



**INDIAN INSTITUTE OF TECHNOLOGY BOMBAY**  
**MATERIALS MANAGEMENT DIVISION**

Direct : (+91-22) 2576 8800 (DR) / 8805 (Tender Section)/8801(Local) / 8803,04,06  
(Import) / 8802 (Enquiry & Bill tracking)/ 8848(Progress) Email : [drmm@iitb.ac.in](mailto:drmm@iitb.ac.in),  
[bkganesh@iitb.ac.in](mailto:bkganesh@iitb.ac.in)

**FLOOR STANDING X-RAY DIFFRACTOMETER SYSTEM**

We intend to purchase a X-RAY Diffractometer System perform crystallographic texture analysis, x-y mapping of samples, micro-diffraction; residual stress analysis (Psi and Omega modes), and standard powder diffraction including transmission mode measurements in one configuration. The proposed system should be equivalent with or better than each of the specifications listed in the technical requirement section.

Please follow the instructions carefully and comply your bid accordingly. If any of the instructions are not followed or violated, a submitted bid will be subjected to disqualify.

**The vendor to provide the following in the quote**

1. The technical quote should provide the detailed technical specifications and photographs of the proposed machine. The additional accessories offered by the manufacturer can also be included. The technical quote should contain only technical specifications without any prices. The price quote should contain the technical specifications as well as prices in details.
2. Upload detail technical specifications of system-ray Diffractometer System. The technical quote should contain a detailed specification vise “Technical Compliance” statement, authenticated with signature and seal of the prospective supplier. The bid should be stating whether the proposed machine satisfies or doesn’t satisfy with the specified requirements. If the value offered by proposed machine doesn’t satisfy the asked specification or any ambiguity left in the specification, the bid will be subjected to disqualify. For such specifications not mentioned then printed brochure relevant document from service manual should be provided to support the technical specifications. In absence of supporting documents the offers may be rejected without assigning any reason.
3. The prospective supplier should be either original manufacturer or authorized dealer of the original manufacturer of the proposed machine. In case of authorized dealer, the technical quote should contain a valid authorisation certificate provided by the original manufacturer on the name of IIT Bombay.
4. The prospective supplier is expected to have supplied the same quoted model of X-ray Diffraction System to at least 2 government institutes or national laboratories such as IITs, IISc, NITs, NML, DMRL, NAL etc. Provide the details of 2 users in India for



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getting first hand feedback about the product. If quoted model or accessories have not been supplied in India then provide the details of users (outside India) who have been running similar equipment successfully for more than 5 years and need to be demonstrated this system before supply.

5. The software should be compatible with the latest versions of windows operating system (minimum windows 7 and desired Windows 10 or equivalent). Up-gradation of software free for 5 years should be provided from date of supply.
6. Support of hardware and spares for 10 years and more after the End of life of the model should be confirmed by supplier.
7. Guarantee and warranty of the product should be provided. The price quote should include 3 years' warranty and additionally quote cost of annual maintenance contract (AMC) for a further period of 3 years.
8. The firm should be equipped with well-trained engineers to offer post warranty maintenance and service support. Number of service engineers employed in this region by manufacturer should be mentioned.
9. Details of service support in India that the firm can offer should be given along with the quote.
10. Nearest service center to Mumbai is to be mentioned.
11. Agent should have exclusive agency for last 5 years or more is mandatory. Copy of certificate for such exclusive agency is mandatory.
12. OEM (original equipment manufacturer) engineer should install the equipment not by the agent in India.
13. Supplier must provide the model number of their product which complies with the tender specifications and an original printed manual of the same shall be submitted with the bid. Bidders should highlight the features in the printed manual which complies with the tendered specifications. Vendors are strongly advised **not to submit any other manual** in their bid. It may lead to cancellation of their bid without any communication from IIT Bombay



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## **TECHNICAL SPECIFICATION FOR X-RAY DIFFRACTOMETER SYSTEM**

**OBJECTIVE:** The instrument required to perform crystallographic texture analysis, x-y mapping of samples, micro-diffraction; residual stress analysis (Psi and Omega modes), and standard powder diffraction including transmission mode measurements in one configuration. The XRD should have following technical features.

- 1. X-RAY Source :** A sealed tube generator for the Cu radiation with power of 3000 watts or better should be offered . It should be possible to exchange with other radiation x-ray tube with the respective optics e.g. Cr, Co, Ag , etc.

High stability, high voltage X-ray power supply for X-ray tube having minimum following specification.

- i) X-ray generator with minimum 3kW capacity.
  - ii) Stability : 0.05 % per 10 % mains variation.
  - iii) Voltage : 20-50 kV or better. System should operate at higher kV than 50kV in case we choose other radiations like Mo and Ag.
  - iv) Current : 20 – 60 mA or better.
- 2. X-RAY TUBE**
    - i) Cu source LFF tube with minimum 2 windows, one line and one point focus.
    - ii) Minimum power 1.8kW. Auto recognition facility of type of focus under usage and anode material
    - iii) Necessary k-beta filter should be offered.
    - iv) Changeover from line to point focus should be without the need for any disconnection of power and water tubings and cables.
  - 3. GONIOMETER:** High-accuracy, high-precision horizontal/vertical goniometer with most modern advanced technology to eliminate manual realignment like CBO, PREFIX, DAVINCI SNAPLOCK should be provided.



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- i) Angular accuracy :  $\pm 0.005^0$  or better.
- ii) Angular reproducibility:  $\pm 0.0002^0$  or better.
- iii)  $2\theta$  movement range : :  $-30 - 140^0 2\theta$  or better.
- iv) Step size :  $\pm 0.0001^0$  or better.
- v) Goniometer linearity (2 theta): 0.01deg or better over complete range using NIST standard.

The goniometer should have facility to mount simultaneously 2 detectors. **Only if in case 2 detectors are required to cover the complete tendered application.**

**4. OPTICS :**

- For Powder applications: Slit based optics both on incident and primary beam side for phase identification and quantification measurements of phases. The slits should facilitate low angle measurements from typically  $0.5\text{deg } 2\theta$ .
- For GIXRD measurements – A parabolic Mirror (like Goebel Mirror) for parallel beam measurements should be quoted along with long soller slits on the secondary beam path.
- For Residual Stress and Texture Measurements – A parallel beam x-ray lens (polycapillary type) should be offered on incident beam side. This lens should be able to work with Cu, Co, Fe and Cr radiations. Spot size to be typically  $\sim 10\text{mm}$ .
- For micro stress, texture and micro diffraction a x-ray lens or similar device with  $\leq 50\text{micron}$  spot size on sample should be offered on primary beam size. This lens or similar device should be able to work with Cu, Co, Fe and Cr radiations.
- For transmission measurement a suitable stage (if different to the cradle described above) should be quoted. Specimens will be textile fibers and also powders. Necessary optics of different from the above should also be quoted. Accessories like goniometer heads, capillary mounting and filling devices should be offered.

**5. SAMPLE STAGE :** Necessary Eulerian Cradle integrates to motorized Chi and Phi rotations and motorized X-Y-Z translations into one sample stage with minimum space requirements, should be quoted for high speed texture and stress measurement. The broad specifications of the cradle should be minimum as below:

- Phi range -----0 to  $360\text{deg}$  with minimum steps of  $0.01\text{deg}$ .
- Chi range ----- minus3 to  $+90\text{deg}$  with minimum steps of  $0.01\text{deg}$ .
- X,Y range ----- $40\pm 40\text{mm}$  with steps of  $0.01\text{mm}$ .



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- Z range ----- 0 to 2 mm with step adjustments of 1micron.
- Sample Height ----up to 20 mm in steps of 1micron or better
- supported mass --up to 500 gms or more

All the five axes movements should be motorized and completely controlled by the computer.

The sample mounting disk can be oscillated perpendicularly to both the phi and chi-axes in order to bring more crystallites into the diffraction position. The influence of particle statistics is reduced in this way. This oscillation is especially useful in texture and chi-stress analyses where spinning the sample during the measurement is not an option. It can also be used for other applications such as phase analysis and omega-stress analysis

**5. Sample mapping/Alignment** : Computer controlled laser or similar based video Microscope for sample viewing, imaging, positioning and alignment should be quoted along with the system.

**6. DETECTOR:** 2 – Dimensional large Area Detector

- 2-dimensional, solid state detector for ultra fast recording of diffraction patterns with minimum specifications as below:
  - Should work both in scanning (step and continuous) and static mode.
  - Should work in 0D, 1D and 2D mode. The switchover of the mode should be via the software and no realignment or repositioning of the detector should be done.
  - Large angular capture typically 20deg 2theta. Vendor to specify the sample to detector distance for achieving this angular coverage.
  - Minimum count rate  $1 \times 10^8$  cps with linearity at this count rate to be minimum 98%.
  - Background noise : < 1cps across the whole detector
  - Spatial resolution : 100  $\mu\text{m}$  or less. The detector resolution should preferably not change with change in sample to detector distance.
  - Point Spread Function: 1pixel.



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- The detector should have capability to remove secondary fluorescence from metal samples. Mechanism should be explained in details. A secondary monochromator to work with above detector is preferred and may be quoted in option **if required**.
  - The area detector should have function to view the area detector plots and also convert the same to a 1D (intensity v/s peak position) plot. Necessary software for the same should be part of the package.
  - Area detector should work with high efficiency for other radiations like Fe, CO, Mo and Ag. The efficiency details for these radiation should be mentioned in the offer.
  - In addition to the above a point detector (scintillation or proportional counter type) should also be offered **if any of the application is constrained with offered 2D detector**.
- 7. ELECTRONICS:** The system electronics should have an integrated shutter control and be capable of monitoring and controlling all Diffractometer functions such as angles, counts, slits, generator safety, etc.
- 8. SOFTWARE:**
- i. **General** - The software should be capable of simultaneous diffractometer control, data collection and analysis, peak search, search-match, profile fitting and elaborate pattern treatment such as data smoothing, background subtraction,  $k\alpha_2$  stripping, etc.
    - ii. Software for basic phase identification, search match function and quantification of phases should be provided.
    - iii. Software for structure refinement (Rietveld) should be provided.
    - iv. **Software for Texture measurement:** planning of measurement strategies, calculating and analyzing of pole figures. For data obtained with a 2-D detector also an extended background handling facility should be available to treat data containing diffraction lines that are simultaneously measured. Calculation of ODF and dislocation density ODFs.



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- v. **Software for Stress Measurement:** The measurement software should be able to collect stress measurements in iso-inclination ( $\omega$ ) or side-inclination ( $\psi$ ) mode. The evaluation software should be able to find peak position by five methods i.e. Gravity, Sliding Gravity, Parabolic, Pseudo-Voigt and Pearson VII. Also Calculation of the stress tensor in the sample and principal coordinates for normal, normal & shear, biaxial, biaxial & shear, and triaxial stress models.
- vi. Commercial software for texture analysis such as (labo-soft) and data base (ICSD) should be quoted as an optional item.

**9. Additionally, the vendors to confirm that debile type tensile stage can be mounted on the quoted system at a later date.**

**10.COMPUTER CONTROL UNIT:** A desk top PC should be provided for all operations of the XRD with minimum i5 or higher processor, DVD-RW drive facility, >500GB HDD, >16GB DDR RAM, 21" LCD Monitor, Minimum 4USBB drives, Windows 7 operating system. A color deskjet printer should be provided.

**11. High Temperature Attachment (Optional):** A high temperature attachment of reputed make is to be quoted with following minimum specifications

Temperature range ambient to 1100 deg C.

Angular range of atleast  $0$  to  $166^\circ 2\Theta$  ,  $0$  to  $85^\circ$  Psi and  $0$  to  $360^\circ$  Phi

It should be able to be mounted on to the above requested cradle. If not

compatible a suitable stage to mount the high temperature stage is to be quoted.

Suitable heating strip of Pt or its alloy to work in above temperature stage should be quoted. Total 2 strips to be quoted.

Accessories such as vacuum system, connecting cables, etc. if required should be quoted.

The system should be able to hold maximum rated temperature for at least a period of atleast 20 minutes.

Transmission to Cu k-alpha should be minimum 60%.

**12.SPARES :** vendor should quote optionally essential spare parts required for 2 years beyond the 3 year warranty period.





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- 13. SAFETY:** Should confirm to Indian and International safety standards and regulations pertaining to X-ray Radiation and other hazards. Vendor to provide certificate stating the radiation dosage for the quoted model. This should be below 1micro sievette / hour at a distance of 10cms from the instrument at full load with Mo radiation. Certificate to this effect should be enclosed with the offer.
- 14. UPS:** Necessary suitable UPS to run XRD system must be quoted additionally.
- 15. WARRANTY –** Minimum 36 months warranty should be provided for XRD system. **During warranty any parts that needs to be replaced should be done by supplier on a door delivery basis free of cost including x-ray source.** IIT Bombay will bear no costs towards, freight, insurance, clearance charges, local taxes and customs duties for parts that are needed to be replaced in warranty.
- 16. TRAINING –** Users should be imparted training at site.
- 17. OPERATING RESPONSIBILITY:** To obtain maximum uptime and upkeep of the XRD system the supplier will take all responsibility and if required will have to provide a high skilled and experienced full time operator to run the system for a period of 3-years from the date of installation of the system in the institute. Cost towards the same (if any) may be quoted. The operator will work as an employee of the supplier and institute shall have no responsibility for his/her service liabilities. The official work hours for the operator would be as per IIT Bombay's calendar.