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]

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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			Common Design review and test report		
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					
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			● 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					

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R1-14	REQ-027277/A	rmance 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			● 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		3.3. Control system	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			● 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					

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R2-05	REQ-027284/A	3. Functional, Perfo		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	rformance and Design requirements		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		

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R5-01	REQ-027294/A	3. Functional, Pe	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: ● 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: • 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: ● *.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		nt (VCD)	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			● Phase of delivery Acceptance protocol/s ● Final Acceptance protocol		

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Q6	REQ-027302/A	4. C	4.3.2. Verification Control Documen	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: