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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 program of the ELI-Beamlines project. This can lead to the identification of product interfaces with the ELI-Beamlines science-based technology and ELI-Beamlines building facility. This RSD also acts as the parent document for the technical requirements that are addressed in lower level design documents (see Section 1.4).

### 1.2. Scope of Work

This RSD contains all of the technical requirements: functional and manufacturing design, manufacture, cleaning, packaging and transportation, as well as safety and quality, requirements for the following product (tender number: TP22\_006): **L4 10PW Laser Beam Distribution Vacuum Bellows** ("Bellows" in further text, where appropriate).

The Bellows are integral parts of the system of vacuum infrastructure of the L4 10PW laser beam distribution, serving to interconnect the node chambers and the large vacuum tubing segments. The Bellows will be installed, as a permanent part of the L4 10PW laser beam distribution vacuum infrastructure, in the E3 and L4c laser halls of the ELI-Beamlines laser building.

The bellows are **products Category A**. Category A is an Off-the-shelf Product without the necessity of modifications and the necessity to be subjected to a verification programme (review of design, inspection and testing) for the ELI Beamlines applications by the actual project specifications. All verification activities performed by the Supplier shall be executed in accordance with the Supplier's plan of outgoing inspection and tests. The Internal Acceptance Procedure of the product Category A shall be established and applied before the product implementation at the ELI Beamlines.

The Bellows are registered in the PBS database under the following PBS codes (corresponding to individual vacuum node chambers of the L4 10PW laser beam distribution): SE.BDS.BT.L4BT.L4F.S3.B.

The scope of work includes manufacture and delivery to ELI-Beamlines of 5 pieces of the DN1000 hydroformed bellows. A schematic layout of the bellows unit is shown in Figure 1.



**Figure 1:** The required vacuum DN1000 ISO-F hydroformed bellows block, with customized end flanges. The bellows is equipped with 4 spacer bars with the indicated arrangement. Delivery of 5 pieces of the bellows is required within the supply of this contract.

### 1.3. Terms, Definitions and Abbreviations

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

Abbreviation	Meaning
CA	Contracting Authority (Institute of Physics CAS)
DN	Diameter Nominal
E2, E5	Identification code of hall in ELI-Beamlines
ELI	Extreme Light Infrastructure
L x W x H	Length x Width x Height
RA1	Research Activity 1
RD	Reference Document
RSD	Requirements Specification Document

#### 1.4. Reference Documents

Number of document	Title of Document/ File
<b>RD-01</b>	L4 DN1000 Vacuum Hydroformed Bellows

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

Drawing No	Drawing Title	Sheets	Filename	File format
00327491/A	DN1000 bellows	1	Bellows DN 1000 9.2.2022.pdf	PDF
00327492/A	DN1000 bellows 3D	1	Bellows DN 1000 9.2.2022.stp	STP

#### 1.5. References to standards

If this document or RD-01 include references to standards or standardized / standardizing technical documents, the CA allows/permits also another equivalent solution to be offered.

## 2. Functional, Performance and Design requirements

### 2.1. General requirements

REQ-033684/A

The Supplier shall provide 5 pieces of the Bellows in accordance with drawing No 00327491/A (see **RD-01**, Section 1.4).

REQ-033685/A

The material of the hydroformed bellows convolutions shall be stainless steel class 1.4404, or equivalent, or class 1.4541 (equivalent to ČSN 17248, equivalent to AISI 321), or equivalent.

REQ-033686/A

The inside and outside clear diameter of the hydroformed bellows convolutions shall be at least 1000 mm, and not exceeding 1080 mm, respectively.

REQ-033687/A

The bellows section structure shall involve 10 to 12 hydroformed bellows convolutions.

REQ-033688/A

The working, compressed and extended length of the bellows module including end pieces shall be 600 mm, 575 mm or less, and 625 mm or more, respectively.

REQ-033689/A

The axial stroke of the bellows module shall be at least  $\pm 25$  mm.

REQ-033690/A

The lateral stroke of the bellows module shall be at least  $\pm 5$  mm.

REQ-033691/A

The angular stroke of the bellows module shall be at least  $\pm 0.5^\circ$ .

REQ-033692/A

The bellows shall be capable of performing 1 000 or more working cycles (axial movements).

REQ-033693/A

The working vacuum (inside the bellows) shall be  $10^{-6}$  mbar or lower. The outside pressure will be 1 bar (atmospheric pressure).

REQ-033694/A

The bellows shall have the leak rate  $1 \times 10^{-9}$  mbar·l/s or lower.

REQ-033695/A

The spring force to axially compress the bellows shall not exceed 350 N/mm.

REQ-033696/A

The nominal operating temperature of the bellows shall be  $21^\circ \pm 1^\circ$  C.

REQ-033697/A

The material for the end pieces shall be stainless steel class 1.4307 (equivalent to ČSN 17249, equivalent to AISI 304L), or equivalent, or class 1.4404 (equivalent to ČSN 17349, equivalent to AISI 316 L), or equivalent.

REQ-033698/A

The end flanges shall be of type DN 1000 ISO-F, according to ISO standard 1609 (Ref. No ISO 1609-1986 rev. 2014), or equivalent, customized according to the reference drawings **RD-01** (see Section 1.4).

REQ-033699/A

The end flanges shall have oblong holes  $\pm 1^\circ$  to relieve constraints on precision of mutual alignment of the opposite pieces during assembling.

REQ-033700/A

All sealing surfaces for the O-ring shall have the roughness of Ra 0.4 or better, with no damage.

REQ-033701/A

Good manufacturing practices for stainless steel machining and welding shall be followed in the manufacture of the Bellows.

### 3. Delivery Requirements

REQ-033702/A

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

REQ-033703/A

The bellows shall be cleaned and packaged in compliance with the cleanliness of class 8 or better according to ČSN EN ISO 14644 (or equivalent, e.g. EN ISO 14644). The bellows assemblies shall be delivered in a protective package preventing damage and contamination and in a minimum of two plies separate clean packaging.

### 4. Safety Requirements

REQ-033704/A

The Supplier shall supply a Declaration of Conformity for each product type if the appropriate legislation determines the Supplier's obligation to have a Declaration of Conformity for the purposes of a Device sale in the Czech Republic. In such a case the Declaration of Conformity shall comply with:

- Act No. 90/2016 Coll., as amended
- Act No. 22/1997 Coll., as amended
- The equivalent legal regulation of another EU member state so that the conditions for the sale of the product in the Czech Republic are met, and/or
- the relevant EU/EC regulation

*NOTE: The compliance with these obligations will be demonstrated by the (EU) Declaration of conformity, other relevant documents and the CE marking if required by the relevant regulations. If a delivered product is not required to assess conformity according to specific legislation, the supplier declares, in written form, by concluding the contract that the product complies with the general safety requirement of EU Directive 2001/95/EC on general product safety and that the Supplier duly complies their obligations under this Regulation.*

## 5. Quality Requirements

### 5.1. General Quality Requirements

REQ-033705/A

The Supplier shall provide Instructions for use (Product User Manual) as part of the delivered Product. The Manual shall include the instructions and descriptions regarding the following procedures:

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

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

REQ-033706/A

The Supplier shall provide full technical documentation related to the delivered Product.

REQ-033707/A

The Supplier shall provide information on outgoing check of the Product. At least this information shall comprise a report about the execution of outgoing check and fulfilment of the technical requirements defined by the product RSD, and completeness of the product.

*NOTE: Alternatively the Supplier might provide the CA with the information detailed enough to prove meeting all requirements stipulated herein (e.g.: catalogue/technical datasheets, product manuals or other similar documentation).*

REQ-033708/A

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

## 6. ANNEX - Overview of drawings package

The overview of the drawings package related to the L4 10PW laser beam distribution vacuum bellows and included within the **RD-01** archive (see Section 1.4) are shown in Section 6.1 below.

## 6.1. L4 10PW hydroformed bellows (Drawing No 00327492 Rev. 01)

