



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076

Mechanical (localized property) Testing System

Purchase Requisition No.1000001451 (Tender/RFx No.6100000075)

Technical Specifications:

We intend to purchase Micro-hardness and scratch testing system with Video Microscope Motion table performance testing system for Mechanical (localized property) testing and research applications. The materials to be tested include (but not limited to) polymeric composites, metallic alloys and ceramic materials. Quotations are invited from the eligible bidders for providing the mentioned products as per detailed technical specifications provided in technical requirements section. 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. Submit detail technical specifications of Micro-hardness and scratch testing system with Video Microscope Motion table performance testing 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.
2. 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 original certificate provided by the original manufacturer on the name of IIT Bombay.
3. Attractive discount for an educational institution should be offered.
4. The prospective supplier is expected to have Micro-hardness and scratch testing system with Video Microscope Motion table performance to at least 2 government institutes or national laboratories such as IITs, IISc, NITs, NML, DMRL, NAL etc. Provide the details of these users in India for getting first hand feedback about the product.
5. The software should be compatible with the latest versions of windows operating system (minimum windows 7).
6. Free upgrades of software for 5 years, if required.
7. Support of hardware and spares for 10 years or more after the End of life of the model.
8. Guarantee and warranty of the product should be provided. The price quote should include 3 years warranty (as per details given at the end).
9. Cost of additional 3 years of annual maintenance contract (beyond the first 3 years of warranty and annual maintenance contract) should be quote as an option.
10. Quotes to be submitted by the vendor’s principal in foreign currency.



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11. The firm should have adequate number (at least 7 worldwide and least 3 in India) of such systems currently in operation for more than 3 years. Manufacturer should furnish the details addresses of such establishments where they have supplied similar equipment and running successful for more than 3 years. At least provide details of two users in India.
12. 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.
13. Details of service support in India that the firm can offer should be given.
14. Nearest service center to Mumbai is to be mentioned.
15. Agent should have exclusive agency for last 5 years or more is mandatory. Copy of certificate for such exclusive agency is mandatory.
16. OEM (original equipment manufacturer) engineer should install the equipment not by the agent in India.
17. The quote should include brochure of the system being offered
18. The manufacturer should agree to supply 3 sets of manuals for operation, maintenance and application software for the system to be supplied. The maintenance manuals should consist of assembly drawings and detailed circuit diagrams.
19. The quotation should provide some basic details of the key technologies used to achieve the above specifications.
20. On-site operation training at the time of installation.
21. On-site application training after 3 months of installation

It is mandatory to quote all the optional items.



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Technical Specification for Micro-hardness and scratch testing system with Video Microscope

Motion table performance

- X motorized table with an automated range of 100 mm (or more) Encoder Resolution 50 nm (or better), repositioning accuracy 1 micron)
- Y motorized table with an automated range of 50mm (or more) Encoder Resolution 50 nm (or better), repositioning accuracy 1 micron or better)
- Z motorized table with an automated range of 25mm (or more) (encoder resolution 50 nm (or better)) with a provision to accommodate samples as tall a 100 mm or more

Optical microscope or equivalent

High Quality video camera with c-mount (min1280 x 1024 Pixels)square CMOS pixel sensor and 60 fps or better.

- Integrated Microscope with the above motorized table
- Turrate with minimum 4slots for objectives on the optical microscope &
- Objectives: Standard – 5X (Optical Magnification x50); 20X (Optical Magnification x200) Infinity corrected Pan APO, 50X (Optical Magnification x500) Infinity corrected Pan APO, with autofocus system **Optional: 100X (Infinity corrected Pan APO)**
- It should allow different modules for measurement or analysis such as scratch testing

Micro-hardness Instrument: Instrumented Indentation:

- Programmable user defined array (over a large area by image data point selection) of indentations with image capture
- Variable depth hardness and stiffness measurement capability
- Continuous multiple cyclic loading
- Two Independent Sensors: One for Force and One for Depth
- Testing from low loads 10 mN or lower to high loads 20 N Load or more
- High Frame Stiffness (above 10E08 N/m) and limited thermal drift and granite (natural or synthetic) for increased vibration damping capabilities

OR

Constant frame stiffness value across entire load range must be demonstrable by analysis of indentation data on tungsten reference sample using a single frame stiffness value resulting in a constant Young's Modulus across that load range (<10% E variation across load range). ISO14577 standard could be used for this.

Resolution and Noise

- Load resolution: 10 μ N or lower, Load Noise floor: 250 μ N or lower
- Depth resolution: 0.05 nm or lower, Depth Noise floor: 1.5 nm or lower
- Force sensor and depth sensor (LVDT depth sensor or equivalent)



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- Maximum indentation depth should be $\geq 50\mu\text{m}$ (100 μm or higher as an option if available)

Temperature testing:

- Heating RT to 400 deg C
- Temperature accuracy of 0.1 deg C or better with independent s/w control
- Sample of minimum 12 mm diameter or better with high conductivity contact heating

Full software package for actuation, data and image acquisition and analysis including

- Fully user definable indentation modes with choice of force controlled or displacement controlled mode or constant strain rate mode under linear or quadratic variation(single/multi cycle, loading with variable holding and unloading profiles)
- Completely automated measurements on multiple samples with varying heights
- Real time display of force and depth data during acquisition, with the possibility to indentation instantaneous user controlled unloading during the experiment
- Video imaging with automatic focus at different heights of the indent
- Automated indenter calibration

Mechanical Properties Results

- Martens hardness curve.
- Automatic calculation of Hardness (Instrumented and Vickers), Elastic modulus and Creep relaxation
- Plastic and elastic parts of the indentation work
- Display of all indentation data results: maximum depth, contact depth, residual depth, projected contact area, stiffness (according to depth-instrumented indentation testing theories).
- Display of Hardness and Elastic modulus vs. Depth

General data analysis capability

Scratch Tester Specifications

- Minimum contact load of 10 mN (or better)
- Load of 20 N (or better) in vertical and lateral 20N (or better)
- From 0.5 to 100 mm/min (or better)
- Optical observation directly synchronized with scratch or equivalent
- Long scratch (mini. 10mm or longer) with synchronized optical observation with sensor signals over the whole length
- Contact surface profiling of the surface at a load of 20 mN or lower
- Correction of surface profile with pre-scanning of the surface
- Display of both elastic and plastic deformations of scratch
- Wear testing mode with bi-directional cycles of scratch



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- Two separate sensors: one sensor for force and one sensor for depth with force measurement in tangential and normal direction

Scratch Software

Full software package for actuation, data & image acquisition and analysis including

Complete measurements modes

- Real time display of force and depth data during acquisition with tiled montage image
- Fully user definable scratch modes (single and multiple scratches, multi-cycle wear, Constant load, incremental or progressive loads, user-defined load profiles, etc.)
- Large range of testing modes: scratch, wear, indentation
- System setting programmable for every single scratch in a multi-scratch experiment
- Automated correlation between scratch and imaging analysis
- Upgradable to a full integration AFM in future
- General data analysis capability

Different indenter and scratch tip:

1. Berkovich
2. 10 μm radius & 20 μm radius sphere
3. Vickers
4. Cube corner

Indentation Testing should be compliant to the following (or equivalent) standards:

1. ISO 6507 Metallic materials – Vickers hardness test
2. ISO 4516 Metallic and related coatings – Vickers and Knoop micro hardness tests
3. ASTM B933 Standard test method for micro indentation hardness of powder metallurgy materials
4. ASTM E140 Standard hardness conversion tables for metals
5. ASTM E384 Standard Test Method for Micro indentation Hardness of Materials
6. ASTM B578 Standard test method for micro hardness of electroplated coatings
7. ASTM E92 Standard Test Method for Vickers Hardness of Metallic Materials
8. JIS B7734 Knoop hardness test – Verification of testing machines
9. JIS R1607 Testing methods for fracture toughness of high performance ceramics
10. SAE J417 Hardness tests and hardness number conversions

Scratch Tester should be compliant to the following (or equivalent) standards:

1. ISO 20502 Fine ceramics – determination of adhesion of ceramic coatings by scratch testing
2. ISO 1518 Paints and varnishes - scratch test
3. ISO EN 1071-3 Advanced technical ceramics
4. Determination of adhesion and other mechanical failure modes by a scratch test



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5. ASTM C1624 Standard Test Method for Adhesion Strength and Mechanical Failure Modes of Ceramic
6. Coatings by Quantitative Single Point Scratch Testing ASTM D7027 Evaluation of scratch resistance of polymeric coatings and plastics using an instrumented scratch machine ASTM D7187 Standard

Other conditions

- Minimum 36 months warranty should be provided for the system. During warranty any parts that needs to be replaced should be done by supplier on a door delivery basis free of cost. 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.
- The supplier must submit (in technical bid) a signoff specification list which should be demonstrated at the site after installation.