



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076

ROCK TRIAXIAL WITH PERMEABILITY TESTING SYSTEM

A triaxial rock testing system shall consist of servo-hydraulic compression load frame, high pressure triaxial cell with exchangeable pressure plates, confining pressure system with automatic pressure and volume control, and complete synchronized control and data acquisition system. Components for testing permeability and hydraulic-fracturing in triaxial set-up must be provided.

Servo-hydraulic Compression load frame:

General Specification:

Stiff 4-column construction designed for standard triaxial closed-loop controlled rock testing

Low friction hydraulic compression cylinder mounted on the bottom plate

Lower compression platen fixed onto piston rod

Rigid crosshead onto columns with compression platens of 150 mm diameter

High quality servo valve for best feedback for stress or strain control

2 x high resolution, high accuracy 50 mm displacement transducer, in the hydraulic cylinder, and on the triaxial cell, +/- 0.001 mm

Deformation under full static load of 1000kN is ≤ 0.33 mm

Integrated stroke transducer

Technical Specifications:

Compression capacity: ≥ 1000 kN

Accuracy 0.05%

Stroke: ≥ 50 mm

Strain rates of 30 down to 0.002 mm/min

Compression platen hardness: 55 HRC

Hydraulic Power pack

Low noise hydraulic power pack with internal gear pump, working pressure 28 MPa

Noise level lower < 59 dba

Heat exchanger (water cooling method), with thermostatic regulation valve for minimum water consumption, emergency button, pressure gauge, max. oil temperature protection (shut down of the system) and motor power indication with electrical safety mode, illuminated bottoms, internal integrated microprocessor for computer controlled pressure ranges

High pressure triaxial cell for cylindrical specimens: It shall be suitable for testing permeability, hydro-fracturing and pore-distribution analysis for pore gas and pore fluids.

General Specification:

Expandable for permeability and hydraulic fracturing test procedures with different diameters

Cell made of corrosion resistant, annealed special steel

Exchangeable end caps for different applications and load pistons for different sample diameters

Couplings for filling/discharging, de-airing of confining pressure cushions

Expandable with strain measuring devices inside the cell

Cell wall closure with only one screw (no multi screw flange type)



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Exchangeable feed-throughs for (coaxial, hydraulic or multi-wire) ≥ 8

Triaxial cell must be temperature resistant up to 150 °C, accuracy: 0.3°C (prepared for temperature control system)

Technical Specifications:

Cell and pore pressure rating: 60 MPa, withstand axial loading : $\geq 1000\text{kN}$

Maximum sample diameter: up to 2 inch

Maximum sample height: up to 4 inch

Cell should have enough inner space to accept submersible local circumferential strain measuring device and in-vessel axial-strain transducer set

Set of adapter platens for True Triaxial cell for permeability tests with spherical seat

Technical Specifications:

Sample size (diameter / length): 2"/4"

Set of seals

Load piston and base adapter with connecting ports for pore pressure and permeability tests

Confining pressure rating: up to 60 MPa

Corrosion resistant stainless steel

Confining Pressure System Control

General Specification:

Integrated limit switches and pressure overload limits (safety stop)

Microprocessor closed-loop control of cell pressure

Fully automatic closed loop control of pressure and water volume through an internal high resolution pressure transducer and displacement transducer

Different modes of pressure control like constant pressure, continuous and step less increasing or decreasing pressure ramps, constant flow rates, constant volume conditions

Pressure panel with high pressure valves and pressure gauge

Fully automatic pressure and volume controller, with servo-hydraulic, double acting actuator, max.

pressure: ≥ 60 MPa, closed-loop control resolution: ≥ 0.001 MPa, pressure accuracy: 0.1 %, volume > 650 ml

Inside the cylinder integrated digital stroke transducer, accuracy 0.001 mm

Volume of intensifier has to pressurize the triaxial cell up to 60 MPa with one stroke

The confining pressure system should be a stand – alone built-in digital real time controller with 20 bit resolution with ethernet interface

Should include high response valve

For better sensor exchange the system must have intelligent programmable sensor plugs with calibration value storage and automatic sensor recognition

Complete Synchronized Control and Data Acquisition System:

General Specification:

High performance controller-system, expandable up to 8 static or dynamic controllers with master/slave function in real time for phase shift control between all controlled axis/actuator



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Close-loop control up to 5 kHz simultaneously for up to 8 control axis in real-time
Seamless transfer between load-, position- and strain control, minimum 20 bit resolution for close-loop control,

Adaptability to analog, digital or incremental transducers via plug-in cards

Communication via ethernet

Digital Controller:

Parallel processing: Optimum distribution of computing capacity and short response time to external events

High system-reliability: Clearly structured system with few highly integrated and easily comprehensible hardware components

Multiple command-value generators

Multiple control and measurement actuator circuit

Synchronization mechanisms for multi actuator applications

High rate of data acquisition

Incremental manual control for setup and operation

Soft- and hardware surveillance and ethernet interfaces

Desired different modules for testing of:

1. Triaxial compression strength test software
2. Rock core creep test software in triaxial compression
3. ISRM rock triaxial compression test software
4. Controlling software for conducting tests to determine fracture toughness according to recommendations of ISRM
5. Modules for calculating permeability as per standard procedures

Computer System requirements:

PC with windows & ethernet ports

Eligibility Criteria: A similar facility must have been supplied and functional in the last three years anywhere in India or abroad.

Technical evaluation: For technical evaluation, supplier would be requested to demonstrate, the operational capabilities of the instrument and the accuracy and precision.

Service Support: Remote assistance with same day response. Telephone/mail assistance when user has sufficient knowledge to attempt small repairs. Maximum onsite response time of 5 working days for both hardware and software related problems. Provide the list of users in India or abroad. Give customer satisfaction reports for service support from at least two users.

Warranty: At least 18 months from the date of commissioning. For free replacement of defective parts, taxes and import duties are to be borne by the supplier.