AutoLab 2000

AutoLab 2000 is a versatile triaxial apparatus for petrophysical and mechanical rock properties measurements at in situ conditions on specimens as large as 102 mm (4.0 inches) in diameter. The apparatus is customized based on experimental requirements of the customer.

AutoLab 2000 is a complete laboratory system that performs standard rock mechanics tests and facilitates the measurement of coupled processes. Velocity, permeability, and resistivity transducers are designed to accommodate strain instrumentation; measure strain and compressional and shear wave velocities to compare static and dynamic elastic moduli; relate changes in permeability to stress induced anisotropy; or correlate electrical resistivity with pore volume compression. AutoLab software acquires these data while simultaneously controlling the loading paths. Rapid data reduction and informative reports speed up analysis.

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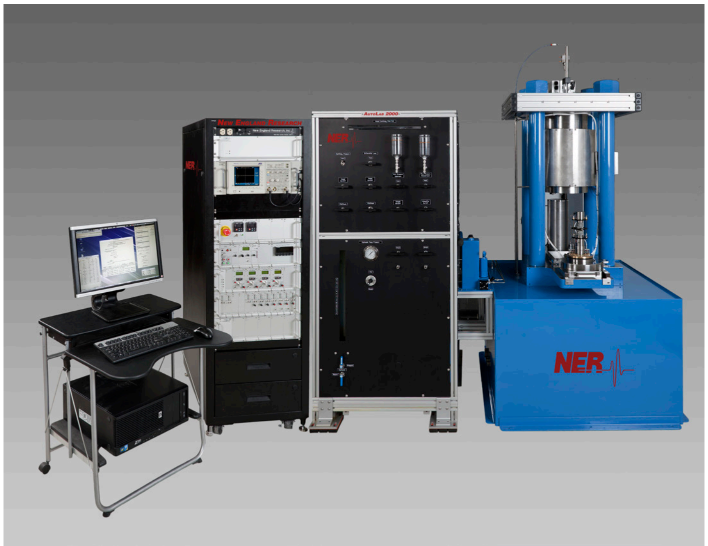

Key Features

- Deformation experiments for conventional and specialized loading paths
- Pore volume compressibility
- Servo-hydraulic control of strain rate, force, confining pressure, pore pressure, and flow rate
- Pore pressure intensifier compatible with water, brine, oil, and gas (including CO2)
- Strain measurement with either LVDTs or strain gauges,
- Reservoir temperatures and pressures,
- Integrated electronics console for servo amplifiers and signal conditioning,
- Autolab software for system control and data acquisition.

Coreholders for the System

PS2 Ultrasonic Transducer

These coreholders measure one compressional and two orthogonally polarized shear waves at confining pressures, pore pressures, and temperatures appropriate for each system.

Steady State Permeability

For steady state permeability measurements, a constant pore pressure gradient across the sample is controlled. The pressure difference across the sample and pore fluid flow rate are used to compute permeability. This method requires two pore pressure intensifiers with automated recycling. The standard configuration is designed for permeabilities between 0.1 and 500 millidarcies.

Transient Permeability

Developed at NER, this technique measures fluid permeability at in situ conditions. The method involves the control of a complex transient in pore pressure at the upstream side of the sample while monitoring the pore pressure response at the downstream end. Permeability is computed by fitting the response to analytical solutions.

Low Permeability

Utilizing a special CO_2 holder with a small dead volume and integral pressure transducer, the standard configuration is designed for low permeability materials of 5 nanodarcies to 50 microdarcies. This option use NER's complex transient method for permeability analysis, allowing use of customizable pressure transients as well as more traditional sinusoidal oscillation and pulse decay.

Complex Electrical Impedance (Formation Factor)

Resistivity is measured as a function of frequency, stress, and temperature using both two and true four electrode techniques. NER's ZMeter impedance analysis is used to perform true four electrode measurements at frequencies between 0.02 Hz and 100 kHz.

In addition to measurements listed above, AutoLab 2000 supports a comprehensive suite of experimental protocols. The following applications have been incorporated into previous systems:

- Velocities parallel and normal to the core axis
- Location and number of acoustic emissions associated with specimen damage
- Permeability parallel and normal to the core axis
- Two-phase fluid flow at high flow rates to evaluate sanding potential
- True triaxial loading on prismatic specimens
- Effect of fluid substitutation on the strength of shales

The apparatus is compact and convenient. Many systems generate force parallel to the core axis with a large hydraulic cylinders operating at 21 MPa (3,000 psi). This necessitates a large load frame. NER adopted an alternative approach. A piston divides the pressure vessel into two chambers. The overburden pressure on the rock is developed in the lower chamber. When the pressure in the top chamber is greater, a differential stress is exerted on the specimen. The pressure in each chamber is controlled with high-pressure servo-hydraulic intensifiers. The axial loading operates in force or displacement control. High pressure translates to reduced size for a high capacity unit.

The pressure vessel is a tube with no threaded closures for greater safety at high pressures. The vessel is lowered onto the base pedestal and secured by moving a yoke between the top plate of the loading frame and the top of the pressure vessel. The differential stress, confining pressure, and upstream and downstream pore pressure are generated with four servo-controlled hydraulic intensifiers housed in a separate safety enclosure.