

## Triaxial Accessories for Rock Mechanics Testing

Replicate in situ conditions with exceptional accuracy

### Triaxial testing solutions

- » Triaxial cells
- » Confining pressure intensifiers
- » High-temperature controls
- » In-vessel load cells
- » In-vessel extensometers
- » Pore pressure intensifiers
- » Ultrasonic Velocity equipment packages

Geomechanical testing experts use MTS Model 815 and 816 Rock Mechanics Test Systems to test all types of rock in a wide variety of applications. One of the more challenging applications is triaxial testing, which aims to accurately recreate high confining pressures, high temperatures, high pore fluid pressures, and a wide range of stress states.

For these applications, MTS offers triaxial testing assemblies that can be integrated within a rock testing system to create a complete triaxial testing solution. These assemblies include

triaxial cells, a type of pressure vessel, along with a wide array of in-vessel accessories designed to withstand extreme conditions.

- » Like all MTS products, triaxial accessories for geomechanical testing incorporate proven, high-quality components that are designed to meet rigorous industry standards and optimized to improve both the quality and efficiency of rock testing.

## Characterize Rock Specimens in Natural States

Triaxial test assemblies from MTS accommodate a wide range of specimen dimensions and pressure ratings. To create a system for your specific application, choose a triaxial cell that accommodates specimen dimensions (with instrumentation attached) and features a confining pressure rating that matches the pressures of the specimen's actual environment. Then add triaxial testing

accessories according to your application needs. Some accessories, such as the temperature control package, should be added to the base system at the time of manufacture. Others, such as in-vessel load cells, in-vessel extensometers and pore pressure intensifiers, are easily installed in your lab.

### Model 656 Series Triaxial Cells

The core of the triaxial cell assembly is the triaxial cell itself. Series 656 Triaxial Cells are fully compatible with the MTS Model 815 and 816 systems. Features include:

- » 140 MPa (20,000 psi) confining pressures, available with optional high-temp control package
- » 200 MPa (30,000 psi) available at ambient temperature only
- » In-vessel spherical seat standard with select platen configurations
- » Up to 20 feedthroughs for in-vessel measurement and control
- » Track and carriage assembly for easy removal and storage
- » Integrated hydraulic lifts that raise and lower the triaxial cell on MTS Model 815 systems
- » Optional Hastelloy® feedthroughs, tubing, and end caps for corrosive pore fluids

### Confining pressure intensifier

The confining pressure intensifier provides closed-loop control of the confining pressure on the specimen. FlexTest® digital controls precisely manage a servovalve mounted on the intensifier. Features include:

- » Console mounting for safe operation
- » Control panel with intuitive valve schematic
- » Pressure transducer and Temposonics® displacement transducer
- » Integration with FlexTest digital controls
- » Transparent reservoir for checking fluid level and condition
- » Integrated air pump for filling and draining

### High-temperature control package

This package allows test engineers to monitor and control temperature inside the triaxial cell. It uses a cascade control concept, where the output of one controller is used as the command signal to a second. The package includes heater bands and heater cartridges, which are attached to the triaxial cell assembly. Multiple thermocouples inside the vessel and attached to the specimen are connected to an outer loop feedback circuit for control, and also to a temperature display panel for monitoring temperature gradient, signal conditioning and data acquisition.

Display modules accept thermocouple input and provide analog output with +/- 0.5°C accuracy. The package stores maximum and minimum temperature levels, takes up to 12 samples per second at 60 Hz (or 11 samples per second at 50 Hz), and displays up to six digits. The entire package includes:

- » Temperature capability to 200°C (400°F)
- » Multiple thermocouples for monitoring temperature gradient in vessel
- » External heater bands
- » Lower platen heater cartridges
- » Cell assembly insulation shroud
- » Ceramic insulation plate
- » Temperature display panel, which holds up to three programmable display modules
- » Heater power distribution box with over-temperature protection
- » Cables



Triaxial cell assemblies help simulate in situ stresses, temperatures and pore fluid pressures.

### In-vessel load cells

MTS in-vessel strain-gaged load cells provide a direct reading of the axial force applied to the specimen, minimizing potential errors due to seal friction and pressure area effects. Maximum operating pressure is 140 MPa (20,000 psi) and maximum operating temperature is 200°C (400°F). These load cells are compatible with approved mineral and synthetic oil confining fluids. Features include:

- » Robust design for high-pressure and high-temperature environments
- » Single- or dual-bridge wiring
- » Compact design for easy installation

### In-vessel extensometers

MTS in-vessel extensometers measure strains on specimens at high pressures and temperatures. They provide outstanding accuracy, control and durability, and are ideal for all types of testing, including uniaxial compression-tension, hydrostatic compression, triaxial stress, calculated variable strain control, extension testing and thermal expansion.

MTS axial testing extensometers clip onto specimens to measure strain over clearly defined gage lengths and avoid specimen-platen interactions. Configurations include single-bridge with single output and dual-bridge with dual outputs measuring strain at points 180° apart on the specimen. Outputs from dual-bridge extensometers can be recorded separately or averaged.

MTS circumferential extensometers feature a unique stainless-steel roller chain for low hysteresis and high repeatability. These extensometers measure circumferential strain deformation that diametral extensometers can miss when local “slabbing” of the specimen occurs. Chain rollers and offset links can be added or removed in increments of 6.35 mm (0.25 in) to accommodate a variety of specimen diameters, and a zero adjustment pin allows fine-tuning.

MTS axial extensometers can be mounted simultaneously with circumferential extensometers in all MTS triaxial cells.

All MTS in-vessel extensometers deliver:

- » Exceptional accuracy and stability
- » Temperature compensation over a wide range of operating temperatures
- » Fast easy installation and removal
- » Heat-shrink Teflon® or thin Viton® jackets to minimize jacket effects
- » Rugged design that withstands extreme conditions

### Pore pressure intensifier

The pore pressure intensifier is used to saturate jacketed specimens, pressurize and control pore fluid in the specimen, and allow for permeability measurements. It is mounted in a console, where a diagram on the control panel indicates the function of each valve. FlexTest digital controls operate a servovalve mounted on the intensifier manifold. Together, a pressure transducer and integrated Temposonics displacement transducer provide feedback for control, allowing the intensifier to be operated in stroke control, which is proportional to volume, or in pressure control.

The intensifier assembly uses a single-ended actuator with unequal piston areas. Fluid pressurized by the intensifier is applied to one or both ends of the specimen. Operators can perform drained and undrained tests, and the Temposonics displacement transducer allows calculation of the pore fluid flow rate.

A Transient Permeability pore pressure intensifier is also available to measure the permeability of the specimen by raising each end of the specimen to a different pressure and measuring the pressure decay of the two ends over time. Features of these intensifiers include:

- » Console mounting for safe operation
- » Intuitive valve diagram for easy control of fluid
- » Pressure and displacement transducers for closed-loop servocontrol
- » Integration with FlexTest digital controls
- » Transparent reservoir for easy monitoring of fluid level and condition
- » Optional design for corrosive pore fluids

### Ultrasonic Velocity Test Solution

The MTS Ultrasonic Velocity Test Solution measures dynamic elastic properties of core samples under changing stress states. It enables detailed characterizations of specimens, yielding insight into porosity, permeability, grain structure, deformational stress and other attributes. The solution includes state-of-the-art platen hardware, application software and electronics for control and data acquisition. These components are engineered to deliver accurate, dependable performance in triaxial test applications at temperatures up to 120°C (248°F) and pressures up to 140 MPa (20,000 psi). The entire solution allows test engineers to:

- » Calculate dynamic Young’s modulus, shear modulus and Poisson’s ratio
- » Enhance materials testing flexibility
- » Improve predictions of overall rock mass properties



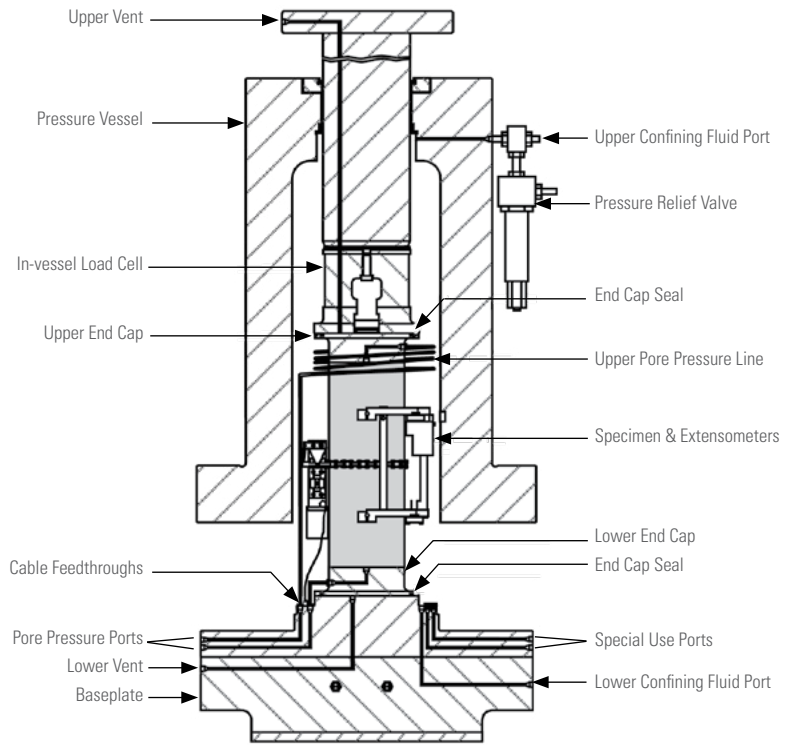
The Ultrasonic Velocity triaxial platens propagate a compression wave and two orthogonal shear waves along the longitudinal axis of the core sample. The system then measures the time of flight through the specimen, calculating dynamic elastic properties that can be compared to static properties collected using traditional techniques.

Take full advantage of MTS expertise

Triaxial test applications require the complex integration of a rock mechanics test system, triaxial cell and accessories. MTS has extensive experience implementing these challenging test configurations in both standard and fully customized systems, and we understand the critical issues related to system integration. Our field engineers can help ensure all components are optimized for your application, which facilitates precise control and accurate measurement, and also helps reduce risk and increase confidence in results.

Learn more today

Contact your MTS representative to learn more about how MTS Triaxial Accessories for Rock Mechanics Testing can optimize your testing program.



Typical Triaxial Cell Assembly  
(Model 656.06 assembly shown)

Specifications for MTS Series 656 Triaxial Cells\*

Model	656.04	656.05	656.06	656.11	656.12
Maximum confining/pore pressure	80 MPa (12,000 psi)	140 MPa (20,000 psi)	140 MPa (20,000 psi)	70 MPa (10,000 psi)	140 MPa (20,000 psi)
Inside diameter	190 mm (7.5 in)	165 mm (6.5 in)	190 mm (7.5 in)	140 mm (5.5 in)	140 mm (5.5 in)
Maximum specimen diameter	102 mm (4 in)	54 mm (2.125 in)	102 mm (4 in)	54 mm (2.125 in)	54 mm (2.125 in)
Maximum operating temperature	200°C (400°F)	200°C (400°F)	200°C (400°F)	175°C (347°F)	175°C (347°F)
Use Load Frame Model	315.0X	315.04	315.04	316.0X	316.0X
Extension Testing Capacity	Yes	Yes	Yes	No	No

\*Contact MTS for the 200 MPa (30,000 psi) Triaxial Cell specifications and configuration options.



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 100-213-762a TriaxialAccessories • Printed in U.S.A. • 08/23