

Triaxial Cell Rock Mechanics



Triaxial 2653 manufactured in 2014

High Pressure Equipment

10 bar (150psi) to 10000 bar (150000 psi)
-80 °C to 800°C.



- Autoclaves
- Catalysis reactors & pilot plants
- Hydrates studies reactors
- Phase equilibria apparatus
- Pumps (syringe pump, pneumatic pump, gas compressor etc)
- Supercritical fluids
- Corrosion
- Hyperbaric technology
- Geomechanics Triaxial cells (permeability etc)



High Pressure Equipment

10 bar (150psi) to 10000 bar (150000 psi)
-80 °C to 800°C.



Parallel reactors

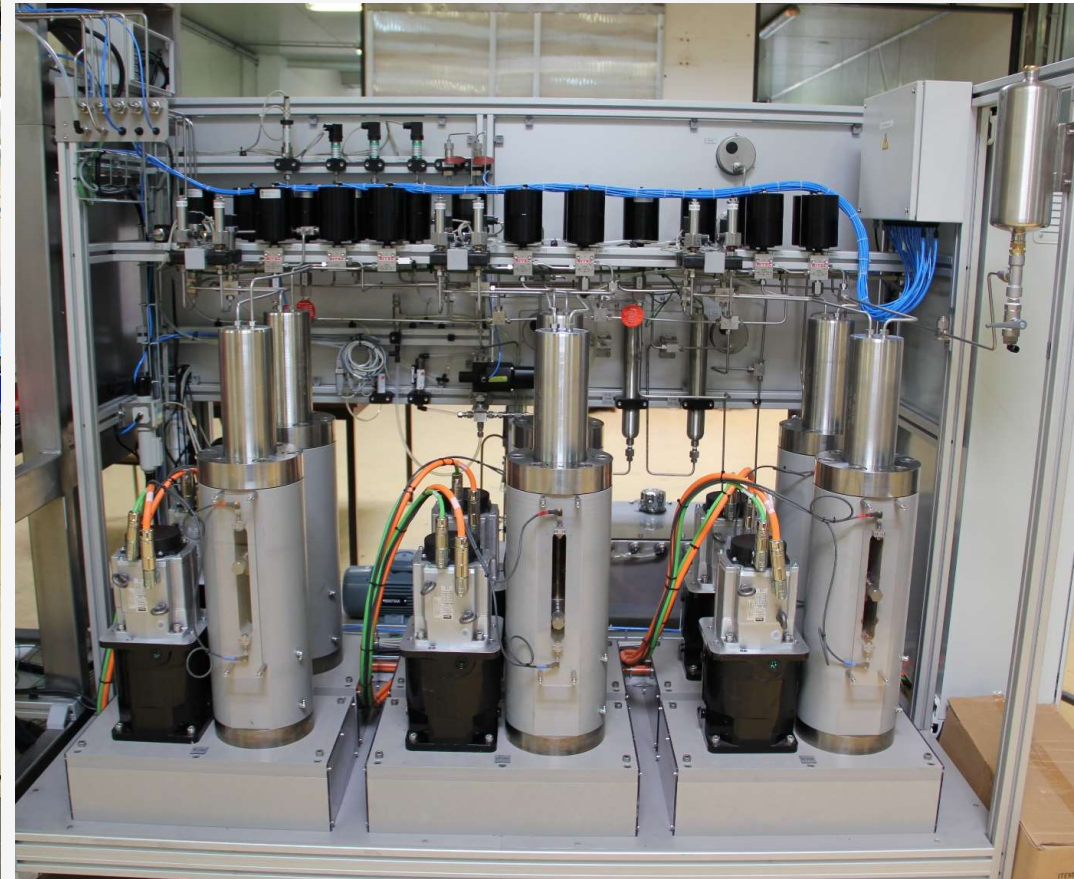


Phase equilibrium apparatus



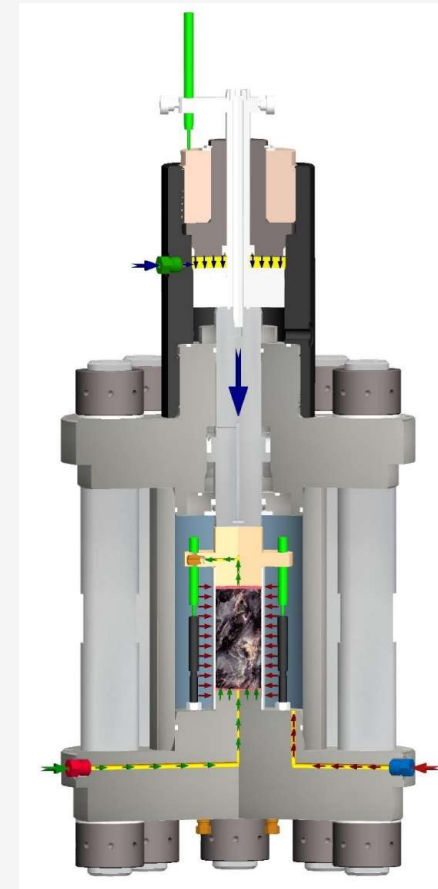
Isostatic press

Overview



Main Characteristics

- Sample diameter : 1 inch to 100 mm
- Confining pressure : up to 2000 bar
- Deviatoric force : up to 2 000 kN
- Pore pressure : up to 2 000 bar
- Liquid or gas draining (CO₂, brine etc...)
- Temperature : -20°C up to 200°C
- Autocompensated



Top Industrie Triaxial Cell for Rock Mechanics



33 projects delivered since 2006
18 projects delivered since 2015

Main customers: EPFL, Sonatrach, BRGM, ENS Paris
China University of Petroleum



Samples from 25,4 up to 100 mm



Triaxial Cell – Rock Mechanics

1000 bar@200 deg C
or
other pressure/temperature

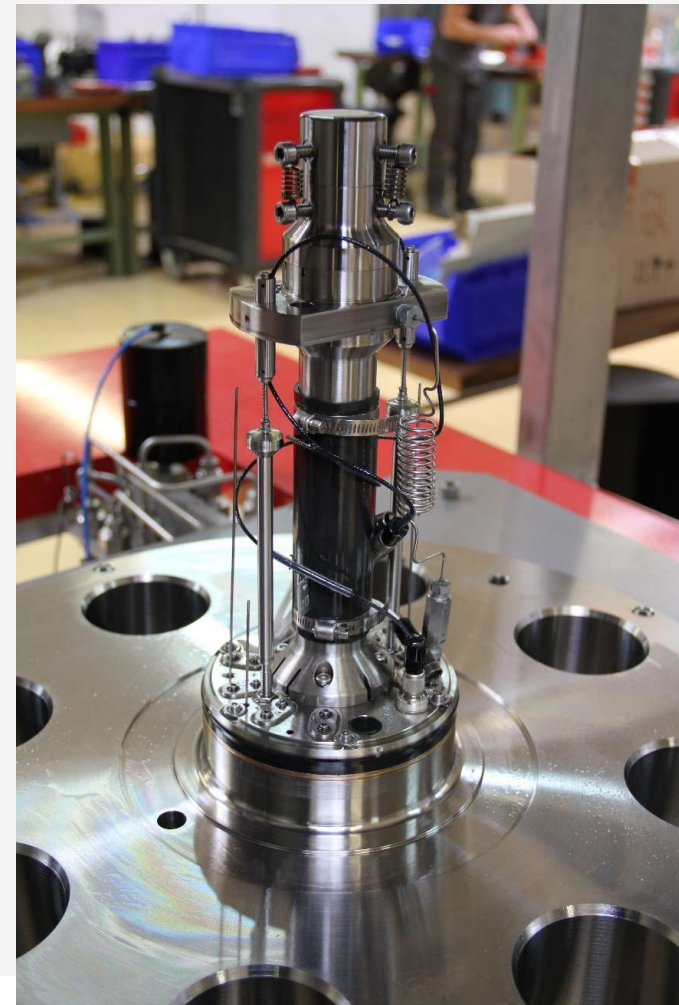
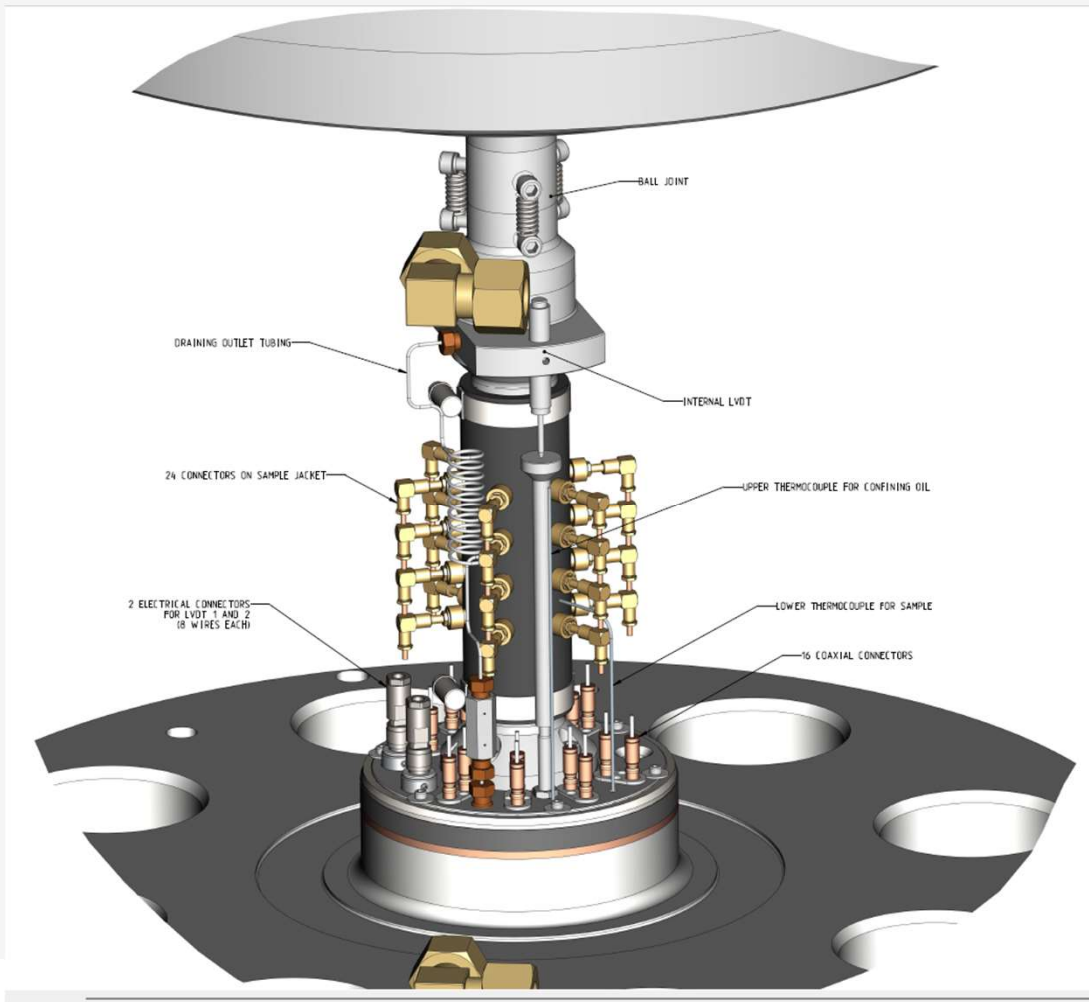


Key Features

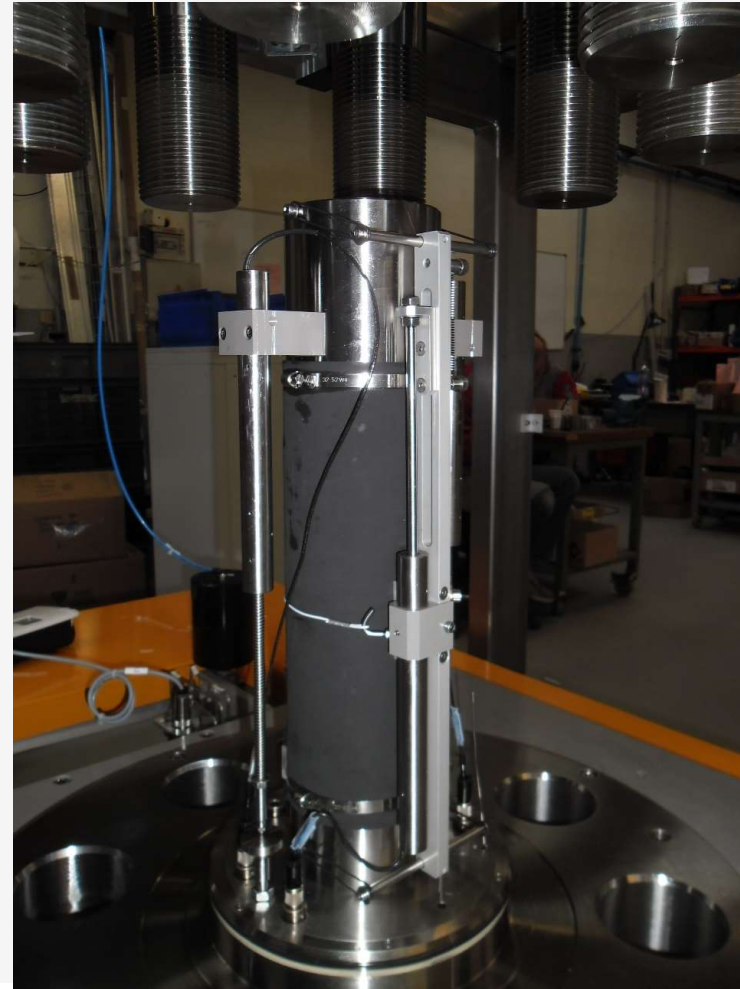
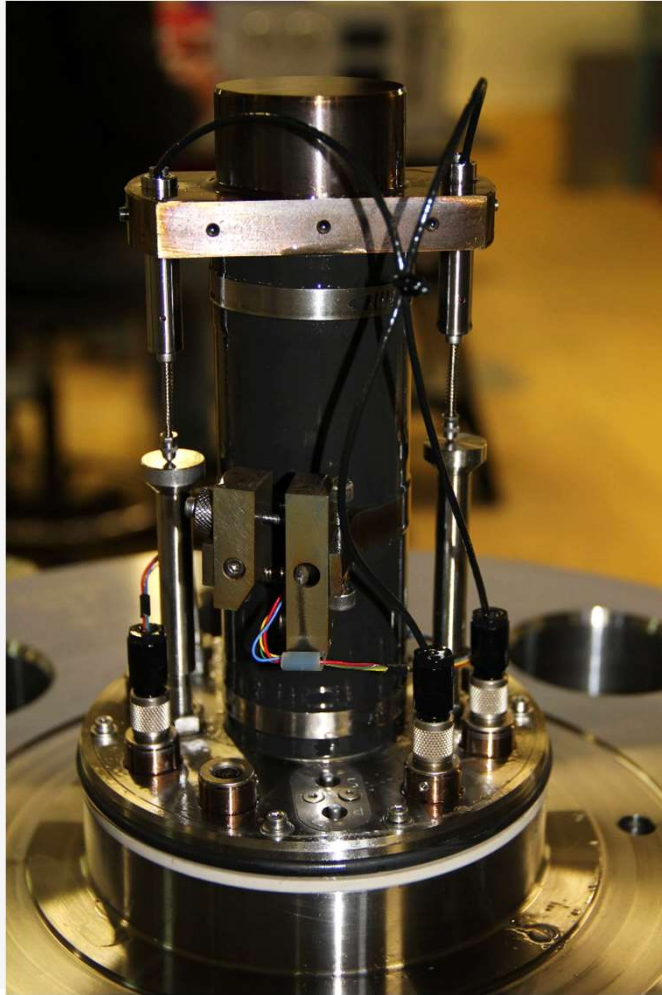


- Latest design - Complete small footprint and compact machine (there is no need to have a vertical press)
- Four syringe pumps for three axis 'pressure' : axial pressure - confining pressure - draining pressure – back pressure
- Flexible machine: the four syringe pumps are independent but can be connected to the deformation sensors (either the 2 LVDT to measure the vertical deformation or the collar to measure the lateral deformation). thus it is possible to make tests where, for instance, you create variations in confining pressure , and adjust the axial pressure to maintain the diameter constant.
- we can have different sample sizes for the same machine. Each size would have it is own tools
- it is possible to include P and S ultrasonic measurement. This can be done either from the beginning or we can create the provision to include that later on.
- Easy operation. When the lower lid is brought down , then the user has an easy access to the sample. You don't have these columns which you find on a press.
- the software includes all features and control such as the four syringe pumps. The software is also able to analyze the post peak situation
- we have around 33 references
- we are flexible regarding the parameters (confining pressure / axial force / sample size / temperature range) and the equipment is customized for the customer

Sample assembly



Sample assembly with 5% and 30% extension meter



Software (SCADA)

PRESENTATION SYNOPSIS GRAPH SEQUENCE PARAMETERS 9

$\sigma 1-\sigma 3$ Bar
3666.9

DIAMETER (mm) 50.00
Calibrate 100.00
length -3.59

P1 (Bar) 449.4
DEVIATORIC 2.00500
SETPOINT P1 0
INIT

P4 (Bar) 0.2
DRAINING OFF 2.02901E-5
0 SETPOINT P4
INIT

P3 (Bar) 0.2
DRAINING 1.66352E-5
SETPOINT P3 0
INIT

P2 (Bar) 388.3
CONFINING -33.89490
0 SETPOINT P2
INIT

F1 ($\mu\text{m/m}$) 20199.999
F2 ($\mu\text{m/m}$) 20199.999
F3 ($\mu\text{m/m}$) 20199.999
F4 ($\mu\text{m/m}$) 20199.999
Extens. (mV/V) 0.822

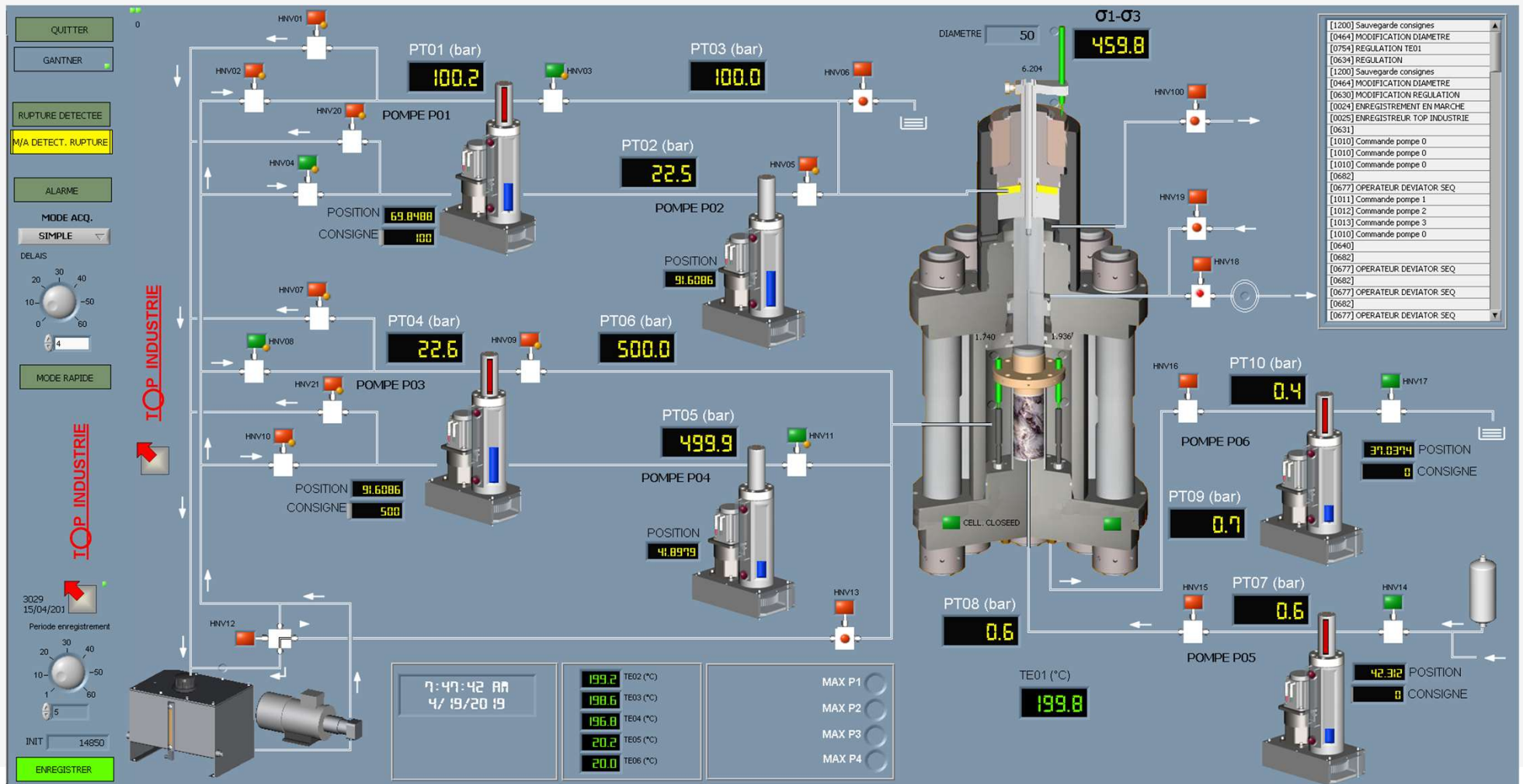
PUMP 1 PUMP 2 PUMP 3 PUMP 4
START
Type of regulation P1 FLOW
SETPOINT P1 0

D1 (mm) 7.771
D2 (mm) 3.718
D3 (mm) 4.167
(D2+D3)/2 3.943
TC01 (°C) 18.5
SETPOINT TC01 0
NO POST PIC
FL(cc/min) -0.027794
Recorder OFF
ALARM
BREAK POINT

Limit Switch P1 - Limit Switch P1 + Pressure high P1
Limit Switch P2 - Limit Switch P2 + Pressure high P2
Limit Switch P3 - Limit Switch P3 + Pressure high P3
Limit Switch P4 - Limit Switch P4 + Pressure high P4

9:58:08 AM
11/9/2020
QUIT

Full automatic triaxial



Programmable test

PRESENTATION SYNOPSIS GRAPH SEQUENCE PARAMETERS 11

SAVE RELOAD START/STOP RAZ LOAD SAVE AS

TOTAL TIME 00:01:00

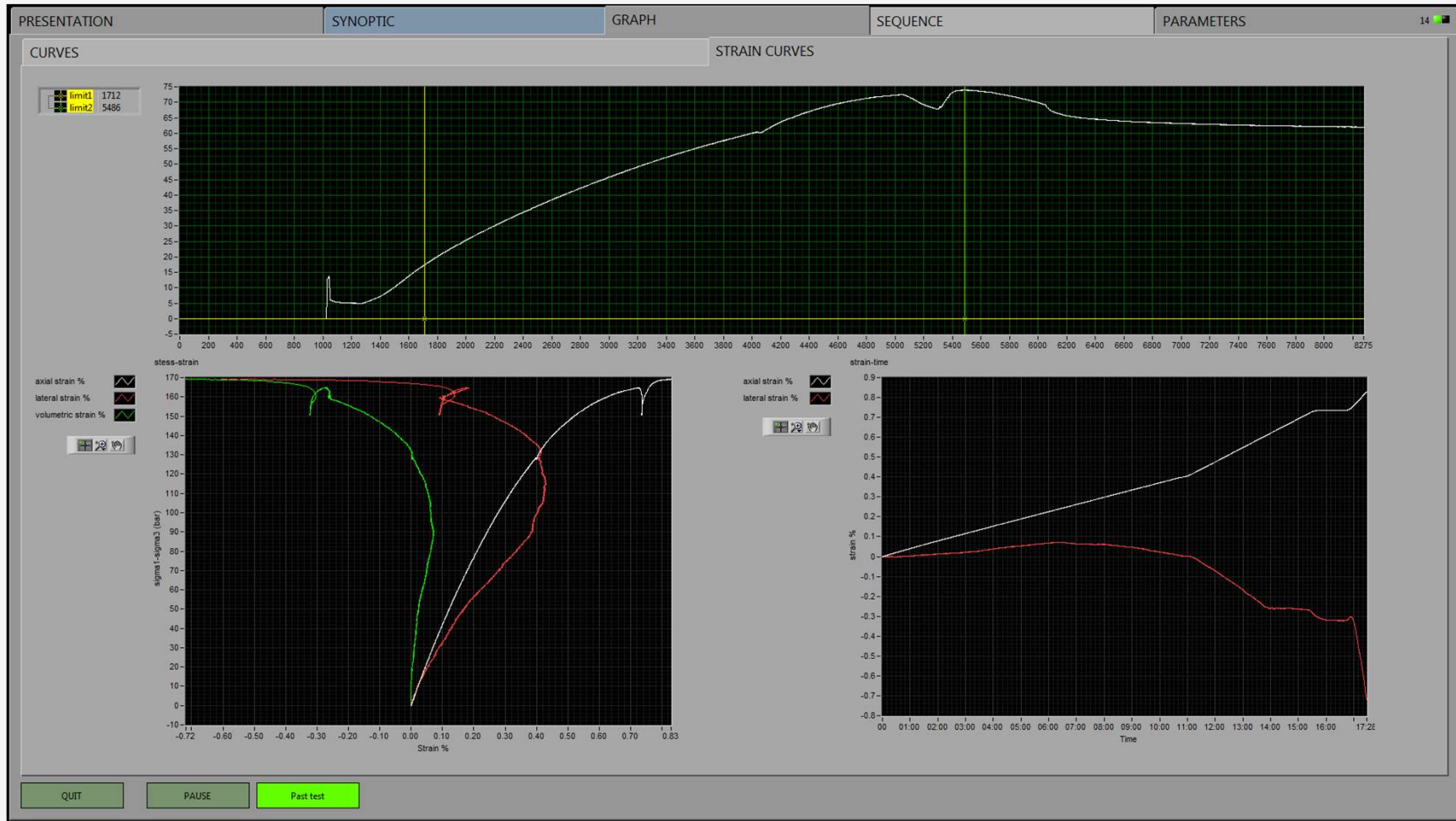
	00:00:30	00:00:30	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
P01	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF
	700	300	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0
P02	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF
	400	600	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0
P03	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF
	220	200	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
P04	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF	P OFF
	160	150	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0
TC01	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF	TE01 OFF
	200	15	21	0	0	0	0	0	0	0	0
	1	2	3	4	5	6	7	8	9	10	11

3. C:\data\sequences.dat

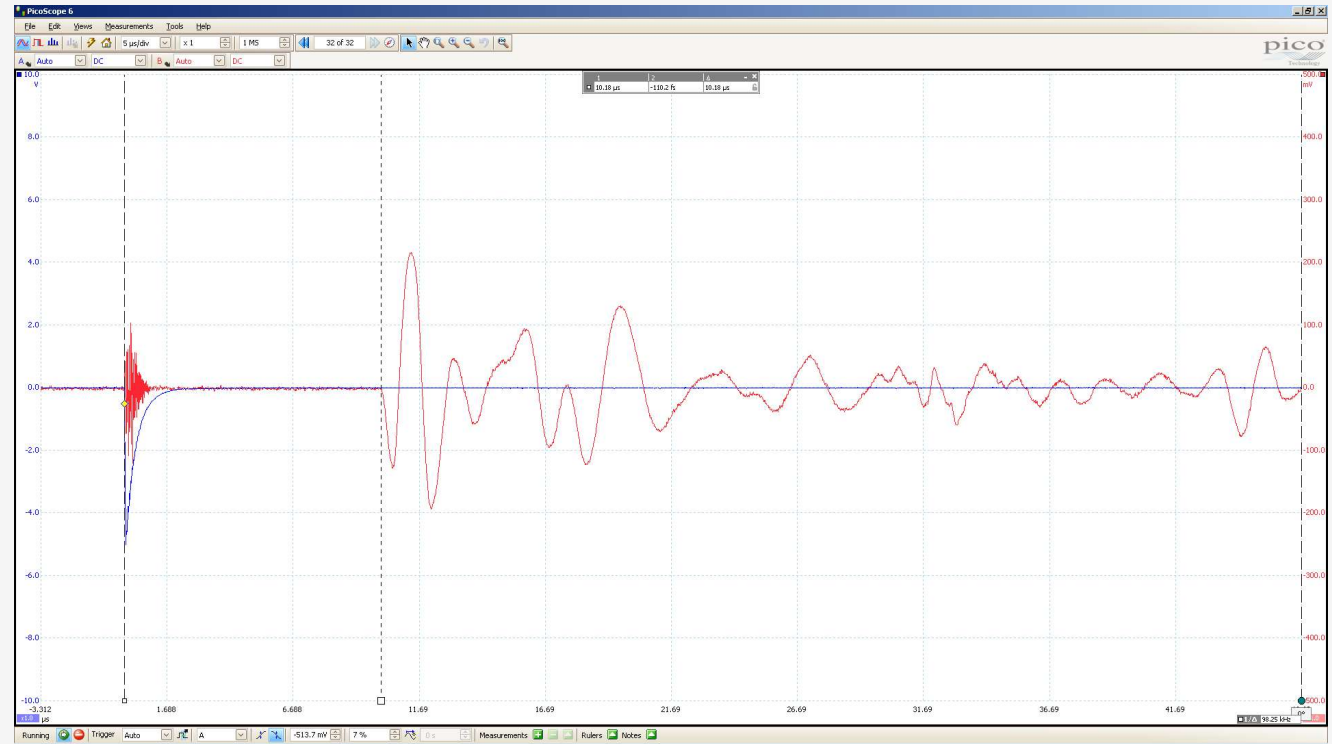
00-10 10-20 20-30 30-40

QUIT

Real time strain graph



Integrated Ultra Sound Velocity measurement (optional)



Main possible studies

- Compression
- Hydrostatique (drained or not)
- Triaxiale
- Permeability
 - Steady state
 - Pulse decay
 - Relative
- Others :
 - Compressibility measurement
 - Hollow cylinder
 - All poro-elastic parameters

