



## INDIAN INSTITUTE OF TECHNOLOGY BOMBAY MATERIALS MANAGEMENT DIVISION

**For PR No.1000015562 (RFx No.6100000422)**

### **Technical Specifications of Axial Torsion System**

#### Axial Torsion System Specification

##### I. GENERAL

The testing instrument shall consist of horizontal test frame, a durable fatigue rated 400N servo electric actuator , an integrated 400 N, 2 Nm electric torsion motor, 2 load cells, electronics controller and software that allows machine control, variable rate data acquisition and data manipulation for a wide variety of Axial Torsion applications in conjunction with existing electromagnetic system for testing of magnetic shape memory alloys and magneto active polymers. All these components must be integrated and supported by the vendor. Vendor must have supplied Axial torsion test systems not limited to above configuration within India or as an International supply.

##### II. SYSTEM SPECIFICATIONS

This unit describes major sub-components of the integrated system and their specifications.

###### A. LOADING FRAME

- I. The axial loading frame shall be capable of cyclic tension, compression and fatigue testing. It should include a digital closed loop command and feedback motion control system with high performance fatigue rated servo electric actuator.
- II. The loading frame must have a minimum footprint of 800mm
- III. The loading frame must have provision to accommodate two additional axial actuators for future upgrade.
- IV. The load frame should also have an integrated torsion motor for applying torque on the test specimen.
- V. For lateral stiffness, robustness and experimental conditions, electromagnetic or voice coil actuators cannot be utilized.
- VI. The Axial motor shall have  $\pm 400\text{N}$  of load applying capacity.
- VII. The axial motor shall provide a minimum of  $\pm 20$  mm (40mm total) of displacement travel
- VIII. The motor shall have a displacement resolution of 0.1 micron or better.
- IX. The motor shall have 0.005 micron or better displacement accuracy.
- X. The maximum axial speed must be 200mm/min or higher and shall be user adjustable with the supplied software.

- XI. The torsion motor shall be able to apply  $\pm 2\text{Nm}$  torque on the specimen.
- XII. The torsion motor should have  $0.5^\circ$  or better rotation resolution
- XIII. The torsion motor should be able to rotate for  $300^\circ$  or better
- XIV. The torsion motor should have a speed of rotation of 2500rpm or better
- XV. The system must include an ISO approved emergency stop switch for safety. For safety reasons the motors must not auto restart upon release of the emergency stop switch.
- XVI. Anti-rotation arrangements must be provided on the system to prevent grip damage or unscrew during torsional testing.
- XVII. The operational usage cyclic frequency can be up to 5Hz.

## B. LOAD MEASURING SYSTEM, ELECTRONICS, & SOFTWARE

- I. Axial and Torsion load cell shall be strain gauge based with an accuracy of  $\pm 1.0\%$  of full-scale reading or better.
- II. Minimum one load cell must have capacity of 400N axial and 2Nm torsion capacity torsion.
- III. To avoid expensive repairs and downtime, load cells shall have an overload capacity of up to 150% of capacity.
- IV. The test electronics shall allow an Ethernet connection to connect to an external laptop. The data acquisition electronics should be designed to be located within the controller. Controller must be properly shielded from the known electronic noise generated in the test frame.
- V. The electronics shall provide at least 5 kHz control loop frequency
- VI. The electronics shall have an Integrated power supply and signal conditioning which minimizes heat generation.
- VII. The electronics shall accept up to eight encoder inputs which provides control capability to two motors.
- VIII. The electronics shall have at least six load channel inputs.
- IX. The electronics shall have at least six control or sense bits.
- X. The electronics shall have at least eight digital to analog channels.
- XI. The electronics shall have at least 4 additional channels to allow connection of additional sensors
- XII. The electronics must be compatible for upgrade with two more axial actuators for future usage.
- XIII. The software shall provide an easy to use point & click user interface.
- XIV. The software shall provide a digital oscilloscope display with user defined channel, scaling, and export capabilities.
- XV. The software shall provide the capability of controlling and monitoring the complete test system.
- XVI. The software should provide independent axial motor and torsion motor control.
- XVII. Software should provide independent & fully synchronized motor control.
- XVIII. The software should provide both load control & displacement control.
- XIX. The software shall be configurable for sine, square, ramp, and block waveforms.
- XX. Integrated data acquisition shall be provided on control channels.
- XXI. Limit monitoring and event logging should be a standard software feature.



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#### C. GRIPS

- I. Tensile grips should be able to apply simultaneous 400 N Axial load and 2 Nm Torsion load on cuboidal magnetic shape memory alloy specimens up to 4 mm thickness, 10mm width and 50 mm in length.
- II. Compression platen grips should be supplied for compression testing of specimens up to 400 N. Platens must be compatible with specimens maximum 15 mm diameter and 5 mm thickness.
- III. Miniature grips should be supplied for testing of soft magneto active polymer materials with specimen thickness up to 1.5mm, width up to 10mm and maximum length up to 25mm.
- IV. Miniature grips should be able to apply loads upto 44N on polymer specimens.
- V. Grips should be made of nonmagnetic material
- VI. Grips should be biocompatible and should allow for use in testing up to 40°C while being submerged in biological media.

#### Computer

- i. Supplier must provide compatible laptop/computer for control, monitoring and logging data from the test system.

#### D. Accessories

- i. Test system should be supplied with bioreactor for testing under physiological conditions.
- ii. Bioreactor should allow for axial and torsional loading of specimens
- iii. Bioreactor should be made steam sterilization compatible and UV sterilization compatible and manufactured from biocompatible material.
- iv. Minimum working space in the bioreactor should be 30mm x 30mm including specimen holding area.
- v. Bioreactor should allow stroke of up to  $\pm 10$ mm.
- vi. Bioreactor should have at least two ports to allow connection of sensors.

### III. SERVICEABILITY & TRAINING

- i. Factory trained service engineers will install system on site
- ii. Factory trained engineers must provide training on the installed test system