanliness level.*

*NOTE 2: Supplier shall certify that actuator and its parts fulfill this requirement.*

*NOTE 3: CA may test random number or all actuators, if they fulfill this requirement, at own cost.*





REQ-029985/A

Outgassing rate of fully assembled actuator including cable in a low enough outgassing vacuum chamber at 1E-6 mbar or lower with mass spectroscopy (RGA) shall meet all following requirements for all masses bigger than 44 AMU up to 200 AMU:

1. The amplitude of the 43 AMU peak shall be ≤ 1/10 of the 44 AMU peak;
2. The amplitude of all peaks > 44 AMU shall be not higher than 1/100 of the 44 AMU peak;
3. The calibrated outgassing rate of the cracked hydrocarbon signature AMUs < 200 after ≤ 8 hours of pumping in an UHV-type cleaned chamber for the sum of all residual gas components with masses > 40 shall be measured to be
≤ 1E-11 mbar\*l/s/cm²;
4. There are no "significant" high AMU components above the background or instrument noise floor (even if < 1/100'th of AMU 44) up to AMU 200.

*NOTE 1: Peak at 45 AMU can be corrected by assuming a contribution from 13C, which is approx. 1.1%.*

*NOTE 2: Supplier shall certify that actuator fulfill this requirement.*

*NOTE 3: CA may test random number or all actuators, if they fulfill this requirement, at own cost.*

# Packaging and transport requirements

## General requirements

REQ-029986/A

All the actuators shall be cleaned and packaged in the clean environment of class 6 according to ČSN EN ISO 14644 (equivalent to EN ISO 14644) or cleaner.

*NOTE: Regarding the referred to standard/s or technical documents the CA allows/permits also another equal solution to be offered.*

REQ-029987/A

Each actuator shall be delivered in a separate double plastic pack preventing damage, contamination and degradation of cleanliness. Each layer shall be equipped with identification label containing: supplier name, product name and product SN.

## Transport

REQ-029988/A

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

# Safety Requirements

REQ-029993/A

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

# Quality control

## Quality Reports (QRs)

REQ-029989/A

The Supplier shall provide the following **specific quality report (certificates) for each actuator, which will consist as minimum from two parts** **(I - II)**:

1. Particle cleanliness of each actuator fulfil particulate cleanliness according REQ-029984/A.
2. Outgassing rate mass spectroscopy (RGA) meet requirements for each actuator according REQ-029985/A.

## Documentation and data control

REQ-030116/A

For each actuator, the Supplier shall provide a ***Declaration of Conformity*** (or the equivalent document) with technical requirements defined by the product RSD and ensure completeness of the products.

REQ-030117/A

The Supplier shall provide **Technical Documentation/Product manual** as part of the delivered products. The documentation shall be written in accordance with standard ČSN EN 82079-1 (or equivalent, e.g. EN 82079-1) and shall include the instructions and descriptions regarding the following:

* transport, handling and storage;
* cleaning and safe operation and maintenance procedures.

*NOTE1: If the contractor defines special conditions relevant to warranty and quality preservation than the Instructions for use shall include information about such conditions.*

REQ-030118/A

The Supplier shall use the following data formats:

* \*.dat (Zygo binary file format for interferograms)
* \*.JPG, \*.PDF/A, \*.HTML
* CAD 2D: \*.dwg
* CAD 3D: \*.stp; \*.ste; \*.step or other 3D CAD formats agreed with the CA
* \*.doc, \*.docx, \*.xls, \*.xlsx, \*.ppt, \*.pptx (for MS Office or OpenDocument Format)

## Nonconformity Control System

REQ-029990/A

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

## 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 shall 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***):

* **Manufacturing**
* **Acceptance**

### Manufacturing

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

This quality gate concerns primarily:

* **Testing at Supplier’s site** (factory testing);
* **Packaging**

The output of this phase is the **Final Product**.

REQ-029991/A

The results of the Manufacturing phase verification shall be recorded by the Supplier in corresponding QRs (see REQ-029989/A) and provided to the CA for approval (see chapter 5.3.2).

### Acceptance

The Acceptance phase shall demonstrate the following:

* Final products have been successfully verified and this process has been documented in an appropriate way through QRs (see REQ-029989/A);
* All detected nonconformities have been solved in accordance with
REQ-029990/A;
* Final products are free of fabrication errors.

The output of this phase is a **Verified Product**.

In case of successful acceptance phase, the CA shall provide to the Supplier signed acceptance protocol. In case of unsuccessful acceptance stage, the CA shall provide to the Supplier Nonconformity Report (NCR) and process in accordance with REQ-029990/A shall be applied.

REQ-029992/A

Verification process shall be carried out by the Supplier and it is successfully completed when the final products comply with all specifications and the results of this process are documented in an appropriate way through QRs (see REQ-029989/A).

*NOTE: Acceptance will be carried out by the CA (or if required, representatives/contractors appointed by the CA) on the final products at the site of the Contracting authority.*