

TECHNICAL SPECIFICATION FOR THE ALBA UHV VALVES

Final revision

Date

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1 Introduction

The Consortium for the Construction, Equipment and Exploitation of a Synchrotron Light Laboratory (CELLS) is responsible for the construction and the operation of a new 3rd generation synchrotron radiation facility, named ALBA.

The facility will comprise a 268.8 m circumference 3 GeV electron storage ring, injected from a 100 MeV Linac through a full energy 249.6 m booster synchrotron, and an initial complement of seven beam lines.

To achieve stored beam life time of many hours in the storage ring, the electrons must circulate in ultra high vacuum (UHV) conditions. The pressure inside the storage ring without beam must be in the low 10^{-10} mbar range and with the design current of 400 mA in low 10^{-9} mbar range.

ALBA storage ring consists of 16 vacuum sections; each vacuum section is isolated with UHV all metal RF shielded gate valves. In addition, the booster, transfer lines, front ends and beam lines will be divided into sections with UHV valves. Other valves are needed for connecting rough pumping or leak detectors and for vacuum safety with a fast response for the beam lines and front ends.

The UHV valves for the ALBA machine, front ends and beam lines are the subject of this specification. The valves included in this CFT are: pneumatic RF all metal gate valves, UHV pneumatic gate valves, all metal manual right angle valves, fast closing shutters including their associated modular controllers, and double gate valves.

All items must be current standard catalogue items for which the supplier has a history of supplying.

The bids must be compliant with this specification or as agreed in writing with CELLS. However, bidders may also offer available alternatives to those outlined in this specification as options.

The documents provided for this call for tender are: this technical specification (END-SR-VCVLV-CC-0001), "General specification for the design, construction and handling of UHV vessels, components and assemblies" (END-VCES-ES-0001).

2 Scope of contract.

- 2.1 The contractor shall perform the scope of works required by this specification which includes (but not limited to): the supply of materials, all tooling and equipment required for the manufacturing, the detailed manufacturing and assembly drawings, handling and testing, manufacturing, cleaning, inspection, vacuum conditioning, testing, packing and the DDP delivery of the valves.
- 2.2 During the construction of the machine and the first beam lines, CELLS will require UHV valves. These have been divided into four lots:
- Lot 1: Pneumatic all metal UHV RF gate valves and pneumatic all metal UHV gate valves.
 - Lot 2: Pneumatic UHV gate valves with Viton gate seal and metal bonnet seal.
 - Lot 3: Manual UHV all metal right angle valves.
 - Lot 4: Fast closing shutters and their associated controllers, modules sensors and cables and Double gate valve (incl. one window valve each)
- 2.3 This call for tender covers the supply of the following items as shown in Table 1.

Table 1 The lots, valve types, description and quantities.

Lot #	Item #	Type name	Description	Qty.	Note
1	1	RF gate valves	Left handed, pneumatic, DN 100 CF	22	21 Machine requirement + 1 spares.
			Right handed, pneumatic, DN 100 CF	22	21 Machine requirement + 1 spare
	2	UHV all metal gate valves	All metal UHV gate pneumatic valves, DN40 CF	32	13 Machine requirement + 2 spares. 15 Front end requirement + 2 spares.
			All metal UHV gate pneumatic valves, DN63 CF	48	34 FE start + 3 spares. 10 Front end requirement + 1 spare.
2	4	UHV Viton-sealed gate valves	Pneumatic UHV gate valves, Viton gate seal, DN40 CF	29	27 Beamline requirement + 2 spares
	5		Manual UHV gate valves, Viton gate seal, DN40 CF	4	3 Beamline requirement + 1 spares
	6		Pneumatic UHV gate valves, Viton gate seal, DN63 CF	9	8 Beamline requirement + 1 spares
	7		Pneumatic UHV gate valves, Viton gate seal, DN100 CF	11	10 Beamline requirement + 1 spares
	8		Pneumatic UHV gate valves, Viton gate seal, DN150 CF	4	3 Beamline requirement + 1 spares
3	9	Right angle valves	All metal UHV manual right angle valves, DN 40 CF	151	73 Machine requirement + 7 spares 35 front end requirement + 4 spares. 29 Beamline requirement + 3 spares
	10		All metal UHV right manual angle valves, DN 63 CF	76	38 Machine requirement + 5 spares 8 front ends requirement +1 spare 22 Beamline requirement + 2 spares
4	11	Fast closing shutters and their associated controllers and sensors.	Including all necessary modules and cables DN 40CF	11	8 with 2 triggers + 1 spare (front end requirement) 1 with one trigger + 1 spare (Beamline requirement).
	12	Double gate valve	Two welded DN40CF gate valves, line offset 90°	7	6 Beamline requirement + 1 spare.

- 2.4 CELLS is prepared to place separate contracts for each lot, bidders may therefore quote for either individual lots or any combination of the four lots.
- 2.5 Interested bidders are invited to submit offers for the lots with a price breakdown of each item and total price for each lot.
- 2.6 If a bidder is in a position to bid for more than one lot, CELLS encourages package discounts for bids including more than one lot. These discounts are to be clearly indicated in the tender together with the prices of the lots excluding the package discounts.
- 2.7 CELLS may also wish to purchase additional items subsequent to the award of the main contract resulting from this call for tender and bidders are asked to propose a price indexation formula for

additional orders placed after the main contract as detailed in the administrative terms and conditions of this call for tender. A competitive delivery time should be also included in the proposal. The bidders are invited to give formulas for other items, sizes and types apart from those specified in this call for tender as well.

- 2.8 After the contract has been placed, any deviations or modifications from the agreed specification will not be allowed, except with the written authorization of CELLS.

3 Tendering and contract management

3.1 Pre-tender discussions

- 3.1.1 All interested bidders are encouraged to contact CELLS and to discuss details of the technical specifications before making an offer. In particular, CELLS wants to make sure that the bidder fully understands the requirements and implications of the technical specifications and that there are no misunderstanding as to its interpretation:

Enquiries of a technical nature should be directed to Miss Eshraq Al-Dmour, CELLS,

Tel.: 0034 (0) 93-592.43.32, e-mail: eshraq.al-dmour@cells.es

Enquiries of a contractual nature shall be directed to Mr. M. Sazatornil, CELLS,

Tel.: 0034 (0) 93-592.43.07, e-mail: alba.concursos@cells.es

- 3.1.2 Any information supplied as a result of such enquiries that affects details of the specification will be formally distributed to all the bidders.
- 3.1.3 Bidders are requested to comment upon the technical specifications and are encouraged to make alternative proposals in addition to the bid for the given technical specifications. However, after the contract has been placed, any deviations or modifications from the agreed specification will not be allowed, except with the written authorization of CELLS.
- #### 3.2 Information required with the tender.
- The bidder shall provide together with the tender documents, sufficient information to allow a satisfactory evaluation and choice of contractor. Two sets of the following documents should be provided:
- 3.2.1 A confirmation of acceptance or detailed explanation of any departure from the conditions defined in this specification. This must be done for **each clause** of the present specification.
- 3.2.2 The bidder shall complete the price breakdown pro-forma for the equipment and services as requested in this specification. Eventual alternative technical proposals shall be described and quoted for in a clearly separated accompanying document.
- 3.2.3 Confirmation that unit prices will remain unchanged for reasonable variations in quantities ordered within the main order resulting from this tender. An acceptable bandwidth for these variations in order to maintain the unit prices is to be specified by the bidders in their bids.
- 3.2.4 The bidders must include in the bid a guarantee formulae for calculating the unit price of individual components in case of additional orders placed after signing the main contract as detailed in the administrative terms and conditions of this call for tender.
- 3.2.5 Full technical specification or data sheet of the items offered.
- 3.2.6 A complete set of general layout drawings and manuals for the proposed valves and controllers. Manuals must be provided in paper and electronic format.

- 3.2.7 Outline design and summary of the proposed manufacturing process and commenting on any particularly critical aspects.
- 3.2.8 Details of communication protocols for the pneumatic valves, including command set and time information (for item # 11 the fast closing shutter).
- 3.2.9 Confirmation that the guidelines, standards and regulations with respect to safety, electromagnetic compatibility (EMC) as well as CE marking are duly fulfilled.
- 3.2.10 Confirmation that each valve will be supplied with its own completed test report.
- 3.2.11 Details of the Quality Assurance Plan (QAP) that the Contractor operates.
- 3.2.12 The Inspection Points Plan (IPP) form to be used for the manufacturing process.
- 3.2.13 The bidder shall provide an outlined programme showing key dates for all stages of:
- The commencement and completion of tooling design,
 - Submission of documents needing CELLS approval,
 - The procurement of materials and bought-in items,
 - Manufacture,
 - Testing (factory acceptance tests),
 - Delivery.
- 3.2.14 The bidder shall confirm his agreement with the acceptance tests as in this technical specification.
- 3.2.15 In case the bidder has different testing procedure than those indicated here, he must include information for the proposed methods and means for undertaking each of the required tests in the bids. Results of performance tests carried out by bidder on the proposed equipment, and detailed descriptions of test procedures and measurement conditions are to be included in the scope of supply.
- 3.2.16 Indications on proposed work packages to be undertaken by the contractor.
- 3.2.17 Indications on proposed work packages to be undertaken by any subcontractors (if any).
- 3.2.18 The proposed subcontractors and proof of their technical capability (if any).
- 3.2.19 Details on warranty period and details.
- 3.2.20 Details on service coverage.
- 3.2.21 A list of previous similar or comparable projects, in size and scope, a list of previous customers along with contact details on any proposed equipment. This information will enable CELLS to assess the bidder's viability and ability to accomplish the present contract.
- 3.2.22 Statistics on the reliability of the proposed equipment compiled by the bidder (information on mean-time-to-failure data etc.).
- 3.2.23 The proposed procedure for the cleaning the valves as well as for maintenance activities such as exchanging the valve seals.

3.2.24 The bidder has to confirm in his bid that he as well as his subcontractor/s do have clean rooms for assembly purposes. An agreement with the cleanliness indicated in this specification is also required.

3.2.25 Details of the proposed packaging and shipping arrangements.

3.2.26 Any other information requested for submission in the bid indicated in other places within this technical specification and any other information that the bidder finds important for submission in his bid.

3.3 **Contract management**

3.3.1 At the start of the contract, the successful bidder shall nominate a contract engineer who will be responsible for all reporting to and contact with CELLS for both technical issues and the contact person with CELLS for administrative issues.

3.3.2 Delivery to CELLS shall not commence until successful completion of all factory acceptance tests (FAT).

3.3.3 The contact engineer must inform CELLS about any delay or manufacturing or technical problem that may affect the manufacture of the items in the tender or may cause a delay in the time schedule of the contract.

3.4 **Programme and Progress Reports**

Within two weeks after the signature of the contract, the contractor must provide the following documents for approval by CELLS:

3.4.1 A detailed programme covering the manufacturing, assembly, and testing phases in sufficient detail.

3.4.2 Details on the production, testing, and acceptance procedures: Quality Control Plan which will be followed during the manufacture, testing, and shipping of the valves.

4 **Responsibilities of the contractor.**

4.1 The contractor will be responsible for the final design, the production methods and the correct manufacture of the valves and controllers, irrespective if they have been chosen by the contractor or suggested by CELLS. The manufacturer is responsible for meeting all the mechanical, electrical, vacuum, thermal, and safety requirements of this specification and reference design, including testing and certification. Strict compliance with this specification is required unless specifically modified in writing by contractual amendment.

4.2 CELLS' approval of the design and components does not release the contractor from his responsibilities to correct errors, oversights, and omissions to ensure conformance to the specification of this document-

4.3 The contractor is responsible for:

4.3.1 The preparation of a detailed time schedule for the contract and the control of the agreed schedule. The detailed programme covering the design, development (if necessary), manufacturing, and testing phases.

4.3.2 The procurement of all necessary materials and bought-in items including the preparation of all procurement documents and the provision of test and acceptance documentation.

- 4.3.3 Study, design, production and assembly drawings, manufacture and/or supply of tools, gauges and all test equipment necessary to fulfil the contract.
- 4.3.4 Preparation of a quality assurance plan and the Inspection Points Plan (IPP).
- 4.3.5 Complete documentation file of manufacture and quality assurance acceptance tests.
- 4.3.6 The manufacturing processes including:
- i. Time schedule,
 - ii. Preparation of detailed manufacturing drawings,
 - iii. Complete design of welds/vacuum brazing and the welding/vacuum brazing process (if any),
 - iv. Qualification of the welding/vacuum brazing operators and welders (if any),
 - v. The manufacture of the items as defined in section 2 of this specification.
 - vi. Cleaning procedures and protection of components during manufacture and shipment.
 - vii. All tests necessary for the acceptance of the valves including, but not limited to:
 - a) Provision of necessary equipment.
 - b) Dimensional checks and control.
 - c) Final cleaning.
 - d) All tests necessary for the acceptance of the produced items.
- 4.3.7 The control of the quality of all materials and manufacturing processes including the provision of all agreed documentation.
- 4.3.8 Informing CELLS about any delay or manufacturing or technical problem that may affect the manufacture of the items in the tender or may cause a delay in the time schedule of the contract.
- 4.3.9 Control of all subcontractors (if any).
- 4.3.10 The production file for each valve, which include the complete documentation file of manufacture and quality assurance acceptance tests.
- 4.3.11 The packing and DDP transport of the valves from the contractor factory to either the CELLS site or to the site of companies contracted by CELLS.
- 4.3.12 All the above points in as much as they apply to the subcontractors (if any).
- 4.4 If after the order is placed and the contractor discovers that he has misinterpreted the specification, this will not be accepted as an excuse and CELLS will insist that the contractor delivers the equipment according to the present specification at no extra cost. During the execution of the contract, all proposed deviations from the specification must be submitted to CELLS in writing; CELLS will give its approval or refusal also in writing. It is understood that the contractor shall record the changes and the approvals, and to control these changes to fulfil this specification.
- 4.5 The schedule which must be followed for the performance of this contract:
- 4.5.1 During the start up meeting, the contractor must issue a detailed programme covering the design, development (if necessary), manufacturing, and testing phases.
- 4.5.2 Within two weeks of the commencement of the contract a programme of technical and progress

meetings will be agreed between the Contractor and CELLS (if needed).

4.5.3 Following the signature of the contract, the design stage (for item # 1, RF gate valves) shall not exceed one calendar month in length unless mutually agreed in writing.

4.5.4 Time schedule:

Item # 1 – RF gate valves:

Three phases:

Phase 1: Design review phase.

Phase 2: pre-series production phase.

Phase 3: series production phase.

Action	Time
Contract placed	0
Start up meeting	0+2 weeks
Engineering design complete (end of phase 1)	Nov. 2007
Start of the first valve production (pre-series) (start of Phase 2)	Nov. 2007
Release of the series production (start of phase 3)	Jan. 2008
Delivery of the first batch (10 valves)	Mar. 2008
Delivery of the second batch (15 valves)	May. 2008
Delivery of the third batch (17 valves) and completion of the series production (end of phase 3)	Jul. 2008

Item # 2-12:

Action	Time
Contract placed	0
Start up meeting	0+2 weeks
Delivery of the first batch	Nov. 2007
Delivery of the second batch	Dec. 2007
Delivery of the third batch and completion of the series production (end of phase 3)	Jan. 2008

4.5.5 For item # 1: The manufacturing for the complete series production will start only after the entire factory acceptance tests (FAT) for the first valve manufactured have been carried out successfully.

4.5.6 For item # 1: The design stage shall cover the discussion of any updates regarding the design as requested from the contractor side or CELLS side, the preparation of the manufacturing drawings, the progress in the procurement of the material and the tools, the detailed preparation for the testing and acceptance and the details of the manufacturing process, details of handling, packing and shipping conditions.

4.6 The final acceptance of the valves will be based on the SAT. For the series production a provisional acceptance for valves will be performed, which will be based on the results of the FAT according to this specification. CELLS shall perform the final acceptance tests for the

series production at CELLS site. CELLS reserves the right to perform any of the tests again.

- 4.7 The valves shall be delivered in batches which will be defined together with CELLS in accordance with the overall installation schedule of the machine during the start up meeting. Each batch may be composed of different types of valves. In General, for items # 2-12: first batch will contain 30% of the quantities of these items, second batch will contain 40 % of the quantities of these items and the last batch will contain 30% of the quantities of these items.
- 4.8 CELLS will not provide the contractor with any component, device or tooling needed for acceptance tests, cleaning etc. of the valves.
- 4.9 CELLS reserves the right to delay delivery or installation at no additional cost by up to three months in the event of unavoidable delay to the general time schedule of CELLS.
- 4.10 Even if CELLS gave its approval for the drawings, certificates, manufacturing process, tests etc., the responsibility for the final design, performance and product is on the contractor.
- 4.11 The contractor must deliver to CELLS:
- a) The specified items according to these specifications or the agreed specifications with CELLS (in writing).
 - b) The detailed time schedule as shown in section 4.5 of this specification, showing all the activities related to the fabrication and the contract.
 - c) The detailed and complete set of the dimensional drawings.
 - d) The quality plan and the quality schedule.
 - e) A complete set of cleaning and testing procedure. In case different cleaning and testing procedure have been suggested from that proposed by CELLS a complete set of cleaning and testing procedure is required and has to be approved by CELLS.
 - f) A complete set of test certificates, factory acceptance tests results, and inspection reports as required by this specification as they become available. This includes a complete set in the form of a documentation file at the end of the contract. This documentation file shall include the results of the material and the magnetic permeability measurements prior and subsequent to work, details of the degassing procedure (pressure and temperature vs. time), results from leak tests, results from the dimensional control, results of tests of permeability for the complete valve assembly, leakage rate, RGA scan, ultimate pressure and desorption rate of the completed valve assemblies.
 - g) Reports of non-conformity (if any).
 - h) Each valve must be supplied to CELLS with: the test reports and the Quality Assurance Plan (QAP) results.

4.12 **Guarantee**

The contractor shall guarantee the delivered equipment against defects due to either faulty components or faulty manufacture for a minimum period of 24 months after the complete delivery of the equipment. The bidder may offer a longer guarantee period in his bid.

4.13 **Service**

It is anticipated that CELLS will operate for at least 20 years. Bidders should guarantee that the required level of service and maintenance presently provided by the bidders for the above equipment will be available during the whole CELLS lifetime. Spare parts and a service organisation must be available

during the whole lifetime of CELLS. In addition, the contractor is to guarantee that service will be competitive in pricing, promptness, and quality.

4.14 Storage

It is possible that items may need to be stored for some time before a delivery can take place. Bidders are asked to provide information on suitable storage conditions and any maintenance operations required during the storage together with the tender documents.

5 General requirements.

- 5.1 The contractor should have an adequate and currently operational Quality Assurance Organisation like ISO 9000.
- 5.2 All equipment should use ISO metric fasteners and fittings.
- 5.3 The contractor shall follow a quality assurance program compliant with ISO 9001 for the design, manufacture, and testing of all systems and equipment provided by them
- 5.4 All equipment shall be manufactured in accordance with the best existing techniques and recognised good engineering practices available at the time of construction.
- 5.5 The supplied equipment shall be in full compliance with the European Safety Regulations in force and the relevant IEC standards and recommendations. CE marking of equipment should be applied wherever appropriate.

6 Description and functional requirements of the valves.

- 6.1 **RF gate valves:** They are used to separate the straight sections in the storage ring from the vacuum sections. These UHV all metal gate valves will allow isolating sectors during the installation of insertion devices and other components without the need of venting the neighbouring sectors. In addition, the RF fingers inside the valve will allow electrical contact and reduced the influence in the circulated beam.
- 6.2 **UHV gate valves:** UHV gate valves are needed on the booster synchrotron and for the front ends and beam lines in order to divide them into vacuum sections.
- 6.3 **All metal right angle valves:** These valves will be needed at several places around the machine as well as along the beamlines to allow the connection of the rough pumping and other devices.
- 6.4 **Fast closing shutter:** These shutters will be needed for the front ends and for one beam line end station and consist of a non leak-tight device. This valve is to close within milliseconds in the event of an air inrush by trigger gauges located on or near the beam line.
- 6.5 **Double gate valve:** The double gate valve shall consist of a linear arrangement two DN40CF gate valves on a common welded valve body, with the two driving axes of the gate valve under a 90 degree angle. One of the two valves shall be a standard Viton-sealed gate valve with a pneumatic actuator. The other valve shall consist of manual window gate valve with a Viton-sealed insert in the valve plate. This insert is to accommodate an Aluminium filter foil with a thickness of about 100-200 nm mounted on a support ring. One of these double gate valves will be installed on either side (i.e., upstream and downstream) a gas cell unit that will be used as a photon beam diagnostic. In this arrangement, the standard gate valve will be used for isolating the (non-operating) gas cell for isolating the gas cell from the adjacent beamline components.

The window gate valve will be used for operating the gas cell with, e.g., Nitrogen gas at a pressure of about 10^{-7} to 10^{-5} mbar. The same technical specifications as for the standard Viton-sealed gate valves apply for the case of the double gate valves, too.

7 Specifications for the valves and controllers.

7.1 Mechanical specification for the RF gate valves:

7.1.1 Each valve assembly must consist of the following major components:

- Pneumatic actuator (removable, double acting).
- Electric solenoid.
- RF shielded aperture.
- All metal valve body and bonnet seal.
- Metal gate seal.
- Actuator motion feedthrough via edge-welded bellows.

7.1.2 Two configurations are needed: left-handed and right-handed, this can be determined from the profile of the valve in the flat seal flange side. The aperture of the valves is shown in the Annex 1; the right- and left-handed RF valve configuration is also indicated.

7.1.3 The manufacture of the valve aperture will be in accordance with the drawing supplied by CELLS in this specification (see Annex 1) or as agreed in writing with CELLS. The contractor must supply the drawing of the profile to be used for manufacturing for CELLS approval.

7.1.4 The valve seat side must be in the CF flange side. The other side of the valve must have a flat seal flange (the detailed drawing of the flat seal flange will be provided to the contractor during the start up meeting).

7.1.5 Although these drawings and associated data are available for use by the contractor, the contractor will be responsible for the adopted designs that are to meet the required performance criteria.

7.1.6 The bidder must define the tolerances expected in the profile in his bid.

7.1.7 The space between the valves interior (RF contact) and the electron beam and the emitted radiation fan is limited. Dimensions and tolerances are therefore critical. The manufacturer must design the RF shield in order to reduce the bended distance of the RF contact to the inside of the profile when the valve is in the open position, this distance must be less than 2 mm.

7.1.8 It is anticipated that one design review meeting will be required to discuss the proposed manufacturing methods and the design of the RF shield of the valve.

7.1.9 A final set of 'as-built' drawings must be provided.

7.1.10 In order to reduce the effect of the CF gap on the overall impedance of the machine, the CF flange must be of small gap flange (Spigot type) keeping a clearance of at maximum 0.1 ± 0.1 mm facing the beam.

7.1.11 The valve must have a visual position indicator for (open) and (close) position.

7.1.12 The valve mounting position is tilted by 30° from vertical.

7.1.13 The valve must have double position indication (i.e. two switches for "open" and "close")

positions) and are to be failsafe.

7.1.14 Solenoid must have a manual lockable emergency operation.

7.1.15 Maximum differential pressure on the valve is 1 bar and it must withstand this pressure difference in either side of the valve.

7.1.16 The valve body and the valve seal must be leak tight to less than $1 \cdot 10^{-10}$ mbar.l/sec. The valve inner vacuum surfaces must have outgassing rate less than $1 \cdot 10^{-12}$ mbar l/(sec cm²).

7.1.17 The valve will form part of the overall storage ring sector, which will be baked inside the bakeout ovens. Therefore, the valve body must be bakeable up to 300°C.

7.1.18 The valve must have at least 10,000 cycles before the first maintenance.

7.1.19 The final assembled valves must have magnetic permeability of $\mu_{rel} < 1.05$. The valve body and bellows must be of 316L and the RF fingers must be of copper beryllium silver plated.

7.1.20 Closing time should be minimised, information on closing time should be provided with the bid.

7.1.21 Actuators are to be extended and removable from the valve body to simplify bakeout.

7.1.22 Solenoids are to be 24 Volt DC, 2.5 Watt.

7.1.23 Unless otherwise stated, solenoids are to be bakeable to 80°C and to be able to withstand up to 10^4 Gy. The rest of the valve must withstand a radiation level of at least 10^6 Gy.

7.1.24 Valves are to be able operate with compressed air within a pressure range of 4-8 bar.

7.1.25 Valves are to close completely upon power failure.

7.1.26 The bidder may offer other specification in his bid.

7.2 **Mechanical specifications for the all metal UHV gate valves.**

7.2.1 Each valve assembly must consist of the following major components:

- Pneumatic actuator (double acting).
- Electric solenoid.
- All metal valve body and bonnet seal.
- Metal gate seal.
- Actuator motion feedthrough via edge-welded bellows.

7.2.2 The valve must have standard CF flanges.

7.2.3 The valve must have a visual position indicator for (open) and (close) position.

7.2.4 The valve must have double position indication (i.e. two switches for “open” and “close” positions) and are to be failsafe.

7.2.5 The pneumatic actuators are to be extended from the valve body.

7.2.6 Solenoid must have a manual lockable emergency operation.

7.2.7 Maximum differential pressure on the valve is 1 bar and it must withstand this pressure difference in either side of the valve.

- 7.2.8 The valve body and the valve seal must be leak tight to less than $1 \cdot 10^{-10}$ mbar.l/sec. The valve inner vacuum surfaces must have outgassing rate less than $1 \cdot 10^{-12}$ mbar l/(sec cm^2).
- 7.2.9 Bakeability: valve body: 250°C, actuator: 140°C.
- 7.2.10 Solenoids and position indicators are to be bakeable to 80°C and to be able to withstand up to 10^6 Gy. The rest of the valve must withstand a radiation level of at least 10^6 Gy.
- 7.2.11 The valve must have at least 20,000 cycles before the first maintenance.
- 7.2.12 The final assembled valves must have magnetic permeability of $\mu_{\text{rel}} < 1.05$. The valve body and bellows must be of 316L.
- 7.2.13 Closing time should be minimised. Information on closing time should be provided with the tender.
- 7.2.14 Solenoids are to be 24 Volt DC, 2.5 Watt.
- 7.2.15 Valves are to be able operate with compressed air with a pressure range 4-8 bar.
- 7.2.16 Valves are to close completely upon power failure.
- 7.2.17 The bidder may offer other specification in his bid.
- 7.3 **Mechanical specifications of the Viton-sealed UHV gate valves.**
- 7.3.1 Each valve assembly must consist of the following major components:
- Pneumatic actuator (removable, double acting) or manual actuator.
 - Electric solenoid (pneumatic valves only).
 - All metal valve body and bonnet seal.
 - Viton gate seal.
 - Actuator motion feedthrough via edge-welded bellows.
- 7.3.2 The valve must have standard CF flanges.
- 7.3.3 The valve must have a visual position indicator for (open) and (close) position.
- 7.3.4 The valve must be provided with a single (normally closed) electrical position switches for the open as well as the closed position that are to be failsafe.
- 7.3.5 Solenoid must have a manual (and lockable, if possible) emergency operation.
- 7.3.6 Maximum differential pressure on the valve is 1 bar and it must withstand this pressure difference in either side of the valve.
- 7.3.7 The valve body and the valve seal must be leak tight to less than $5 \cdot 10^{-10}$ mbar.l/sec and $1 \cdot 10^{-9}$ mbar.l/sec, respectively. The valve inner vacuum surfaces and must have outgassing rate less than $1 \cdot 10^{-10}$ mbar.l/(sec cm^2).
- 7.3.8 Bakeability: valve body: 250°C open, 200°C closed, actuator: 200°C.
- 7.3.9 Solenoids are to be bakeable to 50°C; position indicators are to be bakeable up to 80°C.
- 7.3.10 The valve must have at least 20,000 cycles before the first maintenance.

- 7.3.11 The valve body must be made of 304 (or equivalent) stainless steel. Bellows must be of 316L.
- 7.3.12 Closing time should be minimised. Information on closing time should be provided with the tender.
- 7.3.13 Solenoids are to be 24 Volt DC, 2.5 Watt.
- 7.3.14 Valves are to be able operate with compressed air with a pressure range 4-8 bar.
- 7.3.15 Valves are to close completely upon power failure. Upon compressed air failure, closed valves are to stay fully closed (i.e., mechanically locked in closed position), whereas open valves may become undefined.
- 7.3.16 The bidder may offer other specification in his bid.
- 7.4 **The all metal UHV right angle valves mechanical specification.**
- 7.4.1 Each valve assembly must consist of the following major components:
- Manual actuator (e.g., hexagon head).
 - All metal valve body and bonnet seal.
 - Metal gate seal.
 - Actuator motion feedthrough via bellows.
- 7.4.2 The valve must have standard CF flanges; the size of the flanges is specified in section 2.3 of this specification.
- 7.4.3 The valve must have a visual position indicator.
- 7.4.4 Maximum differential pressure on the valve is 1 bar and it must withstand this pressure difference in either side of the valve.
- 7.4.5 The valve body and the valve seal must be leak tight to less than $5 \cdot 10^{-10}$ mbar.l/sec. The valve inner vacuum surfaces must have outgassing rate less than $1 \cdot 10^{-12}$ mbar l/(sec cm²).
- 7.4.6 The valve must be bakeable up to at least to 250°C.
- 7.4.7 The whole valve must withstand a radiation level of at least 10^6 Gy.
- 7.4.8 The valve must have at least 1,000 cycles before the first maintenance.
- 7.4.9 The final assembled valves must have low magnetic permeability. The valve body and bellows must be of 316L.
- 7.4.10 The bidder may offer other specification in his bid.
- 7.5 **Mechanical specification for the all metal UHV Fast Shutter:**
- The Fast Shutter is a non-leak tight valve.
- 7.5.1 Fast Shutter:
- 7.5.1.1 The valve must be an all metal construction.
- 7.5.1.2 Fully UHV compatible.
- 7.5.1.3 The contact flanges are DN 40 Conflat.

- 7.5.1.4 Clear internal diameter of the shutter shall be 40 mm.
- 7.5.1.5 Total closure time between the signal from the trigger gauge and the full closure of the fast shutter is to be less than 10 ms.
- 7.5.1.6 Leak rate of the shutter with closed position must be $< 1 \text{ mbar ls}^{-1}$.
- 7.5.1.7 The shutter body must be leak tight to less than $1 \cdot 10^{-10} \text{ mbar.l/sec}$. The shutter inner vacuum surfaces and must have outgassing rate less than $1 \cdot 10^{-12} \text{ mbar l/(sec cm}^2\text{)}$.
- 7.5.1.8 Bake out temperature up to at least 250°C for the body of the shutter.
- 7.5.1.9 The shutter must withstand 5000 cycles until first service.
- 7.5.1.10 Distance flange to flange shall be 60 mm.
- 7.5.1.11 The actuator is to be able to withstand temperatures up to 50°C and is to be able to withstand up to 10^4 Gy . The shutter body-must withstand a radiation level of at least 10^6 Gy .
- 7.5.1.12 The Fast Shutter has to be able to operate with compressed air at 5-8 bar.
- 7.5.1.13 The Fast Shutter has to stay in a fixed position and should not move on power failure.
- 7.5.2 Electronics control.
- 7.5.2.1 Trigger gauge HV adjustable 10^{-3} to 10^{-8} mbar .
- 7.5.2.2 Number of trigger gauges and associated logics:
2 trigger gauges: the fast shutter will be closed if the 2 triggers (logic “AND”) detect vacuum failure.
- 7.5.2.3 The controller must provide a signal to the PLC to close the pneumatic valve at the same time as the fast shutter.
- 7.5.2.4 Required status signals to PLC:
- shutter open
 - shutter closed
 - system armed
 - gauge triggered
- 7.5.2.5 Remote commands from PLC:
- close shutter
 - open shutter
 - prime shutter
 - enable/disable shutter
- 7.5.2.6 Manual test button to trigger the shutter and key switch to enable/disable the shutter system.
- 7.5.2.7 Fit into 19” rack.

8 Materials

- 8.1 Each piece of the valve must be identified. The contractor must have an adequate system to ensure the traceability of each piece of material during manufacture.
- 8.2 In case the CF flanges are manufactured in house, the contractor will send to CELLS a detailed drawing for each type of flange used together with the full material specification for CELLS approval. Where the CF flanges are purchased from another company CELLS approval at the proposed flange contractor must be sought prior to purchase.
- 8.2.1 Flanges and other pieces to be milled are to be manufactured from forgings. The structure of these forgings shall be homogeneous, free from porosity and fully austenitic with less than 1% ferrite. The presence of sigma phase or precipitated carbide is not permitted. The material must show a Brinell hardness of 170-300 in the area of the sealing edge of the Conflat flanges and the sealing surface of the Flat-seal flanges, the bidder may specify his specifications in the bid.
- 8.3 All the valves and their flanges have to be bakeable at a temperature up to 250 °C, bake out at the factory shall be performed at 250 °C as part of the vacuum testing (see section 11.1.15).
- 8.4 Metal gaskets shall be used to seal all vacuum joints wherever is required, if another material is used the bidder must indicate it in his bid.
- 8.5 CELLS reserves the right to reject any material or component not completely fulfilling the conditions laid down in this specification.

9 Manufacture

9.1 General

9.1.1 Manufacture of valves and tooling shall commence only after the contractor has submitted and obtained CELLS approval in writing of the following documents:

a) Documents required for the start up meeting:

- I. Detailed time schedule showing the duration of all major activities
- II. The overall quality schedule listing quality control procedures at all stages of procurement, manufacture, assembly, and testing.
- III. The final Inspection Points Plan (IPP).
- IV. For the start up meeting the contractor must prepare a list of the items and raw materials which he expect to have long lead time and for which he would thus like to have CELLS approval at an early stage (if any).

b) Documents required for design review meeting (item #1 – RF gate valves):

- I. General manufacturing process documentation.
- II. General assembly drawings for the component parts of the valves,

9.1.2 CELLS will give approval or otherwise comment on documents submitted for approval within two weeks after receipt. The contractor should allow sufficient time in his schedule for review of documents.

9.1.3 All vacuum joints shall be of metal type sealed; the use of elastomer seals – except for the gate seals on the Viton-sealed gate valves - is prohibited.

9.2 Cleanliness

- 9.2.1 For the valves to be compatible with the ultra high vacuum requirements of the modern synchrotron light sources, a high degree of cleanliness will be necessary at all stages of production to guarantee an acceptable low outgassing rate and weld integrity.
- 9.2.2 All machining work is to be carefully controlled to ensure that no foreign material is embedded in the surface of the material.
- 9.2.3 All mechanical cold working operations must exclude the use of heavy organic lubricants since these can be retained to some extent in the surfaces after the process.
- 9.2.4 When any part of or within the vacuum envelope has been cut, formed, finally machined and cleaned, the vacuum surfaces must never be in contact with oily or greasy objects (including bare hands leaving finger prints), unless a thorough cleaning operation is scheduled to follow immediately afterwards.
- 9.2.5 Identification of the assembled valves (such as with their drawing numbers) should be by engraving on non-vacuum surfaces.
- 9.2.6 All machining coolants shall be water soluble and sulphur free.
- 9.2.7 Where stainless steel fasteners are used in-vacuum and mate with stainless steel threaded components, the threads of the fasteners must be silver plated. A minimum layer thickness of 5 μm must be achieved; the maximum layer thickness must be limited to a thickness that will not cause interference between the mating threads. All threaded fasteners located in blind holes must have a central, coaxial vent hole. UHV flange bolts must be silver plated; no additional thread lubricant is permitted.
- 9.2.8 All parts to be welded must be cleaned prior to welding.
- 9.2.9 To prevent undue oxidation of vacuum surfaces, all welds are to be backed by an inert gas purge to be maintained until the part has cooled down to 60°C.
- 9.2.10 All welds shall be internal. Where vacuum sealing welds are made from the outside the latter must have full penetration leaving a smooth surface on the vacuum inside ($d < 0.3 \text{ mm}$). Any later brushing or other finish work on the welds is prohibited.
- 9.2.11 The use of dye penetrant testing is strictly prohibited.
- 9.2.12 Filler material shall not be used.

10 Cleaning

- 10.1 Standard UHV practices must be adopted through all stages of the manufacturing, handling, assembly etc. of the valves, to guarantee the highest level of cleanliness. Document END-VCGS-ES-0001 describes a general procedure and UHV practice to be followed for handling UHV components and assemblies.
- 10.2 The basic requirement is to remove surface contamination such as grease, tenacious oil, etc. without etching the surface. Therefore, generally, the cleaning process should not include an acid etch or treatment.
- 10.3 The bidder is requested to submit in his bid a detailed description of the proposed cleaning process for assembled valves (with the cleaning agents to be used and the sequence) and at

which stages he will perform the cleaning; attention needs to be taken as some degreasers which may leave stains on the valves.

- 10.4 A written approval for the cleaning procedure must be submitted from CELLS before being used for cleaning the valves assemblies during the design review meeting.
- 10.5 After cleaning the vacuum surfaces must be protected against accidental contamination.

11 Inspection and testing

11.1 General

- 11.1.1 The contractor shall inspect and test the items to ensure that they conform to this specification.
- 11.1.2 The acceptance test procedures shall include - but not be limited to - all of the testing procedures specifically outlined in this document, but also those necessary to prove compliance with this specification. These test procedures are subject to CELLS review and acceptance. The contractor shall submit a detailed quality schedule specifying the intermediate tests and checks that will be made during the whole manufacturing, testing, and assembly procedure. The contractor shall provide all the equipment, facilities, funds and personnel for carrying out the tests. For each test mentioned below, a procedure must be submitted.
- 11.1.3 The contractor shall inform CELLS at least one week in advance of factory acceptance tests and inspections to allow CELLS to witness the tests.
- 11.1.4 All components, equipments, tools, gauges, fittings etc. used to carry out the tests must be according to UHV standards, which will guarantee the cleanliness and performance of the final product according to this specification.
- 11.1.5 All the items must be labelled. The serial numbers will be used to identify the valves during the testing procedure and results recording.
- 11.1.6 Acceptance of any component will only be given when it has met the full requirements of this specification. In the event of a test failure, the contractor shall document the failure and submit a proposal for correcting any fault or failures. Written approval from CELLS shall be required before any corrective action is taken.
- 11.1.7 CELLS by its authorised representatives shall have free access to the contractor's works and the premises of any subcontractor for the purpose of inspection and progress during all stages of manufacture, assembly, testing etc.
- 11.1.8 The contractor shall supply CELLS with a quality assurance document for each item delivered, certifying that it conforms to this specification and listing the results of tests and inspections, and include it in the production file of the valves.
- 11.1.9 The valves shall only be dispatched to CELLS after the contractor has been notified in writing that the factory acceptance tests have been accepted by CELLS.
- 11.1.10 The final decision to accept or reject a valve will be made by CELLS after delivery. Before making its decision CELLS may, at its discretion, repeat any of the tests and inspections detailed in this specification. The final acceptance of the items will be made at CELLS site within one month after delivery. If the final acceptance test is accepted, the two years guarantee period starts.

11.1.11 The factory acceptance tests together with the site acceptance tests must establish that all items of the manufactured equipment completely meet the performance requirements as described in this specification. CELLS reserves the right to require additional or more extensive tests to be conducted in the event of marginal design or performance.

11.1.12 Inspection and testing sequence (FAT)

The sequence of operations for the factory acceptance test (FAT) on each completed and cleaned valve shall be as follows:

- 1) Visual internal, external inspection and dimensional check.
- 2) Vacuum leak test and desorption test after a bakeout of the valves to 250 °C. A He-leakage rate of $< 1 \cdot 10^{-10}$ mbar l/sec and a specific desorption rate of $< 1 \cdot 10^{-12}$ mbar.l/(sec.cm²), ($< 1 \cdot 10^{-12}$ mbar.l/(sec.cm²) for the viton-sealed valves) is to be demonstrated. Also partial pressure measurement.
- 3) Motion tests.
- 4) Visual inspection of the sealing surfaces of flanges immediately prior to protective packing for dispatch.

11.1.13 Visual inspection (for all the supplied valves):

11.1.13.1 The contractor shall visually inspect the valves internally and externally to ensure that there are no defects which might render them unfit for service. Particular attention shall be paid to the form and state of the vacuum surfaces, the quality of welded joints and the sealing surfaces of flanges. Inner surfaces will be controlled in order to detect any surface defect, e.g. incrustation, grooves, traces of pollution, dust...etc.

11.1.13.2 The sealing flanges shall be inspected; any defect on the knife edge of the flanges is a cause of rejection of the valve.

11.1.14 Dimensional check (for item # 1):

Depending on the equipment at his disposal the contractor is invited to describe in his bid the method proposed by him to check all dimensions, the overall length of the valve must be as specified in the manufacturing drawings.

11.1.15 Vacuum testing

Depending on the equipment at his disposal, the contractor is invited to describe in his bid the method and means proposed by him to measure the leak tightness and the desorption rate of the valve.

11.1.15.1 Helium leak testing (for all the valves of item # 1):

The leak testing shall be carried out on the completed valves as the first vacuum test according to UHV practice. The contractor is invited to perform leak tests at any stage of the production. The leak test must be carried out by spraying all the surfaces, welds/brazing, and the sealing flanges with helium.

The leak detection shall be done in a clean area, the valves shall be put on a clean support or table, the contact surface between the valves and the support must be covered with a clean aluminium foil.

The leak detection shall be done with a suitable helium leak detector; the pumping system of the

leak detector must be composed of dry (i.e., oil free) pumps. The leak detector must not include any contamination to the tested valves. No vacuum grease shall be used to guarantee the leak tightness of the connection of the valve on the leak detector.

The leak tests need to be performed before and after bakeout for the assembled valve. The bakeout must be performed at 250 °C.

For the first valve of item #1 and of item # 2, they must be tested in the following procedure: the valve must be baked out to 250 °C, then it must operate successfully up to 200 cycles, afterwards it must be leak tested after each 20 cycles, the leak test results must be as specified here.

For all the other valves: one valve of each item must be leak tested before and after bakeout, and for the rest of the valves, the contractor must guarantee that the valves are leak tight after the performance of the bake out on the valves (for the temperature specified in 7 of this technical specification).

The leak rate requirements for the different types of valves are given below. The upper limit of the measured leak rates have to be documented for each valve in the quality assurance document (the measurement must include the background).

Valve type	Valve seal leak rate	Valve body leak rate
All metal RF gate valve	$< 1 \times 10^{-10}$ mbar l s ⁻¹	$< 1 \times 10^{-10}$ mbar l s ⁻¹
All metal UHV gate valves	$< 1 \times 10^{-10}$ mbar l s ⁻¹	$< 1 \times 10^{-10}$ mbar l s ⁻¹
Viton-sealed UHV gate valves	$< 1 \times 10^{-9}$ mbar l s ⁻¹	$< 5 \times 10^{-10}$ mbar l s ⁻¹
All metal right angle valve	$< 5 \times 10^{-10}$ mbar l s ⁻¹	$< 5 \times 10^{-10}$ mbar l s ⁻¹
Fast closing shutters	< 1 mbar l s ⁻¹	$< 1 \times 10^{-10}$ mbar l s ⁻¹

11.1.15.2 Thermal desorption rate testing:

For the first valve of item #1, thermal outgassing tests must be performed, the thermal desorption rate of the assembled valve has to be below $1 \cdot 10^{-12}$ mbar.l/(sec.cm²) after cooling down to room temperatures from a 24 h bakeout at 250 °C. The valves must be pumped down with a dry (oil free) pumps for the tests.

For all the other valves, the contractor must guarantee that the outgassing rate of these valves after bakeout is below $1 \cdot 10^{-12}$ mbar.l/(sec.cm²) and less than $1 \cdot 10^{-10}$ mbar.l/(sec.cm²) for the viton-sealed valves.

11.1.15.3 For the first valve of item #1, the total and partial pressure (residual gas analysis from 1-100 AMU) must be performed after cooling down to room temperature from a 24h bake out at 250 °C. The residual gas analysis of each valve must show that hydrocarbons contamination is less than 1.0 % of the total pressure. The total pressure measurement after the bake out must be in the low 10^{-10} mbar range.

11.1.16 All roughing pumps used at anytime in the testing process must be oil free.

11.2 These tests must be performed, documented and submitted to CELLS.

11.3 If additional cleaning is required to allow the equipment to meet the acceptance standards then the contractor must undertake to pay for all costs associated with additional cleaning carried out by CELLS or subcontractor.

11.4 The site acceptance tests will be carried out by CELLS and will take place within 3 months from receipt of delivery of the items.

11.5 The final acceptance tests will include any or all of the tests specified in the preceding sections of this specification, under the vacuum conditions described above.

12 Documentation

12.1 The contractor shall provide 2 (two) sets of paper copies of the following documentation as soon as it becomes available in accordance with the schedule presented:

- Project schedule
- Dimensional drawings and operating manuals.
- Quality control test sheet of the tests executed as required by this specification.

12.2 All the technical documents delivered by the contractor shall be in English. The contractor shall guarantee the valves against failure due to either faulty components or faulty manufacture for the period indicated in the Administrative Terms and Conditions after final acceptance of the valves has been granted by CELLS. This guarantee shall not be invalidated by unpacking and handling the components for visual examination and diagnostic tests. CELLS warrants that no modifications will be undertaken without the written permission of the contractor.

13 Packaging, protection, and transport.

13.1 The valves are to be supplied ultra-high vacuum cleaned and conditioned. For storage and shipping each valve must be backed filled with dry pure nitrogen at a slightly above atmospheric pressure, according to the standards of UHV practice.

13.2 All valves must be labelled and given a serial number for reference inscribed close to the flange. The marking process must be carried out by dry scribes, vibrating engravers or laser engravers.

13.3 The contractor shall include in his tender DDP delivery to the following locations:

For the machine:

- Either to the site where CELLS may perform some tests on the valves. This place will not be necessarily in the CELLS site, but within close distance to CELLS.
- or to the storage area that CELLS will indicate. This storage area will be at the CELLS site or nearby.

For the beamline and front end valves:

- Either to the premises of the different beamline and front end manufacturers, (for price estimation, the bidder may consider the delivery inside Europe), however there is possibility that the delivery will be overseas,
- or to the same CELLS premises as for the machine.

13.4 Shock detectors shall be fixed on the containers at visible places.

13.5 The valves will be delivered by in three batches, the type of valves in each batch which will be defined together with CELLS in accordance with the installation schedule and the requirements.

13.6 The containers must be supplied with lifting hooks and be compatible with fork-lift trucks or crane (if needed). The contractor will be responsible for providing special purpose lifting equipment if necessary.

- 13.7 The valves must be supplied in appropriate packaging and with all the appropriate protective covers for the flanges (to be agreed with CELLS).
- 13.8 The valves shall be properly supported and contained to prevent damage and contamination during transport. Packing-cases shall be non-returnable and of a stout and robust nature suitable for lifting and transportation without damage using a forklift truck or crane. The contractor must supply to CELLS the conditions of the package and the lifting tools needed and procedure, which guarantees safe unloading at the various delivery sites.
- 13.9 Where air transport is to be used the packing and protection against contamination shall be suitable for use in an un-pressurized cargo hold.
- 13.10 The following is to be displayed clearly on the outside of the container:
- 1) Shipping address as specified within the contract.
 - 2) CELLS contract number.
 - 3) Contractor name and address.
 - 4) The components contained within the container.
 - 5) Labels like “FRAGILE”, “TOP”... are required.
 - 6) The weight of the loaded container.
 - 7) Support points for transport and lifting.
- 13.11 Details of the shipment procedures and methods must be approved by CELLS before any shipments are made.

