**Tender Specifications for 50 kN Electromechanical Universal Testing Machine with Environmental Chamber and non-contact Video extensometer**

1. ***Technical Specifications for Load Frame***
   1. The UTM is intended to be used for performing tensile, compression, tear, adhesion, peel and cyclic tests under quasi-static loading rates on polymers, geosynthetic materials and other building materials over a range of temperatures.
   2. The UTM should have an electromechanical servo-controlled actuator positioned in a dual column construction with guide columns and ball screw on each side. The force capacity should be at least 50 kN and the axial stiffness of the frame should be at least 110 kN/mm or higher, for daylight of 700 mm. The maximum cross head/actuator travel/stroke should be at least 2000 mm .
   3. Test area height should be at least 2500 mm, without grips. The maximum daylight space within the chamber should be at least 700 mm with screw/self tightening grips in place. Horizontal clear space between columns shall be at least 415 mm and able to accommodate the environmental chamber.
   4. Actuator should be able to operate over a speed range of 0.005 to 600 mm/min at full capacity of the machine. The accuracy of speed should be 0.1% of set speed or better. The crosshead return speed of 600 mm/minor higher. The position and repetition accuracy shall be 0.002 mm or better.
   5. The electronics to be placed such that it is protected from accidental damage, dust and spillage.
   6. The UTM should have closed-loop controller and data acquisition system for simultaneous measurement of load, cross-head displacement and two additional control variables. Control modes of displac**e**ment, load and strain should be possible.
   7. The controller electronics should have industry standard ethernet interface, for fast and reliable communication with the computer. The controller should have data sampling rate of 400 kHz or better.
   8. The data acquisition card should have 24-bit resolution with minimum acquisition rate of 500 Hz per channel or better. Data acquisition rates should be user selectable up to 100 Hz or better.
   9. Two independent electronic load cells of 5 kN and 50 kN static capacities (in tension and compression), should have self identification facility, and should automatically load the suitable calibration data. These load cells should have at least 150% over load protection. The 5 kN capacity load cell should piggyback on 50 kN load cell. Both load cells should be calibrated for 10 % and 100 % of full scale. All load cell accuracy shall be ISO 7500-1 Class 0.5 from 1% to 100% and must fulfill all criteria of ISO 7500-1
   10. Test control panel should be provided with result display, start, stop and return functions, programmable function keys, test status indicators, variable speed jog and specimen protection. Power and emergency stop switches shall be located where they are visible to the operator at the front of the machine.
   11. The system should be provided with a remote control with the help of which specimens can be positioned, test started and stopped.
   12. System should be usable and durable under local laboratory ambient conditions. The electronics should be protected in a casing satisfying IP 40 protocol.
   13. Pull rods to be provided for use with environmental chamber.
2. ***Technical Specifications of Environmental Chamber***
   1. The environmental chamber should be able to maintain temperature in the range of ambient to 250°C. The accuracy should be equal to or better than ±1°C in the temperature range of ambient to 100°C, ±1.5°C in the temperature range of 101°C to 150°C, ±2.5°C in the temperature range of 151°C to 250°C.
   2. The environmental chamber should be capable of achieving the ramping rate of 15°C/min.
   3. The minimum internal dimensions (depth D x width W x height H) of the environmental chamber shall be 250 x 350 x 900 mm, and the set of screw/self tightening grips should occupy less than 300 mm vertical space. The dimensions of the chamber should permit comfortable operation, and setting up and removal of the specimens. The chamber should fit within the load frame supplied.
   4. The environmental chamber should have at least three view ports for non-contact extensometers or other observations. One view port in front and two side view ports (each of at least 500 mm height and at least 100 mm width).
   5. The environmental chamber should be such that it can be rolled-in and rolled-out of the frame without removal of pull rods and grips. Suitable arrangement should be provided for easy roll-out of the environment chamber when not in use.
   6. The exterior of the chamber should be insulated so that accidental contact with the operator does not cause any harm when the test is running at high temperatures.
   7. The weight of the chamber should preferably be less than 50 kg
   8. Details about the durability of the chamber in the local conditions and safety certification should be provided.
   9. The chamber should operate with standard single/three phase power supply, 50 Hz
3. ***Technical Specifications of Grips***
   1. Wedge action tensile grips of 50 kN capacity or higher to conduct test on flat specimens of thickness up to 10 mm with two sets of flat jaws. The gripping area on each end of the specimen should be at least 50 mm X 35 mm (H × W)
   2. Screw grips of 2.5 kN capacity to conduct tensile, grab and trapezoidal tear tests on woven & non-woven geotextiles, geomembranes, fabric strips, materials and polymer dog bone samples having very high elongation, as per ASTM D 4632, ASTM D 5035, ASTM D 4533 and ASTM D 6392.
   3. The height of the grips along with fixtures should be such that the minimum daylight between the grips (screw/self tightening grips) within the chamber is at least 700 mm and the minimum day light between the grips (including hydraulic grips) without the chamber should be at least 1500 mm.
   4. The grips should be usable inside the environment chamber over temperature range from -40°C to 250 °C.
4. ***Technical Specifications of Video extensometer***
   1. Video extensometer shall be of non-contact type, compatible for use with the UTM controller.
   2. Video extensometer must be suitable for use with the environment chamber over the temperature range from -40°C to 250 °C.
   3. Video extensometer shall conform to ASTM E83, ISO 9513 and EN 10002-4 standards.
   4. The displacements and strain should be obtained between several user chosen points.
   5. Gauge length shall be selectable.
   6. Measuring range (field-of-view, FOV) of video extensometer should be at least 500 mm.
   7. Geometrical lens distortions should be corrected optically.
   8. The lens should have coaxial illumination facility.
   9. The resolution should be at least 0.75 µm until FOV of 150 mm, 2.5 µm up to FOV of 500 mm.
   10. The video extensometer should be capable of recording in-plane strains.
   11. Video extensometer should be capable of identifying and recognizing patterns on the sample, if any, and use them to measure extension.
   12. The synchronized video recording for later usage in classroom should be possible. Capability should be provided for storing real-time test videos.
5. ***Technical Specifications of* *Software***
   1. Should have the capability for tension, compression, flexure, and other test control based on extension, load or strain.
   2. The software shall allow exporting the raw data by a single mouse click into Excel or Word etc
   3. The software should have the capability to save the test method along with the start position, limit positions, etc. so that the machine automatically comes to the start position for testing when the test file is opened.
   4. Test software to provide standard templates for running monotonic tests (tensile, compression, bending). All test templates should be modifiable by the user using the graphic interface (no requirement to change source code). Test software to have graphical drag-and-drop test layout design. It must be possible to create test templates. Software to have freely configurable run time view (show an unlimited number of variables, meters. charts and tables). All variable definitions and calculations as well as the test flow/sequence and logic should visible and can be changed by the user.
   5. Software must support data acquisition modes according to time, peak/valley, cyclic/ logarithmic.
   6. The software must have password protection filter for the administrator, so that user cannot change critical setting of the machine
   7. Software must run on a computer to be provided by the supplier with Intel Core i5 processor, 8 GB RAM, 1 TB storage hard drive, Windows 7 Pro, 64 bit, OS, MS Office 2013 and 23 inch monitor or better
6. ***General Specifications and Conditions***
   1. The system should be delivered within 16 weeks from the opening of the letter of credit or issue of purchase order, whichever is later.
   2. The cost should include 12 month warranty and CIF/CIP up to Chennai airport or seaport
   3. Prices quoted should be valid for at least one (1) year
   4. Individual costs should be indicated for the different items (parts) quoted, e.g., loading frame and electronics, chamber, extensometer, grips, etc.. IIT Madras reserves the right to exclude some items from the purchase
   5. Costs and related information should be given only in the financial bid
   6. The system should be installed and commissioned with no additional cost. At least two days of training at IIT Madras should be provided with no additional cost. Installation and training shall be done by the suppliers' engineer(s).
   7. Two copies of the system manual should be provided in CD form
   8. The list of at least three users of similar installations in India including contact details (name of the person in-charge, email and phone number) is to be provided
7. **Optional Items to be quoted separately**
   1. Self-tightening grips of 2.5 kN capacity for soft plastic and rubber dumbbell samples.
   2. Parallel acting dual cylinder hydraulic grips of 50 kN for performing wide-width tensile test on geogrids, geotextiles, woven and non-woven materials, coated fabrics, tapes, belts as per ASTM 4595, ASTM 6637, ASTM 4885 and ISO 10319. The hydraulic/pneumatic grips must facilitate mounting of wedge action/screw type/self-tightening grips or pull rods on top of them using simple adapters and pull rods.
   3. Liquid nitrogen cooling accessory to ensure the working temperature of the environmental chamber below ambient temperature and down to -40 °C