



TECHNICAL BROCHURE



TM-EML Series D Dual-Column Floor-Standing Universal Testing System



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GENERAL DESCRIPTION

The [TM-EML Series D Dual Column Floor Standing Universal Testing System \(50 kN – 1000 kN\)](#) by TensileMill CNC is a robust electromechanical solution designed for precise and stable testing of high-strength steels, advanced composites, high-temperature alloys, and other demanding materials. It is ideal for both standardized testing and advanced research applications that require exceptional rigidity, accuracy, and long-term repeatability.

The system utilizes a dual-column floor-standing frame optimized through finite element analysis (FEA) to provide superior structural stiffness and alignment. Reinforced guidance columns and preloaded precision assemblies contribute to outstanding mechanical stability. The servo direct-drive and high-rigidity synchronous belt transmission enable quiet, high-speed, and backlash-free motion across tensile, compression, and flexural testing modes.

Exceptional accuracy is maintained even under extreme conditions, with a minimum test speed of 0.00005 mm/min and a real-time sampling frequency of up to 1200 Hz. The TM-EML Series D supports intelligent waveform generation, fine strain-rate control down to 0.00007/s, and integrates adaptive closed-loop control, overload protection, and real-time collision prevention.



Intuitive System & Interface



Rapid Delivery



Fully Standards-Compliant



Turnkey Testing Packages



High ROI, Low Operation Costs



Reliable Support & Calibration

Force Capacity: 50 kN, 100 kN, 200 kN, 300 kN, 500 kN, 600 kN, 1000 kN (11,240 – 224,800 lbf)

Frame Configuration: Dual-column, floor-standing electromechanical frame with servo direct-drive and synchronous belt transmission

Test Space: Single-space and dual-space configurations available; extended-travel models optional for longer specimens or specialized fixtures

Typical Applications: Suitable for high-strength metal evaluation, composite material development, fatigue analysis, thermal performance testing, and precision quality control in laboratory and industrial environments



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TYPICAL SPECIMENS

Engineered for high-precision testing of advanced and high-strength materials, the TM-EML Series D system by TensileMill CNC accommodates a wide range of specimen types and configurations, including:

- Rubber, elastomers, and soft polymers (ASTM D412, ISO 37)
- Engineering plastics and fiber-reinforced composites (ASTM D638, ISO 527, ISO 604)
- Metal sheets, rods, and wires, including high-strength steels (ASTM E8, ISO 6892-1, GB/T 228)
- High-temperature alloys and prepregs (ASTM E21, ISO 7500)
- Biodegradable and flexible polymer materials (ISO 1184)
- Flexible electronic components and printed substrates
- Structural materials and assemblies tested under high load and temperature conditions
- Samples requiring fine strain-rate regulation or waveform-based loading control

KEY FEATURES OF THE TM-EML SERIES D UNIVERSAL TESTING SYSTEM

The TM-EML Series D is built to meet the demanding performance and accuracy requirements of modern materials testing laboratories. Its main features include:

- **Dual-column floor-standing configuration:** Designed for maximum stiffness and alignment stability, optimized through finite element analysis (FEA). Reinforced guidance columns and precision linear guides minimize vibration and ensure accurate crosshead positioning during operation.
- **Servo direct-drive with synchronous belt transmission:** Replaces conventional gear reducers to achieve high-speed motion, reduced vibration, and improved energy efficiency. Enables rapid acceleration and consistent test stability across various materials.
- **Preloaded precision ball screws:** Guarantee uniform load transmission and minimize mechanical backlash, providing consistent results during cyclic and high-load testing.
- **Photoelectric encoder-based position measurement:** Integrated into the servo system to track displacement with micro-level precision (down to 0.0095 μm depending on the model), ensuring accurate strain-rate control (as low as 0.00007 s^{-1}).
- **Closed-loop control and high-speed data acquisition:** Operates at a 1200 Hz sampling and control frequency with 6-channel 24-bit AD acquisition and 3-channel digital inputs (up to 4 MHz). Supports waveform control including sine and trapezoidal patterns.
- **Comprehensive safety architecture:** Includes 103% overload protection, mechanical stroke limiters, software-defined safety thresholds, and real-time collision detection to safeguard specimens and hardware.



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- **GenTest™ software platform:** Preinstalled with ASTM, ISO, GB/T, and EN standard methods. Features intuitive test workflows, result recalculation, customizable reporting, multi-language interface, voice guidance, and smart accessory synchronization.
- **Flexible system integration:** Compatible with extensometers, video extensometers, environmental chambers, pneumatic grips, and strain gauges. Includes analog signal output and Ethernet/USB connectivity for integration with external DAQ systems.
- **3.5" touchscreen handset:** Magnetically mounted handheld controller with real-time data display, crosshead jog, grip control, fine-tuning, and return-to-origin functionality. Supports dual communication with both the controller and connected PC.



DIGITAL CONTROL SYSTEM

The TM-EML Series D Universal Testing System incorporates a high-performance digital control architecture engineered for precise test execution, high-speed data communication, and seamless integration across all subsystems. The design emphasizes synchronization, responsiveness, and operational safety under all testing conditions.

- **Advanced Connectivity – Ethernet and USB:** Alongside standard USB connectivity, the TM-EML Series D supports Ethernet (TCP/IP) communication via a dedicated high-speed processing chip with built-in hardware logic for complex protocol management. This configuration enables stable, low-latency data transmission ideal for remote operation, laboratory network integration, and distributed data acquisition setups.
- **Signal Processing and Data Acquisition:** The system operates at a 1200 Hz closed-loop control frequency with 1200 Hz real-time sampling, maintaining precise synchronization between force, displacement, and extensometer signals. It includes a 6-channel 24-bit AD analog measurement system and 3 high-speed digital inputs capable of capturing orthogonal pulse signals—such as encoder or grating ruler feedback—at rates up to 4 MHz.
- **Integrated System Safeguards:** Embedded firmware continuously monitors voltage, current, motor temperature, overload, and displacement limits. Both hardware and software emergency stop circuits are active at all times, providing immediate protection against abnormal operating conditions.
- **Standard Handheld Control Console:** Each TM-EML Series D system is supplied with a 3.5-inch color touchscreen handset featuring tactile silicone buttons and a precision rotary control wheel. The console allows operators to perform essential test functions, including:
 - Crosshead movement (up/down)
 - Test start and stop operations
 - Return-to-origin with memory recall
 - Grip open/close control (when equipped)
 - Specimen protection logic to prevent overloading during setup



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OPTIMIZED STRUCTURAL RIGIDITY

The TM-EML Series D Dual Column Floor Standing Universal Testing System is engineered with a precision dual-column frame architecture that provides exceptional stiffness, alignment stability, and long-term mechanical durability. Its structure is optimized through finite element analysis (FEA) to minimize frame deflection and eliminate mechanical backlash under full load conditions, ensuring consistent and repeatable testing performance.

- **Reinforced guidance columns** with a self-lubricating design to maintain high lateral stiffness and perfectly linear crosshead motion.
- **Preloaded precision ball screws** that deliver consistent axial force transmission and eliminate clearance during high-load operation.
- **Integrated servo motor encoder system** providing high-resolution position feedback for precise control and repeatable displacement measurement.
- **High-rigidity mechanical interfaces**, including load cell mounts, actuator couplings, and crosshead assemblies, are engineered for a zero-clearance fit. This design guarantees reproducibility for critical test parameters such as modulus, yield strength, and ultimate tensile failure points.

ADVANCED DIRECT-DRIVE SERVO ACTUATION

The TM-EML Series D UTM by TensileMill CNC utilizes a servo direct-drive transmission, replacing conventional gear reducers with a high-rigidity synchronous belt mechanism. This design greatly increases mechanical efficiency, removes transmission backlash, and improves energy use under all testing loads.

Key performance benefits include:

- **High-speed crosshead movement:** Up to 850 mm/min for 50–100 kN models and 300 mm/min for the 1000 kN model, depending on frame capacity.
- **Fast return speed:** Up to 1200 mm/min, minimizing downtime between consecutive tests.
- **Ultra-low minimum test speed:** As low as 0.00005 mm/min, allowing precise control for low strain-rate applications, including high-temperature tensile tests with strain rates down to 0.00007 s^{-1} .
- **Smooth acceleration profiles:** Optimized for dynamic responsiveness during ramp, hold, and waveform-controlled testing cycles, ensuring accuracy and stability throughout all test phases.



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INTELLIGENT SAFETY AND CONTROL ARCHITECTURE

The TM-EML Series is equipped with a multi-layered safety and control framework designed to protect the equipment, specimens, and operators throughout every stage of material testing.

- **Real-Time Collision Detection:** The system continuously monitors force changes during operation. If an unexpected force spike occurs, such as from specimen failure or obstruction, the crosshead motion automatically stops, preventing potential damage to the load cell or specimen.
- **Overload Protection (103%):** Built-in software-controlled overload protection stops the test when the applied load exceeds 103% of the rated capacity, ensuring safe and reliable system performance.
- **Dual Position Limit Safeguards:** Mechanical limit switches and programmable stroke limits prevent crosshead overtravel, maintaining precise motion control and mechanical safety.
- **Emergency Stop System:** An integrated emergency stop circuit allows operators to halt all machine motion instantly in the event of abnormal operation or emergency conditions.
- **Sensor Range Protection:** All measurement channels (force, displacement, and extensometer) operate under defined protective logic that automatically stops the test if signals exceed their calibrated limits.
- **Handheld Console Safety Functions:** The 3.5-inch touchscreen handset includes built-in safety mechanisms such as grip lockout, overload prevention, and an automatic return-to-initial-position function to prevent misalignment or accidental movement during setup.

OPTIONAL SAFETY ENCLOSURE

An optional full protection shield features an aluminum alloy reinforcement frame with high-impact polycarbonate panels. Designed in accordance with international safety standards, it provides maximum protection during high-force or high-throughput testing. The shield includes an integrated door locking mechanism and software-linked interlock system, preventing crosshead movement when the door is open to enhance operator safety.

EFFICIENT OPERATION AND EASY MAINTENANCE

The TM-EML Series D UTM is built for practical daily use, combining intuitive operation with a maintenance design that supports long-term reliability. Every element, from the interface to the hardware layout, has been developed to help technicians complete tests faster, maintain accuracy, and reduce service interruptions.

- **User-Friendly Software Interface:** The system operates through an intuitive, icon-based layout with preloaded test templates compliant with ASTM, ISO, GB/T, and EN standards. The drag-and-drop configuration and real-time graphical feedback make setup and monitoring simple and efficient.



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- **Step-by-Step Test Configuration:** Operators can create test sequences using a guided interface that walks through each stage of setup. This reduces configuration errors and promotes consistency across multiple users and testing sessions.
- **Automated Reporting and Data Export:** After each test, results such as modulus, yield strength, and peak force are calculated automatically. Data and reports can be exported with a single click. Batch processing is supported for high-volume testing environments.
- **Accessible Maintenance Design:** The pull-out controller and redesigned outer covers allow tool-free access to belts, motors, and sensors. This makes routine inspection and servicing fast and convenient, minimizing operational interruptions.
- **Flexible Control Options:** The TM-EML Series D can be operated using the integrated 3.5-inch touchscreen handset or an optional industrial touchscreen PC, providing flexibility for both independent and PC-synchronized control modes.

MECHANICAL AND ELECTRONIC ARCHITECTURE

The TM-EML Series D Universal Testing System combines a reinforced dual-column load frame with advanced electronic control to deliver unmatched stability, precision, and repeatability under varying test conditions and material types.

PRECISION LOAD FRAME

The structural design of the TM-EML Series D ensures high accuracy and minimal mechanical loss through its rigid construction and optimized motion system.

- **High-Stiffness Linear Guide System:** Reinforced columns with integrated self-lubrication maintain precise crosshead alignment and smooth, low-friction movement, minimizing displacement errors and strain-sensitive testing.
- **Synchronous Belt Drive:** The servo-driven synchronous belt enables high-speed, vibration-free operation and long-term maintenance-free performance.
- **Integrated Optical Encoder:** A high-resolution photoelectric encoder tracks crosshead position in real time, achieving micro-displacement measurement accuracy up to 0.0095 μm , depending on model configuration.



LOAD CELL ASSEMBLY

The load cell configuration guarantees accurate and consistent force measurement, supported by advanced protection and calibration features.

- **High-Precision Load Cells:** Provide excellent stiffness, linearity, and stability across the entire force range.



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- **Protective Features:** Integrated safeguards prevent overload and lateral force damage to ensure long-term measurement reliability.
- **Bidirectional Testing Capability:** Supports both tensile and compression testing without hardware reconfiguration.
- **TEDS Auto-Recognition:** IEEE 1451.4-compliant TEDS technology allows automatic load cell identification and setup.
- **Self-Verification and Temperature Range:** Regular self-calibration ensures accuracy within the operational range of -55°C to $+90^{\circ}\text{C}$.

CLOSED-LOOP CONTROL SYSTEM

The TM-EML Series D employs an intelligent closed-loop controller designed for real-time responsiveness, high precision, and adaptive performance across complex test scenarios.

- **Advanced PID Control Algorithm:** Optimized for the direct-drive system, ensuring consistent behavior across diverse material types and strain rates.
- **Smooth Control Transition:** Maintains precision at very low speeds for creep, relaxation, and cyclic testing, allowing seamless switching between control modes such as force and displacement.
- **Waveform Generation:** Capable of producing sine and trapezoidal waveform patterns for advanced cyclic and fatigue testing applications.
- **Multi-Channel Data Acquisition:** Includes six synchronized 24-bit analog channels and three high-speed digital channels for extensometers, strain gauges, or temperature sensors, with data acquisition up to 4 MHz and 1200 Hz control frequency.

REAL-TIME DATA VISUALIZATION AND ANALYSIS

The software provides continuous visual feedback, meaning that operators can monitor and interpret data effectively during testing.

- **Live Graphing:** Displays force–displacement, stress–strain, and time-dependent curves in real time at a 1200 Hz sampling rate.
- **Comprehensive Analysis Tools:** Features include zooming, panning, scaling, and curve overlay functions for detailed comparative evaluation.
- **Flexible Data Export:** Results and graphs can be exported in CSV, Excel, PDF, PNG, or SVG formats for documentation and external processing.



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INTEGRATED CONTROL INTERFACES

The TM-EML Series D supports multiple control and interaction modes, allowing operators to manage every test function efficiently and safely. Whether used in production, research, or training environments, the system's interface design ensures smooth operation, precise control, and intuitive user interaction.

STANDARD HANDHELD CONTROL CONSOLE

Every TM-EML Series D system includes a compact, magnetically mountable 3.5-inch full-color touchscreen handset that provides direct access to all primary machine functions and test parameters.

- **Ergonomic Design:** Silicone-coated buttons and a fine-resolution rotary control wheel allow precise manual positioning of the crosshead. Operators can jog, return to origin, or fine-tune alignment before specimen clamping.
- **Real-Time System Feedback:** The handset displays live force, displacement, and status updates, minimizing the need to shift focus between the controller and the PC screen.
- **Core Control Functions:**
 - Start/Stop test execution
 - Return-to-home position
 - Manual crosshead jog (up/down)
 - Grip open/close control (when equipped with pneumatic grips)
 - Specimen protection logic to prevent excessive preloading during setup
- **Flexible Communication Modes:** Operates in either direct mode, communicating with the system controller, or PC-synchronized mode, functioning as a secondary interface for software-guided test workflows.

OPTIONAL INDUSTRIAL TOUCHSCREEN PC

An optional industrial-grade all-in-one touchscreen computer can be mounted directly on the load frame, enabling fully standalone operation without an external PC.

- **GenTest™ Software Ready:** The preinstalled GenTest™ software provides access to complete test method libraries, custom sequence configuration, live data visualization, and automated reporting tools.
- **Intuitive Multi-Touch Interface:** The display supports tap, drag, and pinch-to-zoom gestures for direct interaction with test graphs, parameters, and results, simplifying navigation and reducing training time.
- **Industrial Build Quality:** The PC enclosure includes a shock-absorbing housing, sealed surface for dust and moisture resistance, and optional vibration isolation mounts for demanding environments.
- **Expanded Connectivity:** Multiple USB ports allow connection for data export, report printing, barcode readers, or peripheral automation systems.



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GENTEST™ SOFTWARE

The GenTest™ software used in the TM-EML Series D Universal Testing System provides a modern, user-oriented environment for precise control, data processing, and analysis of material tests. Designed for efficiency and adaptability, it integrates all essential tools for standard and customized test execution.

Key features and functions:

- **Comprehensive Standards Library:** Includes preloaded testing methods compliant with ASTM, ISO, GB/T, and EN standards, organized by material and test type.
- **Customizable Test Procedures:** Users can modify existing protocols or create new methods for specific applications.
- **Real-Time Data Display:** Up to 12 configurable data channels with adjustable layout, units, and refresh intervals.
- **Advanced Graphing and Analysis:** Real-time force–displacement and stress–strain curves with interactive zoom, scaling, and comparison features.
- **Automatic Calculations and Reporting:** Instant computation of parameters such as modulus, yield strength, and elongation. Reports and raw data exportable in CSV, Excel, and PDF formats.
- **Accessory Integration:** Seamless communication with extensometers, temperature chambers, and pneumatic grip systems for synchronized testing.
- **Sample Protection and Control:** Automated clamping pressure adjustment and parameter verification minimize the risk of specimen damage.
- **User Interface:** Flat, intuitive design optimized for both horizontal and vertical displays, supporting touchscreen input and voice-guided prompts.
- **Multi-Language and Access Control:** Real-time language switching and tiered permission management for secure operation.



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TECHNICAL SPECIFICATIONS

Model	TM-EML 50-100	TM-EML 200-300	TM-EML 500-600	TM-EML 1000
Force Capacity	11,240 / 22,480 lbf (50 / 100 kN)	44,960 / 67,440 lbf (200 / 300 kN)	112,400 / 134,880 lbf (500 / 600 kN)	224,810 lbf (1000 kN)
Frame Type	Floor-standing			
Test Space	Single-space / Dual-space			
Max Speed	850 mm/min	600 mm/min	330 mm/min	300 mm/min
Min Speed	0.00005 mm/min			
Return Speed	1200 mm/min		500 mm/min	400 mm/min
Position Resolution	0.0095 µm	0.0067 µm	0.011 µm	0.011 µm
Frame Stiffness	270 kN/mm	380 kN/mm	900 kN/mm	1300 kN/mm
Weight	2205 / 2690 lbs (1000 / 1220 kg)	2701 / 3307 lbs (1225 / 1500 kg)	6528 / 7654 lbs (2960 / 3470 kg)	12,082 / 13,621 lbs (5480 / 6180 kg)
Power Supply	2 kW		7 kW	11 kW
Voltage	3-phase AC 220 V ±10 %, 50 Hz / 60 Hz			
Common Parameters				



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Model	TM-EML 50-100	TM-EML 200-300	TM-EML 500-600	TM-EML 1000
Accuracy	Class 0.5			
Force Range	500 N – 1000 kN (0.2% – 100% FS) 10 N – 250 N (0.4% – 100% FS)			
Calibration Standard	GB/T 16825.1, ISO 7500 (Class 0.5), ASTM E4			
Speed Accuracy	±0.2% of set speed			
Position Accuracy	±0.2% of set position			
Force Resolution	1 / 600000 FS			
Extension Resolution	1 / 600000 FS			
Strain Accuracy	Better than GB/T 228, ISO 6892-1, ASTM E8, ASTM E21			
Safety Protection	Overload protection (103% of rated force), position limit, over-voltage protection			
Single-Channel Sampling Rate	Data	1200 Hz		
Control Frequency	1200 Hz			
Environmental and Operational Conditions				
Working Temperature	+5 °C to +40 °C			



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Model	TM-EML 50-100	TM-EML 200-300	TM-EML 500-600	TM-EML 1000
Storage Temperature	-25 °C to +55 °C			
Relative Humidity	At 20 °C, +10% to 90%, non-condensing			
Maximum Operating Altitude	2000 meters			
Motor Type	AC servo motor			
Ball Screw	Pre-loaded			
Position Measurement	Optical encoder			



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DIMENSIONAL SPECIFICATIONS AND DRAWING REFERENCES

Machine dimensions vary depending on the selected capacity. The tables below provide reference values for each configuration of the TM-EML Series D UTM.

TM-EML 50–100 & TM-EML 200–300 Models

Specification	Standard (Single-space)	Standard (Dual-space)	Extended 300 mm (Single-space)	Extended 300 mm (Dual-space)	Extended 600 mm (Single-space)	Extended 600 mm (Dual-space)
Dimensions (W × D × H)	46.3 × 28.0 × 100.4 in (1175 × 710 × 2550 mm)	46.3 × 28.0 × 103.1 in (1175 × 710 × 2620 mm)	46.3 × 28.0 × 112.2 in (1175 × 710 × 2850 mm)	46.3 × 28.0 × 115.0 in (1175 × 710 × 2920 mm)	46.3 × 28.0 × 124.0 in (1175 × 710 × 3150 mm)	46.3 × 28.0 × 126.8 in (1175 × 710 × 3220 mm)
Crosshead Travel (H)	53.1 in (1350 mm)	49.2 in (1250 mm)	65.0 in (1650 mm)	61.0 in (1550 mm)	76.8 in (1950 mm)	72.8 in (1850 mm)
Test Width (W)	23.6 in (600 mm)					
Touchscreen Height (A1)	65.2 in (1655 mm)					



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TM-EML 500–600 Models

Specification	Standard (Single-space)	Standard (Dual-space)	Extended 300 mm (Single-space)	Extended 300 mm (Dual-space)
Dimensions (W × D × H)	56.3 × 33.5 × 108.7 in (1430 × 850 × 2760 mm)	56.3 × 33.5 × 111.8 in (1430 × 850 × 2840 mm)	56.3 × 33.5 × 120.5 in (1430 × 850 × 3060 mm)	56.3 × 33.5 × 123.6 in (1430 × 850 × 3140 mm)
Crosshead Travel (H)	29.5 in (750 mm)	25.6 in (650 mm)	41.3 in (1050 mm)	37.4 in (950 mm)
Test Width (W)	29.5 in (750 mm)	29.5 in (750 mm)	29.5 in (750 mm)	29.5 in (750 mm)
Touchscreen Height (A1)	90.6 in (2300 mm)	90.6 in (2300 mm)	90.6 in (2300 mm)	90.6 in (2300 mm)

TM-EML 1000 Model

Specification	Standard (Single-space)	Standard (Dual-space)	Extended 300 mm (Single-space)	Extended 300 mm (Dual-space)
Dimensions (W × D × H)	61.8 × 39.4 × 122.0 in (1570 × 1000 × 3100 mm)	61.8 × 39.4 × 128.0 in (1570 × 1000 × 3250 mm)	61.8 × 39.4 × 133.9 in (1570 × 1000 × 3400 mm)	61.8 × 39.4 × 139.8 in (1570 × 1000 × 3550 mm)
Crosshead Travel (H)	19.7 in (500 mm)	35.4 in (900 mm)	31.5 in (800 mm)	23.6 in (600 mm)



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TM-EML 1000 Model

Specification	Standard (Single-space)	Standard (Dual-space)	Extended 300 mm (Single-space)	Extended 300 mm (Dual-space)
Test Width (W)	35.0 in (890 mm)	35.0 in (890 mm)	35.0 in (890 mm)	35.0 in (890 mm)
Touchscreen Height (A1)	96.5 in (2450 mm)	96.5 in (2450 mm)	96.5 in (2450 mm)	96.5 in (2450 mm)

ALIGNMENT DEVICE ADD-ON

The Electro Mechanical Universal Testing System (50kN – 1000kN / 11,200lbf - 224,800lbf) by TensileMill CNC can be improved with a special alignment device that will help you meet the meticulous demands of modern testing laboratories. To enhance your testing capabilities and achieve NADCAP readiness, we offer a specialized alignment fixture designed to optimize equipment performance.

This advanced fixture allows for fine-tuning the coaxiality of our testing system. After an initial coarse adjustment, our high-precision coaxiality meter and detection system help achieve a coaxiality of $\leq 5\%$, ensuring compliance with ASTM E1012 and NASM 1312B standards - key requirements for NADCAP accreditation.

Key Features:

- **Precision Alignment:** Minimizes errors for more consistent results.
- **Multi-Purpose Use:** Suitable for tensile, compression, bending, and shearing tests.
- **Enhanced Reliability:** Delivers accurate and repeatable test outcomes.

Integrating this alignment fixture with the TensileMill CNC Universal Testing System gets your lab / business [NADCAP](#) ready. This ensures the highest level of compliance, accuracy, and performance available today.



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