TTC-series TRUE TRIAXIAL CELL

APPLICATIONS

- **Realistic simulation of in-situ anisotropic stress conditions**
- **Independent control of three principal stresses (X, Y, Z)**
- **High stress capacity for testing strong rock materials**
- **Advanced monitoring capabilities (strain, ultrasonic waves, acoustic emission)**
- **Capability to perform hydraulic fracturing tests under controlled true triaxial stress conditions**

DESCRIPTION

The TTC-series true triaxial compression cell is specifically engineered for testing cubic rock specimens It provides fully independent control of the three principal stresses along the X, Y, and Z axes, enabling accurate reproduction of complex anisotropic stress states representative of in-situ geological conditions. The system can generate very high loads, reaching stress levels of up to 400 MPa along the Z axis for a 50 mm cubic specimen. This allows highly differential stress configurations, for example 400 MPa along the Z-axis while maintaining 70 MPa along the X and Y axes, thereby simulating realistic stress anisotropy encountered at depth. An optional temperature control system allows simulation of deep subsurface environments, while standard tests may also be conducted at ambient laboratory temperature. In summary, the TTC cell enables precise measurement and control of principal stresses in three orthogonal directions, continuous monitoring of strain and deformation behavior, and accurate identification of the specimen's peak strength and failure conditions under true triaxial loading. Optionally, acoustic transducers can be mounted on opposite faces of the cubic specimen to measure compressional P-waves and orthogonal shear waves S_1 and S_2 along the three principal axes (X, Y, Z). The P-wave propagates through volumetric compression and is mainly controlled by the bulk modulus and confining stress. S_1 and S_2 propagate through shear deformation in perpendicular polarizations. Under true triaxial stress, differences between S_1 and S_2 indicate stress-induced anisotropy and directional damage. Increasing confining stress closes microcracks, raising P- and S-wave velocities, whereas crack initiation and growth near peak stress reduce velocities, reflecting stiffness degradation. Continuous monitoring of P, S_1, and S_2 waves enables the evaluation of elastic moduli evolution, the early detection of microcrack initiation prior to macroscopic failure, the quantification of stress-induced anisotropy, and the tracking of stiffness degradation and damage progression. As a second optional feature, the true triaxial cell can perform hydraulic fracturing tests. A borehole is drilled into the specimen, and fluid is injected at increasing pressure while independent principal stresses are applied. When fluid pressure exceeds tensile strength and confining stresses, fractures initiate and propagate. Breakdown pressure and fracture behavior can be determined. Fracture development is monitored in real time using acoustic emission (AE) sensors, which detect high-frequency waves from crack initiation and growth, allowing characterization of fracture networks under true triaxial conditions.

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FEATURES

Specimen diameter	Type 1: 1.5 x 1.5 x 3 inches
	Type 2: 50 x 50 x 100 mm
Maximum X stress	70 MPa
Maximum Y stress	70 MPa
Maximum Z stress	Type 1: 400 Mpa
	Type 2: 689 Mpa
Temperature range:	Ambient to 120°C (optional)
Wetted part material:	Stainless steel
Connection ports:	1/8 inch

REQUIRED CONFIGURATION

- Load frame
- Two hydraulic pressure pumps
- True Triaxial cell
- Heating mantle (optional)
- Acoustic velocity system (optional)
- Acoustic Emission system (optional)
- Hydraulic fracking system (optional)

The cell must be installed within a load frame capable of applying up to 1000 kN along the Z-axis, while two independent hydraulic pressure pumps, each rated up to 70 MPa, are used to generate and control the X and Y stresses on the specimen. Strain along each axis is automatically recorded by the computer system using LVDTs (Linear Variable Differential Transformers) mounted on each side of the specimen. Stress along the X axis is measured using a load cell, whereas stresses along the Y and Z axes are determined from the hydraulic pressure generated by the pumps.

Fig. 1 : True triaxial cell mounted within a load frame.

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