

# AutoLab 1000

# Laboratory System

**AutoLab 1000 is a comprehensive servo-hydraulic system for measurements of compressional and shear wave velocities, permeability, electrical resistivity, pore volume compressibility, and linear compressibility on rock cores at *in situ* overburden pressure, pore pressure, and temperature.**

AutoLab 1000 focuses on precise measurements of elastic, flow, and electrical properties of rock. You can measure static and dynamic bulk modulus simultaneously as a function of effective pressure, correlate changes in permeability with pore volume changes, and determine the effect of overburden pressure and temperature on resistivity. AutoLab software controls the apparatus and continuously acquires data. Rapid data reduction and informative reports encourage the continuous evaluation of the results.



Compressional and shear wave velocities are measured with NER's PS<sup>2</sup> ultrasonic transducer assembly. These assemblies easily measure one compressional and two shear wave velocities at confining pressures to 15,000 psi and pore pressures to 10,000 psi. Rugged core holder assemblies accommodate core diameters to 1.50 inches.

The AutoLab system is designed to allow for both two electrode and two-four electrode resistivity measurements as a function of frequency, effective pressure, and temperature. Routinely, complex resistivity is measured over at frequencies between 0.01 Hz and 500 kHz.

## Key Features

- PS<sup>2</sup> Ultrasonic transducers for compressional and shear wave velocities,
- rock permeability with water or brine,
- formation factor (electrical resistivity),
- strain measurements with strain gages,
- pore volume compressibility,
- measurements at temperatures to 250° F (121° C),
- servo-hydraulic control of confining pressure, pore pressure, and flow rate,
- integrated electronics console for servo- amplifiers and signal conditioning,
- AutoLab software to:
  - control the confining pressure, pore pressure, and measurement sequence,
  - acquire data from each pressure transducer
  - acquire and process compressional and shear waveforms,
  - acquire and processes resistivity as a function of frequency,
  - compute permeability from pressure transients and flow rate,
  - display reports results in a turnkey system.



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Since the system is servo-controlled several unique capabilities are possible. One key technique is a new transient technique for the measurement of permeability. The method involves control of a complex transient and pore pressure at the upstream side of the sample while monitoring the pore pressure response to the downstream side. The permeability is measured by fitting the response to analytical solutions. An important feature of the permeability technique is its short duration (10 seconds) and that it involves only a small perturbation in pore pressure above the mean value. The characteristics are significant advantages over traditional methods.

The high-pressure system consists of a pressure vessel and servo-hydraulic confining and pore pressure intensifiers. Coreholders for velocity, permeability, and resistivity are mounted on cloverleaf closures, which insert in the pressure vessel and lock with a 120° rotation. This design is convenient for routine measurements at normal reservoir pressures and temperatures. An external furnace heats the vessel up to 250° F (121° C).



**AutoLab 1000****Specifications****Pressure Vessel**

Bore Diameter, inches	3.00
Effective Bore Length, inches	10.50
Pressure Rating, psi	15,000

**Confining Pressure Intensification System**

Output Pressure, psi	15,000
Output Volume, cubic inches	8.9
Pressure Transducer Accuracy	+/- 0.5% F.S.

**Pore Pressure Intensification System**

Output Pressure, psi	10,000
Output Volume, cubic inches	1.23
Pressure Transducer Accuracy	+/- 0.5% F.S.
Piston Stroke, inches	4

**Electronics Console**

Servo-amplifiers; NER AutoLab	2
Fail Safe / Emergency Shutdown	1
Signal Conditioning	
Pressure Transducers	3
Strain gages	3
Thermocouple	1
Pulser-Receiver	1
Digital Oscilloscope	1
NER Z meter	1

- **Computer Control and Data Acquisition with AutoLab Software Control**

Confining Pressure
Pore Pressure
Pore Pressure Flow Rate

**Data Acquisition**

A/D 32 channels@12 bits
Compressional and Shear Waveforms
Resistivity
Permeability

**Data Reduction**

P and S Wave Velocity
Permeability

**Hydraulic Power Supply (Axial Piston Pump)**

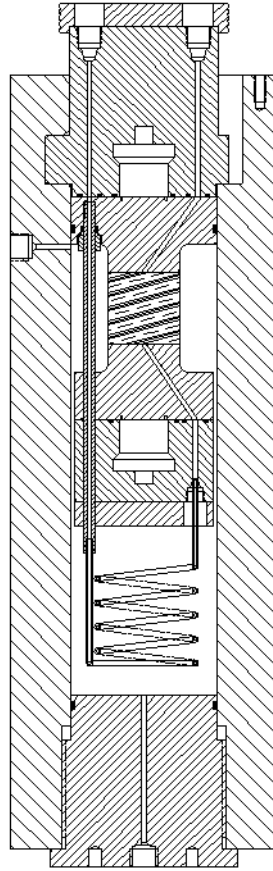
Maximum Operating Pressure, psi	3,000
Reservoir Capacity, gallons	15

\* These specifications are based on a 1.50 inch diameter specimen supporting velocity, permeability, resistivity, and strain measurements. The specifications will vary depending on applications and sample requirements.



# AutoLab 1000

# Schematic



Schematic of AutoLab 1000