

NOTICE INVITING
“EXPRESSION OF INTEREST”

For
Development, manufacture, testing, installation &
commissioning
of
Unbaked Ultra High Vacuum (UHV) Beam Diagnostics Vacuum
Chambers
for
Facility for Antiproton & Ion Research (FAIR) GmbH, Germany

BOSE INSTITUTE
Indo-FAIR Co-ordination Centre (IFCC)
KOLKATA

ADVT. No. BI-IFCC/FAIR/09/2018-19, dated: 24/05/2018

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**BOSE INSTITUTE (IFCC)
KOLKATA**

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Sub: Development, Manufacture, Testing, Supply, Installation & Commissioning of Unbaked Ultra High Vacuum (UHV) Beam Diagnostics Vacuum Chambers for HEBT Line at FAIR, GSI, Germany

1. INTRODUCTION

Bose institute, Kolkata, an autonomous R&D Institute, registered under Societies Registration Act, under Department of Science & Technology, Ministry of Science & Technology, Government of India, has been designated as the Indian shareholder in the Facility for Antiproton & Ion Research (FAIR) Company, GmbH, Germany and the nodal Indian Institution for the management of FAIR programme in India.

Bose Institute Indo-FAIR Co-ordination Centre (BI-IFCC) established at Bose Institute by the DST, Govt. of India, as the implementing body of the Indo-FAIR Programme.

Bose Institute (IFCC) invites **Expression of Interest** for prequalification process to be followed by seeking 2-part tender from selected vendors from only reputed, renowned, experienced and highly skilled engineering & technology companies/manufacturers for development, manufacture, testing of Ultra High Vacuum (UHV) Beam Diagnostics Vacuum Chambers for HEBT Line at their own site and delivery, installation, commissioning and testing at FAIR, GmbH, Germany. Total quantity of UHV Vacuum Chambers will be around 58 (fifty eight) of seven or more types slightly different from each other. The number of chambers to be built might go up to 71 including prototypes.

The chambers have been grouped in two categories (list given in Annexure-I), i.e. Category-I and Category-II based on the technical complexities. In the EOI, vendor must mention clearly the Category that is being applied for. One can apply for both or one of the two. Evaluation of EOIs and the process of selection of vendors will be done for two categories independently. Selected vendor of a category will need to fabricate the prototype chamber of the respective category.

Based on the evaluation in the pre-qualification process, selected vendors of each category will be asked to submit two-part (1. Technical, 2. Commercial & Price) tender documents for respective category. The design drawings & detailed Technical Guidelines will be supplied only to those vendors selected in prequalification process.

Constituents of Vacuum Chambers.

Beam line Entry/Exit flanges & Vacuum Pump interface flange are DN 150 CF-F. Two flanges for vacuum measurement are DN 35 CF-F. Flanges for diagnostic elements are mostly DN 200 CF-F, except in one case DN 250 CF-F. Number of ports for diagnostic elements & their orientation varies from one type to the other type of vacuum chambers. Minimum number of ports for diagnostic elements are three & Maximum seven. The length of chamber barrel varies from one type to another. The minimum chamber barrel length is 362 mm & the maximum 1040 mm. Tube socket extension lengths are 43 mm for all Beam line Entry/Exit ports, & 110.8 mm for all Vacuum pump ports. Tube socket extension lengths are 85.9 mm for all vacuum measurement ports. Tube socket extension lengths are either 248.5 mm or 148.5 mm for all DN 200 CF-F ports. Tube socket extension lengths are 279.5 mm for DN 250 CF-F ports.

Chamber barrel is \varnothing 308x4 mm wall thickness for all vacuum chambers. Tube sockets for Beam line: Tube sockets are: for DN 250 CF-F flanges, \varnothing 256x3 mm wall thickness, for DN 200 CF-F flanges, \varnothing 206x3 mm wall thickness, for DN 150 CF-F flanges, \varnothing 159x2 mm wall thickness & for DN 35 CF-F flanges, \varnothing 41x1.5 mm wall thickness.

Each vacuum chamber will have a pair of "Console for Fiducial target seats" welded, which would serve as a reference surfaces for placement of laser targets & will be used for alignment of the vacuum chamber with FAIR Beam Axis accurately.

- ii. The manufacture and testing of the vacuum chambers shall be as per the specified dimensions, tolerances and accuracies mentioned in the tender document. The tender document will be furnished only to the selected vendors. The mechanical construction shall comply with the relevant CE guidelines, DIN and ISO standards.
- iii. The vacuum chambers require the use of highly cleaned atmosphere and degassed weldable authentic stainless steel with very low sulphur content (sulphur < 0.015% w/w), low magnetic permeability (Relative Magnetic permeability <1.05).

The following materials shall be used for manufacturing diagnostic vacuum chambers:

Detailed Technical Guidelines will be furnished only to the selected vendor.

- Flanges: 1.4429 ESU (equivalent to AISI 316LN Electro slag remelted)
- Tubes: 1.4301 or 1.4307 (equivalent to AISI 304)

- Cover: 1.4306 or 1.4404 (forged) (equivalent to AISI 304L or 316L Forged)
- Non vacuum parts: 1.4301 (equivalent to AISI 304)

All materials have to be non-porous and free of bubbles.

Furthermore a DIN EN10204 Certification has to be demanded for purchased parts and will be part of the documentation. Following tests are required to be performed on the materials & documented:

- Chemical composition
 - Folding test
 - Inspection and checking of dimensions
 - Test of inter-crystalline corrosion
 - Hardness test
 - Ultrasonic testing
 - Test of magnetic permeability ($\mu_r < 1.05$)
- iv. The CF flanges are to be manufactured by using electro-slag refined multi-directionally forged austenitic stainless steel X2CrNiMo17-13-3 (Material no. 1.4429 ESU DIN EN 100888-1-2-3) equivalent to AISI 316LN blanks.
- v. The wall materials, X5CrNi18-10 (Material no. 1.4301 DIN EN 10888) Non-porous, free of bubbles, equivalent to AISI 304, that do not require surface machining shall be purchased. Any surface defect will require special technique for its acceptable removal
- If required surface machining / polishing pipe inside may be allowed to achieve the required surface finish.
- vi. Most of the welds shall be from vacuum side without the use of filler metal. Very few welds which will be not from vacuum side require special edge preparation & shall be full penetration welds with no surface defects on the vacuum side. Each of the welds shall be completed without interruption of the welding process. TIG is the proposed welding process. In order to minimize weld shrinkage, other welding processes (electron beam welding or laser welding) are possible, but may only be applied after written agreement by GSI/FAIR. Filler metal specification will be furnished only to the selected vendor.
- vii. Special cleaning methods suitable for UHV chambers are to be used. Post cleaning handling should be done with proper care.
- viii. Detailed vacuum acceptance tests have to be carried out for the UHV chambers, which includes helium leak test, ultimate pressure measurement, residual gas analysis & surface out-gassing rate measurement.

1 Acceptance Test

1.1 Factory Acceptance Test (FAT)

The following Factory Acceptance Tests shall be carried out for all diagnostic chambers by the manufacturer:

1.1.1 Visual Inspection

Upon completion of the chamber, the manufacturer shall inspect internally and externally the vacuum chamber to ensure that there are no defects which might render it unfit for UHV application. Particular attention shall be paid to the form and state of the inner surfaces of the vacuum chamber, the quality of welding and brazing seams on the ribs and on the sealing surfaces of flanges. All welding regions must be scale-free, free from voids, blow holes, etc., and there should be no visible evidence for inclusions. Any trace of colour oxide is not acceptable. All internal surfaces must be free from scratches, dents, inclusions and other superficial contaminations. The sealing flanges must be inspected. Knife edges must be free from any scratches.

1.1.2 Mechanical Acceptance Test

The Mechanical Acceptance Tests are described in Technical Guideline, which will be furnished only to the selected vendor. The labelled dimensions and position tolerances have to be checked and documented.

1.1.3 Vacuum Acceptance Tests

Detailed vacuum acceptance tests have to be carried out for the UHV chambers, which includes helium leak test, ultimate pressure measurement, residual gas analysis & surface out-gassing rate measurements.

The required vacuum tests are described in Technical guidelines which will be furnished only to the selected vendor. For all vacuum tests the vacuum chamber has to be closed with metal sealed blind flanges.

1.2 Site Acceptance Test (SAT)

Formal acceptance of the delivered chambers will take place only after successful completion of the site acceptance test (SAT) at FAIR, Germany. The sequence of tests will be as follows:

1.2.1 Visual Inspection

After delivery, an internal and external visual inspection of the chamber will be carried out to ensure that there are no chamber defects. Particular attention will be paid to the form and condition of the inner surface of the vacuum chamber, the quality of welding seams and on the sealing surfaces of flanges. All internal surfaces must be free from scratches and dents. The sealing flanges will be inspected intensively. All knife edges must be free from any scratches.

All welding seams have to be checked by a certified person (DIN EN ISO 9721-Quantification and Certification of Non Destructive Testing). The inspection of the welding seam has to be based on DIN EN ISO 5817 quality class B.

1.2.2 Mechanical Acceptance Test

The Mechanical Acceptance Tests are described in Technical Guideline, which will be furnished only to the selected vendor. The labelled dimensions and position tolerances have to be checked and documented.

1.2.3 Vacuum Acceptance Tests

Detailed vacuum acceptance tests have to be carried out for the UHV chambers, which includes helium leak test, residual gas analysis & surface out-gassing rate measurements.

The required vacuum tests are described in Technical Guidelines, which will be furnished only to the selected vendor. For all vacuum tests the vacuum chamber has to be closed with metal sealed blind flanges.

3. Scope of Work and Delivery

3.1 Scope of Work

- a) Manufacture and testing of vacuum chambers shall be as per the specified dimensions, tolerances and accuracies mentioned in the technical document.
- b) Manufacturing and tests (FAT & SAT) for one prototype vacuum chamber of each category shall be successfully completed before initiation of series production. This prototype is not a part of delivery. The prototype shall undergo all stages of manufacturing and testing and shall be demonstrated to be acceptable as per of the specification. The prototype will be further evaluated at FAIR/GSI for final acceptance tests.
- c) Manufacturing and complete acceptance tests (FAT and SAT) of diagnostic vacuum chambers

3.2 Scope of Delivery

Each vacuum chamber has to be delivered with corresponding number of blind flanges (NW200/NW 250 CF-F Mat: 1.4429 ESU) for each tube socket for diagnostic elements and tube socket for vacuum measurement (NW40 CF-F Mat: 1.4429 ESU).

For entry, exit and tube sockets for vacuum pump there is no flange necessary for delivery. But entry, exit and tube sockets for vacuum pump shall be covered with screwed aluminium covers (copper gaskets).

For each flange connection the corresponding number of screws, washers and nuts has to be delivered. All screws, nuts and washers have to be according to Technical Guideline, which will be furnished only to the selected vendor.

For each flange connection copper CONFLAT gaskets are to be furnished as per Technical Guideline, which will be furnished only to the selected vendor.

4. PRE-QUALIFICATION PROCESS (both categories)

The company/matrix manufacturer applying for pre-qualification must satisfy the following qualification criteria and manufacturer experience & credentials. A

documentary proof in this regard shall be submitted. The pre-qualification process comprises of evaluation of the submitted documents, visits to the manufactures' works site & detail technical discussion (wherever considered necessary) which will be recorded and short listing for the purpose of handing over the Tender Document with all the drawings & technical guidelines.

4.a. Qualification Criteria

The company/manufacturer shall preferably have the following facilities & expertise: (Incase all the facilities are not currently available, indicate the available facilities out of this list)

- i. Facilities for prototyping, manufacture, testing, qualification, supply, installation & commissioning of vacuum chambers at FAIR Darmstadt (Germany) and their maintenance during warranty period of 2 years after their satisfactory installation & commissioning.
- ii. Software & personnel for preparation of digital drawings using CATIA V5 or as step files.
- iii. Welding equipment for welding processes used for the manufacture (TIG, MIG, micro-plasma, orbital-/electron beam welding).
- iv. Qualified welders according to DIN EN ISO 9606 shall exist in-house for the entire welding processes of the vacuum chambers.
- v. Facilities for completion of internal welding of the vacuum chamber weld joints without interruption of the welding process.
- vi. Quality Control & quality assurance Departments for all stages of manufacture including verification of material test acceptance of materials received, welding procedure and welders performance tests, metrology for detailed measurement of dimensions & tolerances, vacuum properties acceptance tests without bake out, cleaning, post cleaning handling, clean room, packaging, and transport. Quality management system shall conform to DIN EN ISO 9001:2000.
- vii. Cleaning procedure require high pressure hot (80⁰ C) water cleaning, rinsing, ultrasonic cleaning in hot (60⁰ C) alkaline cleaner, rinsing in de ionised water in two different baths, drying in **hot air oven** (180⁰ C), cool down and bake out in UHV compatible vacuum furnace or with an adequate bake-out jacket at UHV conditions at 250⁰ C for 24 hours using only completely dry pumping stations & controlled heating and cooling at $\leq 30^0$ C/Hr. Subsequent to the UHV bake out, dry air shall be injected in the UHV chamber. All cleaned components are to be covered with oil free aluminum foil and sealed with PE foil. Facility for cleaning of vacuum chambers should be available

- viii. A clean room facility and a set of trained personnel shall be available for post cleaning handling & testing of each vacuum chamber using clean room techniques only.
- ix. Facility for carrying out Vacuum Acceptance Test for unbaked vacuum chambers shall have the following
- a) Integral helium leak test under vacuum: A UHV calibrated Helium Leak detector with its internal dry pumping shall be used for this test. The leak test shall be done under vacuum with a jacket filled with Helium gas surrounding the vacuum chamber for duration of 20 minutes and requires no change in the leak detector back ground reading in the most sensitive range of 10^{-10} mbar l/s or better. Partial pressure of Helium gas in the jacket shall be monitored & recorded. The helium leak rate shall be $< 1 \times 10^{-10}$ mbar l/s. Use of non-metallic gaskets are to be completely avoided in the helium leak test set up. Also, in order to avoid any increase in the helium background around the leak detector, any helium gas used for the leak test shall be let off only through a high stack outside the test area.
- b) The complete vacuum test setup, all (completely dry) pumps used and the measurement equipment have to be documented in detail.
- c) Residual Gas Analyzer (RGA) UHV type with minimum partial pressure of 10^{-12} mbar shall be used. RGA Analysis with documentation shall be done.

Residual gas composition after 24 hours pumping:

- All peaks from masses between 18 and 44 have to be 100 times lower than the peak from mass 18, except peak from masses 28 and 44
 - All peaks from masses higher than 44 have to be 1000 times lower than the peak from mass 18.
- d) A measurement set-up for measurement of out-gassing rate. A surface related out-gassing rate of $< 5 \times 10^{-10}$ mbar l/sec/cm² has to be demonstrated & documented.

4. b. Company/Manufacturer Experience & Credentials

The company/manufacturer shall also have the following:

- i. Bank Solvency Certificate of minimum value of Rs 10.00 Crore or equivalent Indian rupees
- ii. Overall annual turnover during the last three years ending 31st March 2018 shall be at least Rs. 10.00 Crore or equivalent Indian rupees
- iii. Experience of having completed similar works during last 5 years ending March 31, 2018. The company/manufacturer shall submit the performance data of the similar works to substantiate their statement.

- iv. Shall have supplied critical vacuum equipment to reputed national or International organizations such as DAE, Defense, ISRO, Railways, etc meeting strict quality requirements in last five years.
- v. Request for relaxation on financial terms as per Government of India rules will be entertained after furnishing all relevant documents.

5. DOCUMENTS TO BE FURNISHED

Interested companies/ manufacturers are requested to furnish the following documents:

- i. Company Name, Address and Profile.
- ii. Category to which the EOI is being submitted, Both/Category-I/Category-II.
- iii. Structure and organization chart of the company
- iv. Name of contact person along with position in the company structure
- v. Annual Turn Over as per abridged Annual Financial Statements of Accounts for the last 5 years.
- vi. PAN Reference, TAN Reference and Unique Numbers or equivalent identification number
- vii. Latest bank Solvency Certificate.
- viii. Performance Certificate.
- ix. List of similar nature of works in hand and work carried out in last five years indicating agencies for whom executed and value of work. The company/manufacturer shall submit the performance data of the similar works to substantiate their statement.
- x. Completion time stipulated and actual or present position of work.
- xi. List of qualified and skilled technical staff they possess.
- xii. List of plants & machinery and infrastructural facilities they possess for execution of this work.
- xiii. List of contractors usually employed, their credentials, list of machinery and infrastructural facilities available, list of qualified and skilled technical staff, list of similar nature of work carried out.
- xiv. A brief description of the proposed plan for the execution of this work.

6. INSTRUCTIONS AND INFORMATION TO BIDDERS

Interested companies/ manufacturers are requested to furnish all the required documents mentioned above. The submitted documents shall demonstrate compliance with the qualification criterion. Evaluation of the companies/ manufacturers shall be carried on the basis of information submitted as well as visit to their manufacturing facilities & infrastructure by our authorized engineers. If any information furnished by the applicant is found incorrect at a later stage they shall be liable to be debarred from further participation.

*The interested & eligible companies/manufacturers are requested to submit their “**Expression of Interest**” under sealed cover super scribing the Advertisement Number on the envelope with relevant documents as stated here-in-above to the office of the **Administrative/Accounts Officer, Bose Institute-IFCC, at Bose Institute Centenary Building, P-1/12, CIT Scheme VII M, Kolkata- 700 054, on or before 20th June, 2018 within 15.00 hrs. (IST) clearly mentioning the category of interest. In the event of the specified last date for the submission of EOI Bid being declared a holiday due to Strike/Bandh or on any account by the Institute, the EOI Bids will be received up to the appointed time on the next working day. Late Bid shall not be accepted. For any queries (Technical or Commercial) the party can contact the Administrative/Accounts Officer, Bose Institute-IFCC over e-mail (aao_ifcc@jcbose.ac.in).***

After completion of the Pre-Qualification process (vide para 4), the short-listed companies/manufactures will be contacted for the next step of the procedure, i.e.; two-part tender.

Bose Institute (IFCC) reserves the right to reject any or all applications without assigning any reason whatsoever. Only those Bidders who fulfill all the eligibility criteria shall be allowed to participate in two-part tender.

**Administrative/Accounts Officer
Indo-FAIR Co-ordination Centre (IFCC)
Bose Institute
Kolkata**

Annexure-I

Ultra High Vacuum Chambers for Beam Diagnosis for HEBT beam lines for FAIR

Ser. No.	Type number	FAIR Drawing number	No. of ports (except vacuum pumping port)	Quantity
1	Type 1	FT-DK 2010	5	13
2	Type 2	FT-DK 2020	5	14
3	Type 3	FT-DK 2030	6	11
4	Type 4	FT-DK 2040	6	2
5	Type 5	FT-DK 2050	6	6
6	Type 6	FT-DK 2060	5	1
7	Type 7	FT-DK 2070	6	2
8	Type 8	FT-DK 2080	3	3
9	Type 9	FT-DK 2130	6	2
10	Type 10	FT-DK 2131	5	2
11	Type 11	FT-DK 2132	7	2

Total numbers of UHV chambers: 58

Category I (Number of ports: 3 to 5)

Type number: 1,2,6,8,10

Prototype: Type 2

Category II (Number of ports: 6 to 7)

Type numbers: 3,4,5,7,9,11

Prototype: Type 11