

**TECHNICAL SPECIFICATIONS -
TESTER FOR RELIABILITY STUDIES ON RESIN TRANSFER HYBRID COMPOSITES**

1. Load Frame

- 1.1. Frame rated for at least 25kN in tension / Compression.
- 1.2. Minimum stiffness better than 50kN/mm, precision aligned load frame with fixed lower platen and adjustable upper crosshead.
- 1.3. The column clearance is 400mm and the maximum vertical daylight is 700mm.
- 1.4. Load frame to sit on an enclosure that houses pump and digital controls.
- 1.5. It should have castors for easy re-location of system
- 1.6. System should be rated for indefinite operations

2. Fatigue rated actuator assembly

- 2.1. Linear dynamic/static capacity: ± 25 kN
- 2.2. Minimum Stroke length: ± 25 mm with resolution of $0.1\mu\text{m}$
- 2.3. Shall include anti-rotation assembly
- 2.4. Servo valves of suitable rating and accumulators of suitable capacity.
- 2.5. Operating frequency, load and displacements needs to be satisfied based on the following table (Table 1)

Load (%)	Frequency, Hz	Displacement Double Amplitude, mm
100	20	0.06
100	10	0.4
100	5	1.1
100	1	6.0
50	20	0.3
50	10	0.9
50	5	2.1
50	1	11.0
25	20	0.4
25	10	1.1
25	5	2.6
25	1	14.0
0	20	0.5
0	10	1.4
0	5	3.1
0	1	17.0

3. Hydraulic power pack

- 3.1. Hydraulic power pack of sufficient capacity to run the system continuously has to be provided.
- 3.2. Proper size of accumulators has to be incorporated to avoid jerks/pressure transients in the event of power failure.
- 3.3. All safety provisions, pressure indicators, temperature indicators, relays have to be incorporated.
- 3.4. Hydraulic oil of sufficient quantity for the first time filling for the use of hydraulic power pack has to be provided.
- 3.5. Maximum working noise of 65 dB
- 3.6. Power pack shall be compact (an integrated power pack is preferable).
- 3.7. System should be self-cooled.

4. Digital Servo Controller including/ensuring

- 4.1. 1 channel of digital encoder input
- 4.2. Minimum 5 channels of conditioned analog inputs with BNC connectors (+/-10V) with suitable signal conditioners
 - 4.2.1. 2 channels for load measurement
 - 4.2.2. 1 channel of strain-bridge extensometer/crack-opening displacement gage input
 - 4.2.3. 1 channel for measuring displacement using LVDT
 - 4.2.4. 1 Spare Channel
- 4.3. 1 channel of digital servo-control with loop update frequency of at least 5 kHz
- 4.4. 8 digital I/O / Logic drive and sense lines.
- 4.5. Synchronized data acquisition into host computer at 5 kHz from up to:
 - 4.5.1. 1 channels of 32-bit digital encoder readouts
 - 4.5.2. 8 channels of 24-bit analog feedback readouts
 - 4.5.3. 1 channel of Set Point
 - 4.5.4. 1 channels servo-output for monitoring purposes
- 4.6. 8-bits of digital I/O status for time tagged device sense and control at 1kHz data acquisition rate
- 4.7. User settable software safety limit interlocks on upper and lower limit readout on each of 2+8 feedback channels with individual option of Stop/Hold/Trip
- 4.8. Servo control of actuator with user settable/programmable:
- 4.9. Mode control (Load, Stroke, Strain)
- 4.10. Real-time automatic adaptive servo-gain adjustment to account for system stiffness variation as a function of specimen stiffness
- 4.11. Static ramping of Load / displacement/ strain with independently settable ramp rate.

- 4.12. Cyclic loading with ramp/sine waveform and user settable mean, amplitude and phase at frequency of up to 50 Hz and restricted as per the actuator performance curve, with better than 2% accuracy in loading through adaptive control.
- 4.13. Provision for multi-step static and cyclic loading, with provision to switch control mode(s) as required.
- 4.14. User settable error limit on servo-control with option of Stop/Trip
- 4.15. Host computer with Windows 7 or higher version of operating system and suitable application software for ease of performing tests under specified conditions with provision for report generation by way of multiple worksheet XL-tables including raw data arranged suitably as columns for individual channels.
- 4.16. Additional, easy to use Tablet/Smartphone with WiFi interface to host computer to permit easy stroke positioning by operator during specimen mount/dismount through local access to readouts and device control/status. Tablet mounting with power supply to be provided at convenient location.
- 4.17. One Hardwired E-Stops, located on the frame for easy access.
- 4.18. UPS to guarantee safe shut down and unloading in the event of power failure

5. Grips and Accessories for Room Temperature Applications

5.1. Hydraulic Wedge Grips:

- +/- 25 kN Capacity hydraulic grips with symmetrical housing and control manifold
- Grips must include below wedges for testing flat and round samples.
- Wedges for flat specimen of thickness 0 to 5 mm and width 35 mm
- Wedges for flat specimen of thickness 5 to 10 mm and width 35 mm
- Wedges for round specimens of diameter 3 to 5 mm
- Wedges for round specimens of diameter 6 to 9 mm

5.1. Four Point Bend Fixture

- +/-25kN rating
- Top anvil with 20mm to 90mm span
- Bottom anvil with 50 to 180mm span.
- Roller diameter for top and bottom fixture to be 10mm
- Fixture must have attached scale for easy location of support blocks
- Rated for room temperature operation

5.2. Software for Static and Dynamic Applications

- Performs cyclic, static, Multi-Step and Time History (custom) waveform testing.
- Test can be done in stroke, load and extensometer control modes.
- Single and multi channel applications

Display meters for current readouts, maximum and minimum readouts, peak valley readouts, set point and cycle counters.

Data recording collects time and/or peak-valley data to binary formats. Data is exported to MS Excel/text format where report generation and graphing can be performed.

Data reduction options are available in when logging data in real-time or during export of data.

This application will work only in conjunction MTL32.exe

Report Generator:

Data playback

Calculations for cyclic tests: amplitude, area under curve, phase angle, stiffness, modulus, etc.

Report template in excel format

5.3. **Tensile and Compression Testing Software (As per ASTM E8 and ASTM E9)**

Software to perform Tensile and Compression test. The user interface contains specimen description, loading parameters, pump controls, test run/stop, graph display, numeric readouts of multiple relevant test parameters.

Tests can be done in stroke or strain control.

Online graphs of stress vs. strain and load vs. displacement.

Option to save the test profiles.

Auto data acquisition settings

Option to view multiple test graphs in one plot.

Option to run test in dual rate.

Option to remove the extensometer and continue the test in stroke control.

Option to stop the test after specified percentage load drop.

Limit settings on stroke, strain and load channels.

Offline post processing program to analyse the results in MS Excel.

Warranty: 1 years for the machine + 1 year AMC

This specification is for design, supply, installation, commissioning and demonstration of the mechanical tester for composite material.

This equipment is proposed to be used to evaluate aforementioned properties on various materials like composites as well as aluminum alloys, steels and titanium alloys at ambient temperature. Tests like tension, compression and fatigue will be conducted to evaluate material properties and to assess the material behavior.

Proof of technical competency with at least five similar equipment supplied, installed, maintained, within three years which are currently working elsewhere, shall be submitted along with the offer (IISc/IITs/IISER/NITs/Central Universities/DRDO/CSIR and other government Labs). Parties not meeting this criterion will be rejected.