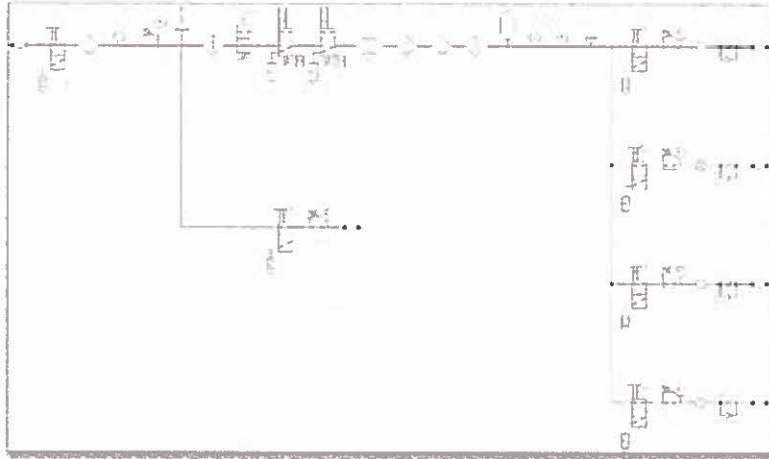


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1. Introduction

The Contracting Authority is undertaking the ELI project with the objective of building a facility using cutting-edge laser technologies and to implement research and application projects in the field of laser-matter interaction. Part of the project realization requires the reliable generation and distribution of very high quality Clean, Dry Air for the purging of laser system enclosures and for the venting of vacuum chambers containing extremely contamination-sensitive optics. This supply is required to meet very stringent limits for particle content, dew point and hydrocarbon contamination so as to provide maximum protection of high-value and long lead-time assets, as well as having a full suite of diagnostics and controls integrated into a single standard-sized hub to provide online monitoring and fault identification.

The aim of this public contract is to procure a set of three (3) (two within basic scope and one optional – see contract) identical CDA hubs meeting the requirements in the following sections.

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints for the selection of Precision Clean Dry Air Supply hubs. 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 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 TP18_038): **Precision Clean Dry Air Supply Hubs** (further "CDA hubs").

The CDA hubs are integral parts of the standalone L2 and L4 laser systems and will be placed in the L2 and L4 laser halls at the ELI Beamlines facility. These products are registered in the PBS software under the following PBS codes: *RA1.L2.L2_1.CSS.AIR (L2 - 1 pc)* and *RA1.L4.CSS.AIR (L4c - 1 pc, L4b - 1 pc)*.

These CDA hubs are **products Category B** according to the ELI Beamlines RSD categories. Category B is an Off-the-shelf Product with customization (e.g., product performance). All verification activities performing by a supplier shall be executed in accordance with the supplier's plan of outgoing inspection and tests. The verification of all specified parameters listed in this RSD will be undertaken by the supplier before delivery to the ELI Beamlines facility and the CDA hubs shall be furnished with a verification (test) reports and a declaration of conformity, to reflect their proper characteristics. Furthermore, the CDA hubs will be subject to testing and verification upon delivery to the ELI Beamlines facility. All nonconformities (if any) must be addressed by the supplier in a timely manner.

1.3. Terms, Definitions and Abbreviations

For the purpose of this document, the following abbreviated terms apply:

Abbreviation	Meaning
CA	Contracting Authority (Institute of Physics AV CR, v. v. i.)
CDA	Clean and Dry Air
DIN	<i>Deutsches Institut für Normung</i>
ELI	Extreme Light Infrastructure (project of the CA)
FAT	Factory Acceptance Test
FD	Functional Demonstration (as a verification method)
GC-MS	Gas Chromatography - Mass Spectrometry
I	Inspection (as a verification method)
IP	Ingress Protection
L x H x W	Length x Height x Width
MCB	Miniature Circuit Breaker
NCR	Nonconformity Report
R	Review (as a verification method)
RAL	Reichs-Ausschuß für Lieferbedingungen und Gütesicherung – European color matching standard
RD	Reference Document
RH	Relative humidity
RSD	Requirements Specification Document
SAT	on-Site Acceptance Test
T	Test (as a verification method)
VCD	Verification Control Document

1.4. Reference documents

Number of document	Title of Document/ File
RD-01	00163567-B_1.2_Q_M_Guide_for_Instructions_for_Use_Ver-9_EN_fully_signed.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.

1.6. Compliance diagrams

Figure 1 below shows the pneumatic function that each CDA hub shall perform. Figure 2 shows the dimensions of the cabinet that shall be used to integrate the system and the location of the DIN rail and cable trunking required.

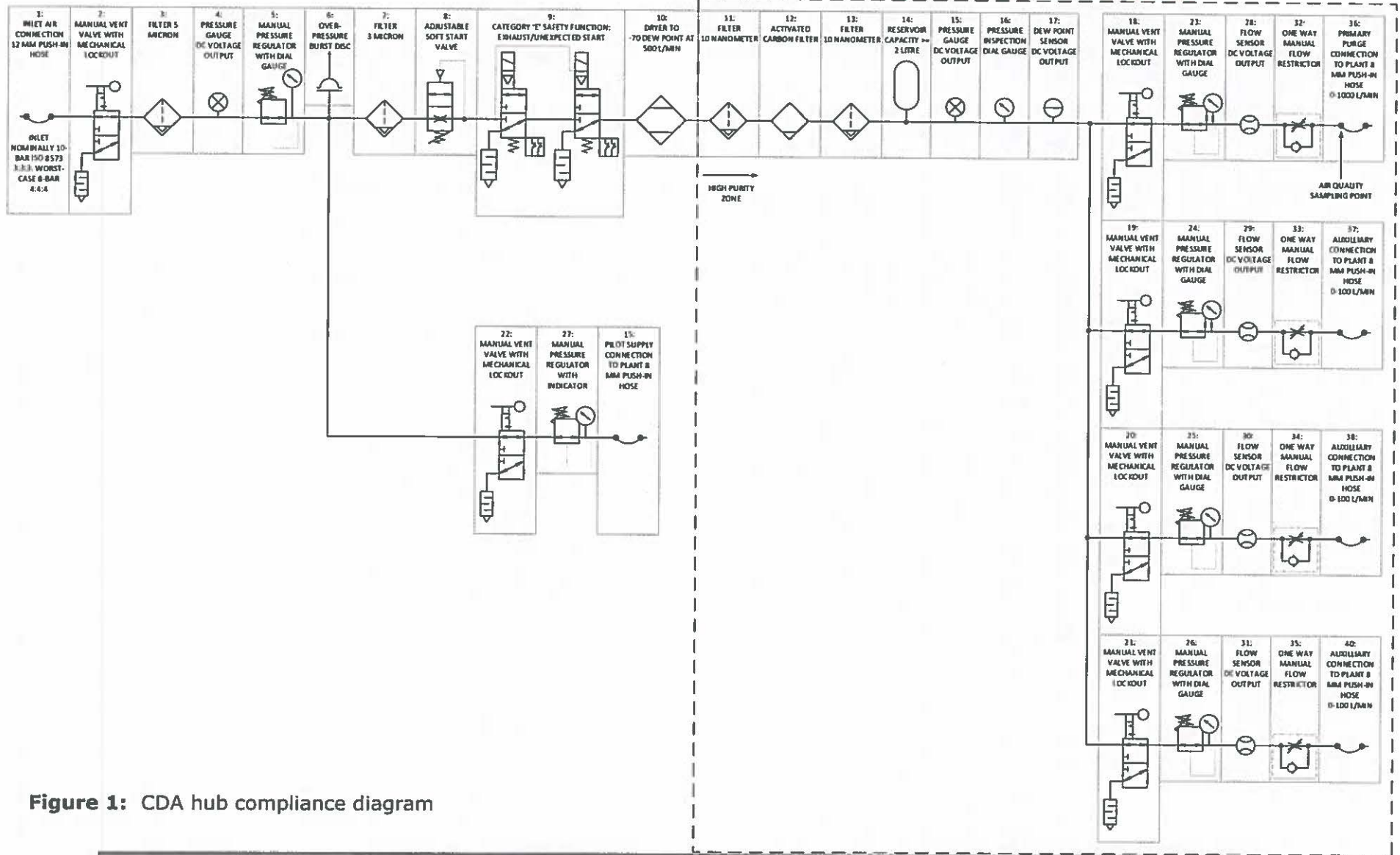


Figure 1: CDA hub compliance diagram

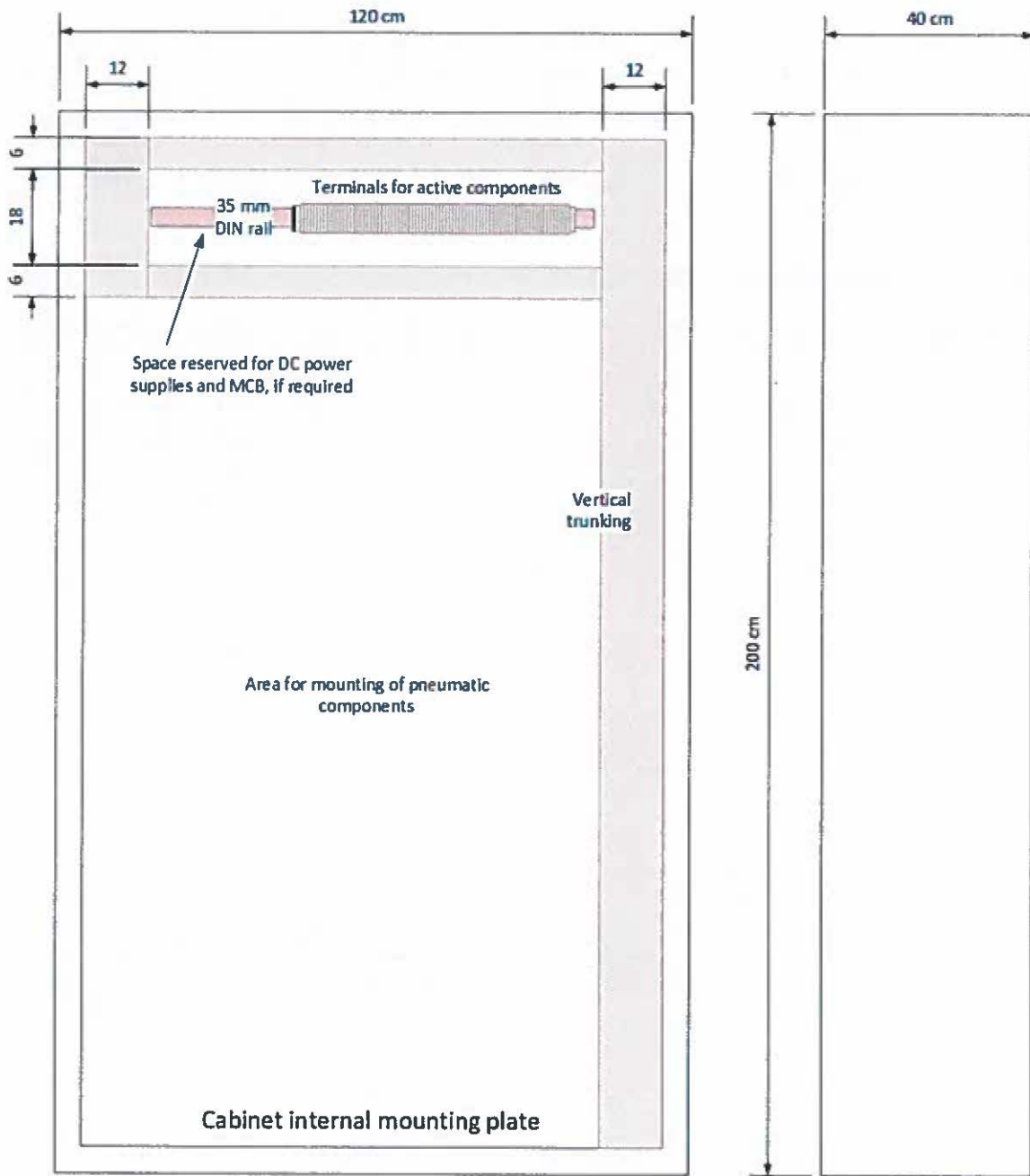


Figure 2: CDA hub cabinet layout (all dimensions in cm)

1.7. Key Specifications

Table 1 below summarizes the main specifications of each CDA hub.

Description of Specification	Required Parameter (Equal or Better)	Description of verification
Number of output lines	5: 1x Pilot, 1x Main purge, 3x Auxiliary	Review of documentation
Combined flow output capability with all specifications satisfied (sum of all output lines)	500 l/min with all specifications met	Test using the digital display of the built-in flow meters
Combined flow output capability with relaxed dew point specification (sum of all output lines)	1000 l/min with air quality to 1:2:1	Test using the digital display of the built-in flow meters
Pressure adjustment range of all outputs	0-7 bar with individual continuous manual adjustability per output	Test using the built-in pressure gauges/sensors
Flow adjustment and measurement range of each individual output when all other outputs vented	Pilot: Not required Main Purge: 0-1000 l/min Auxiliary: 0-100 l/min Individual continuous manual adjustability per output	Test using the built-in flow meters
Basic air quality of Main and Auxiliary outputs to ČSN ISO 8573-1 (equivalent to ISO 8573-1:2010)	1:1:1, measured at the main purge and each auxiliary output	Samples submitted to 3 rd party laboratory following ČSN ISO 8573-1 (equivalent to ISO 8573-1:2010) standards
Particulate content of Main and Auxiliary outputs	ISO Class 0 according to ČSN EN ISO 8573-1 (per 1000 liters: ≤ 10 particles for 0.3-0.5 μm, ≤ 2 particles for 0.5-1 μm, zero particles above 1 μm)	Particle counter fitted with high pressure diffuser provided by the Supplier or 3 rd party laboratory
Volatile organic compound content of Main and Auxiliary outputs	Peaks of all detected hydrocarbon species from 16 to 300 Da shall be below 0.01 mg/m ³ (i.e., even those with fewer than 6 carbon atoms).	Using purge & trap GC-MS provided by 3 rd party laboratory. Spectrum shall be provided.
Enclosure	Each CDA hub shall be fully contained within a single IP55 lockable 2-door, dimensions 1200 x 400 x 2000 mm (W x D x H), cabinet of sheet steel ≥1.5 mm thick, power coated to RAL 7035, with 4 removable eyebolts	Review of documentation

Table 1: Key Specifications

1.8. Summary of Deliverables

Table 2 below summarizes the deliverables of the contract (including RSD) fulfilment:

	Description	Deadline*
D1	Detailed pneumatic diagram complete with full bill of materials, a panel layout showing placement of all components and an electrical wiring diagram showing all active components	T0 + 8 weeks
D2	Receipt by the CA of identical completed CDA hubs at the CA site together with full Factory Acceptance Test report collating the results and supplementary materials for all Verification Tests listed in Table 1	T0 + 10 weeks
D3	Acceptance	T0 + 18 weeks

* T0 is defined as the date of entry into force of the contract, i.e. the contract is signed by the CA and the Supplier, or the date of activation of the option.

Table 2: Summary of Deliverables

2. Functional, Performance and Design Requirements

2.1. General Requirements

REQ-023485/A

Each CDA hub assembly shall conform to Figure 1. The 40 numbered components shall be provided, assembled and interconnected so as to conform to this diagram and in accordance with all other requirements and performance specifications.

NOTE 1: Additional components may be provided and connected as required.

NOTE 2: Numbered component functionality may be satisfied by combining separate individual parts, or several component functions may be merged and realized by a single multi-functional device.

NOTE 3: The precise internal pneumatic connections of each numbered component are not important as long as the implicit functionality is observed.

Verification method: I - inspection

REQ-023486/A

The Supplier shall deliver the (D1) and (D2) deliverables listed in Table 2 to the CA before the associated deadline.

Verification method: I - inspection

REQ-023487/A

The performance of each CDA hub shall meet or exceed all Key Specifications in Table 1 above. All Key Specifications shall be met simultaneously, except where noted, and in normal operation.

NOTE: The Supplier is responsible for performing all Verification Tests listed in Table 1 before delivery and for collating the Factory Acceptance Test report (D2).

Verification method: R – review, T – test

2.2. Specific component requirements

REQ-023488/A

Active components shall be provided with all necessary connectors and cables for their correct operation and complete interface to external control systems.

NOTE: Active components are the following (see figure 1 above): inlet pressure sensor (4), safe exhaust valve (9), dryer (10), manifold pressure sensor (15), dew point sensor (17), and flow sensors (28-31).

Verification method: I - inspection

REQ-023489/A

Active components of each CDA hub shall be cabled in a logical arrangement to the lower side of a row of 35 mm top-hat profile DIN rail screw terminals of nominal 4 mm² conductor cross section, located towards the top of the enclosing cabinet.

Verification method: R – review, I - inspection

REQ-023490/A

Terminals shall be labelled and numbered and a full set of wiring diagrams shall be provided ready for the CA to connect to external control systems and mains power as required.

Verification method: I - inspection

REQ-023491/A

Active components shall be powered from 24 V DC power where possible. For supplying any DC power source, the Supplier shall provide an industrial DIN-rail mount power supply mounted on DIN rail and suitable for connecting to a single phase 230 V AC mains supply after installation at the CA site.

Verification method: I - inspection

REQ-023492/A

An MCB of appropriate type and rating shall be provided on the mains inlet and the wiring diagram shall be sent to the CA for electrical safety approval as part of D1.

Verification method: R - review, I - inspection

REQ-023493/A

All active components shall be provided with a full set of documentation including the specifications of all electrical interfaces and any calibration and scaling data necessary to recover their calibrated readings from the output signal voltage, where applicable.

Verification method: I - inspection

REQ-023494/A

The component (6) of each CDA hub (see figure 1 above) shall be a simple non-resettable overpressure relief mechanism based on rupture of a metal disc with nominal rupture pressure of 10 bar.

Verification method: R - review

REQ-023495/A

The component (17) of each CDA hub (see figure 1 above) shall have a measurement range of at least -70 °C to -10 °C (-80 °C preferred) with an accuracy of better than +/- 3 °C (+/- 2 °C preferred accuracy).

Verification method: R - review

REQ-023496/A

The component (17) of each CDA hub shall have a DC voltage output in the range from 0 to 10 V.

Verification method: R - review

REQ-023497/A

The component (17) of each CDA hub shall be calibrated and the calibration certificate shall be delivered to the CA.

Verification method: I - inspection

REQ-023498/A

The component (9) of each CDA hub shall be consistent with performing the safety functions "safe exhausting" and "prevention of unexpected start" in accordance with ČSN EN ISO 13849-1 (equivalent to EN ISO 13849-1) performance level "e" category 3.

Verification method: R - review

REQ-023499/A

The component (9) of each CDA hub shall have two enabling channels (suitable for 24 V DC signals) and two feedback position channels and shall have internal (pneumatic) self-monitoring.

NOTE: The CA will provide the safety PLC, logic and external wiring connections in order to complete the full safety functionality. Responsibility for evaluating the final safety level is understood to remain under the CA.

Verification method: R – review

REQ-023500/A

The maximum peak noise level of the component (10) shall be carefully minimized by the Supplier and shall not exceed 70 dBA.

NOTE: The maximum permissible peak noise level is 70 dBA with the enclosure doors shut. If the CA suspects that the noise level is excessive, an additional verification measurement may be requested prior to acceptance.

Verification method: T – test (Measurement on the CA request – sound pressure meter located 1 m from closed enclosure door at 1 m height)

REQ-023501/A

The inlet and outlet pipe fittings for external connections to the ELI Beamlines technologies shall consist of an ČSN EN ISO 228-1 (equivalent to EN ISO 228-1) female parallel thread of either G ¾" or G ½" size, into which a removable adapter to 12 mm hose (inlet) and 8 mm hose (all outlets) is attached by the Supplier so as to permit fittings to be exchanged for other types and sizes by the CA as required.

Verification method: R – review, I - inspection

2.3. Pipe and cable management

REQ-023502/A

All pipes and cables shall be properly routed and mechanically supported at intervals of no more than 200 mm or fully enclosed in fixed cable trunking.

Verification method: I - inspection

REQ-023503/A

At least one full-height (2000 mm) section of fixed cable trunking of at least 120 mm wide x 80 mm high (see Figure 2) shall be provided to permit routing of the CA's external connection from either the top or the plinth of the enclosure as necessary.

Verification method: I - inspection

2.4. High purity zone components

REQ-023504/A

All the components in the designated high purity zone shown in Figure 1 (downstream of the first 10 nm filter) shall be precision cleaned, internally and externally cleanroom compliant, low particulate generating (particularly valves and components with moving parts), free from oil and hydrocarbon-based grease, and shall be handled and assembled solely in the cleanroom of ISO Class 7 according to ČSN EN ISO 14644 (equivalent to EN ISO 14644) or better environment.

Verification method: R – review, I - inspection

REQ-023505/A

All the components outside of the designated zone, including the cabinet, shall be externally cleaned with clean, dry air and pure isopropanol or similar before final assembly and shall not have external particle-generating materials.

Verification method: R – review, I - inspection

3. Environmental Requirements

REQ-023506/A

The CDA hubs shall be designed for and capable of meeting all requirements during long term operation in a cleanroom environment of ISO class 7 according to ČSN EN ISO 14644 (equivalent to EN ISO 14644) at temperature range of 19-21 °C with stability $\pm 0,6$ °C and humidity 40-60 % RH, and subject to a supply of compressed air of 9-11 bar and quality 4:4:4 according to ČSN ISO 8573-1 (equivalent to ISO 8573-1:2010).

Verification method: R – review

4. Delivery Requirements

REQ-023507/A

The final assemblies of all cleaned components of the CDA hubs and packaging of the finished assemblies shall be carried out by the Supplier in a cleanroom of ISO Class 7 according to ČSN EN ISO 14644 (equivalent to EN ISO 14644) or better. The assembled CDA hubs shall be double-wrapped in low-outgassing film before being removed from the cleanroom for palletization.

Verification method: I - inspection

REQ-023508/A

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

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

Verification method: I - inspection

5. Safety Requirements

REQ-023509/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 Product sale in the Czech Republic to fulfil the requirements of 2001/95/EC directive or applicable Czech law.

Verification method: R - review, I - inspection

6. Quality requirements

6.1. General Quality Requirements

REQ-023510/A

The Supplier shall provide Instructions for use (Product User Manual) as part of the delivered Product. The Instructions for use shall be written in accordance with standard ČSN EN 82079-1 (equivalent to EN 82079-1) and shall include the instructions and descriptions regarding the following:

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

*NOTE: As an alternative to standard ČSN EN 82079-1 (equivalent to EN 82079-1) an internal ELI "Instructions for use" methodology can be used (see **RD-01**; chapter 1.4) which will be provided to the Supplier upon request.*

Verification method: R - review, I - inspection

REQ-023511/A

The Supplier shall provide information on execution of outgoing check of the Product. At least this information shall comprise declaration about execution of outgoing check and declaration of conformity with technical requirements defined by the product RSD and completeness of the Product.

Verification method: I - inspection

REQ-023512/A

The Supplier shall supply the following relevant manufacturing documents:

- all approved by the CA detailed pneumatic diagram complete with full bill of materials, a panel layout showing placement of all components and an electrical wiring diagram showing all active components;
- all approved by the CA "requests for deviation/waiver from requirements described herein".

NOTE: The manufacturing documents may be supplied in electronic form in relevant data formats described in the REQ-023513/A.

Verification method: I - inspection

REQ-023513/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-023514/A

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

Verification method: Not To Be Tracked within VCD

6.2. Specific Quality requirements

REQ-023515/A

In case of a warranty repair of the CDA hub by the Supplier, the Supplier shall redo necessary parts of the verification procedure. The results of this process shall be provided to the CA.

Verification method: Not To Be Tracked within VCD

REQ-023516/A

All the documents shall contain strictly the units which are used to define the requirements in the chapters 1.7 and 2.

Verification method: R - review

REQ-023517/A

All tests of CDA hubs shall be performed with the measuring instruments with valid metrological confirmation.

NOTE: The CA can request the Supplier to provide the valid Calibration Certificates.

Verification method: Not To Be Tracked within VCD

7. Verification requirements for the Supplier

The verification process will be performed by the Supplier to demonstrate that the CDA hubs meet the specified requirements of the CA.

7.1. General requirements

REQ-023518/A

The verification process 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 visual examination of the manufactured and/or assembled product, i.e. its physical characteristics proving that the specific requirements have been met.
3. **Test** (including functional demonstration); Verification via Test (**T**) shall consist of measuring product performance and functions under realistic operating conditions. When the test

objectives include the demonstration of qualitative operational performance (functional demonstration), the execution shall be observed and results recorded.

Verification method: Not To Be Tracked within VCD

REQ-023519/A

The results of the tests shall be documented by the Supplier in the appropriate **Factory Acceptance Test Report** (further "**FAT report**") and submitted to the CA before delivery.

NOTE1: The content of the FAT report shall be agreed with CA.

NOTE2: The analysis of data derived from testing shall be an integral part of the test and the results included in the FAT report.

Verification method: R - review

REQ-023520/A

The results of the test, inspection and the review of documentation shall be tracked in the VCD (see chapter 7.2).

Verification method: R - review

7.2. Verification Control Document (VCD)

The Verification Control Document (**VCD**) lists the requirements to be verified with the selected methods at the defined phases of the delivery.

The VCD is a living document which shall be used throughout the entire Contract delivery and its phases (see Table 2 above). This document provides traceability during delivery phases and represents a formal tool of communication between the Supplier and the CA (formal record, reporting tool).

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

REQ-023521/A

The Supplier shall provide a **Verification Control Document** (further "**VCD**") for the reviews 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.

Verification method: R - review

REQ-023522/A

In the VCD the Supplier shall specify **HOW** and **WHEN** each requirement is planned to be verified.

Verification method: R - review

REQ-023523/A

The final issue of the VCD shall be submitted to the CA after the approval of the last report and before delivery (D2 according to Table 2 above).

Verification method: R – review

REQ-023525/A

The Supplier shall make available to the CA for consultation the VCD's supporting documentation in addition to the reports.

Verification method: Not To Be Tracked within VCD

7.3. Acceptance

Acceptance will be carried out by the CA at ELI Beamlines premises upon delivery and final verification of the installed CDA hubs. The basis for acceptance will be completed VCD summarizing the overall verification results together with relevant documentation supporting the verification (i.e. FAT reports, approved manufacturing documents, Instructions for use and etc.).

The CA reserves the right to repeat any Verification Test as part of the on-Site Acceptance Test conducted at the CA's site within 8 weeks of delivery. A failure of any parameter to reach the required specification, either during the Factory Acceptance Test or during the on-Site Acceptance Test, shall result in non-acceptance and non-fulfilment of the contract unless rectified and successfully re-tested.

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 Nonconformity Report (NCR) and process in accordance with REQ-023514/A shall be applied.

REQ-023524/A

The Acceptance phase shall demonstrate the following:

- Final CDA hubs have been successfully verified by the Supplier and the results of this process has been documented in an appropriate way through FAT reports (see REQ-023519/A) and VCD (see chapter 7.2);
- All detected nonconformities have been solved in accordance with REQ-023514/A;
- Final CDA hubs are free of fabrication errors and are ready for the intended operational use.

Verification method: Not To Be Tracked within VCD