INSTRUCTIONS

MANUAL

AUTOMATIC TRIAXIAL SYSTEM

Model: TT-CU-CD-UU

REFERENCIAL IMAGE

File No.: TEST- V2.3-EN

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- Used to perform large range of Triaxial tests on soil samples to determine the strength parameters and the mechanical properties.
- Capable of performing:
  - Standard Triaxial Tests:
    - UU Test (Unconsolidated Undrained Test)
    - CU Test (Isotropically Consolidated Undrained Test)
    - CD Test (Isotropically Consolidated Drained Test)
  - Wide range of advanced Triaxial tests (ie, K_0 consolidation, and custom stress paths)

- The load cell is installed inside the cell to eliminate the piston friction calculations from the test and provide very precise measurements, which is directly applied on the sample. The water-proof load cell is made completely of stainless steel.

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- The cell is made of high-strength plexiglass specially designed for this particular device with thickness of 10 mm.
- Equipped with 2 PVAs (Pressure-Volume Actuator) which controls and measures both pressure change volume change in the cell and the sample. The PVA is completely controlled from computer with the supplied software.
- The pressure is measured using very precise pressure transducer that sends the data to the equipped acquisition system.
- The acquisition system gathers the data from all the sensors (load cell, pressure transducers, electronic position indicators … etc), analyses it and sends it to the computer via USB.
- The water tank is fitted with a magnetic stirrer to de-air the water before pumping it into the system. Adding this feature significantly reduces the time required to saturate the sample and provide air-free water during the test to the whole system.
- The LCD indicator at the front of the system shows the readings from all the sensors and the position of the PVA pistons with the amount of water left in each one simultaneously.
- The tests are all performed from computer with the help of ALFA's state-of-the-art Triaxial Control software (refer to appendix A for more details).
- The device is supplied with all the required accessories to perform Triaxial Tests, Uniaxial UCS Tests, Permeability Tests, and all the tools for proper sample preparation.

SUPPLIED WITH

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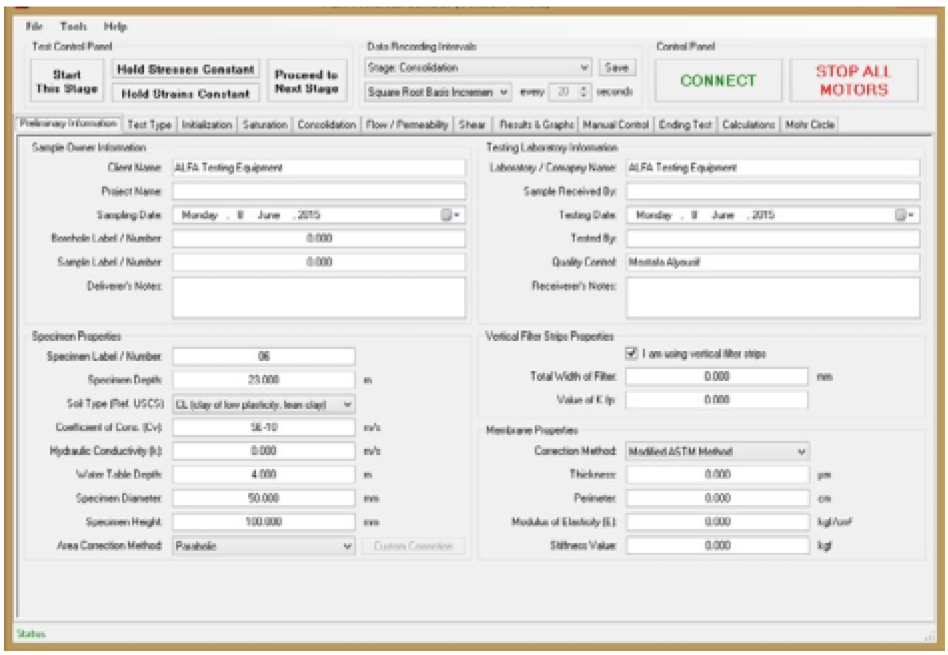
TRIAXIAL SOFTWARE



- The software provides full control consists of different tabs with self-explanatory notes and guides taken from the international standards and based on the findings of reliable researchers and universities in the world.
- Each tab guides the user to what should be done in very simple step-by-step progress. The top part of the software is constant that provides quick access to some important control functions on the software and the machine like proceeding to next stage, changing the data recording method for the report, emergency stop for the machine ... etc.

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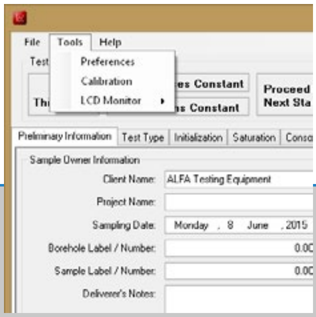
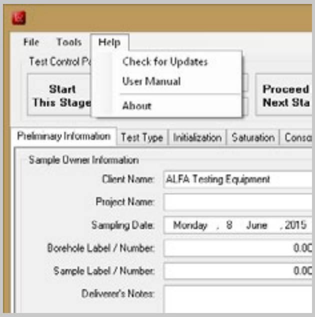
TRIAXIAL SOFTWARE

File Menu		
• Start New Test	Used to start new test from beginning	
• Continue Old Test	Used to continue an old test and merge the data of sets together for comparison	
• Save	Saves the current test	
• Save As	Saves the current test to different file	
• Reporting	Adjust the report settings and what to include in it	
• Data Export	Export the data to third-party applications like Excel	
• Exit	Closes the software	
Tools Menu		
• Preferences	Adjust test preferences like units, connections ... etc	
• Calibration	Perform / check the sensors' calibration	
• LCD Monitor	Turn ON and OFF the LCD monitor	
Help Menu		
• Check for Updates	Check if there is any update available for the software (requires internet connection)	
• User Manual	Views the user manual	
• About	Gives information about the software and its version	

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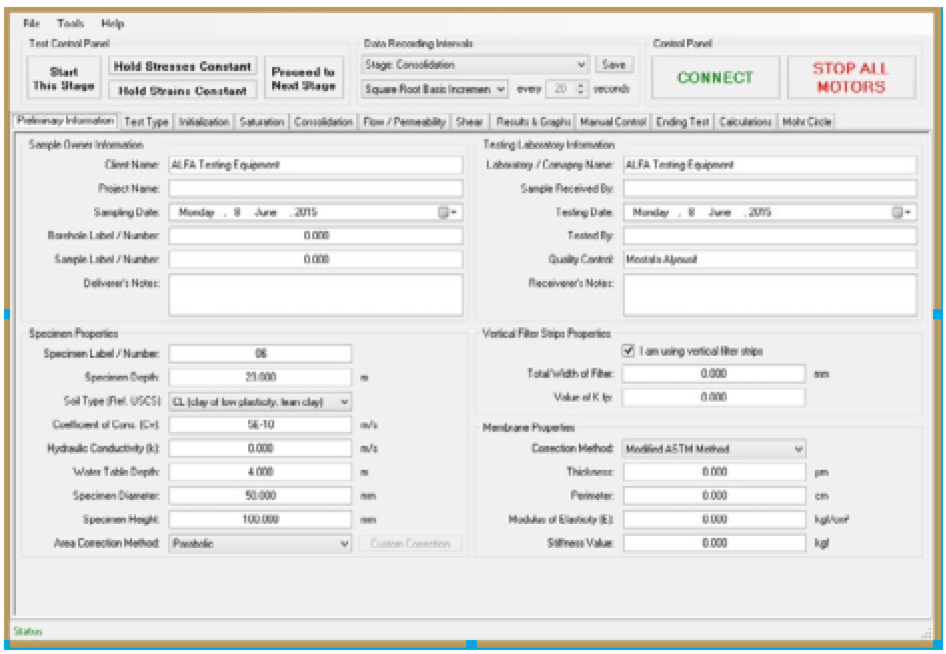
TRIAXIAL SOFTWARE : Preliminary Information Tab



Sample Owner Information:

- To be filled with the sample owner's information. These information are used in the final report.

Testing Laboratory Information:

- To be filled with the testing laboratory or institute's information. These information are used in the final report.

Specimen Properties:

- Specimen number, depth, coefficient of consolidation, water table, soil type, diameter, height, area correction method ... etc are all selected and specified from this section. These information are crucial and to be used in further calculations and to decide the behavior of the equipment based on the sample properties.

Vertical Strips:

- Specifying whether the vertical strips are used or not, with its properties.

Membrane Properties:

- Specify the correction method for the membrane and specify is properties.

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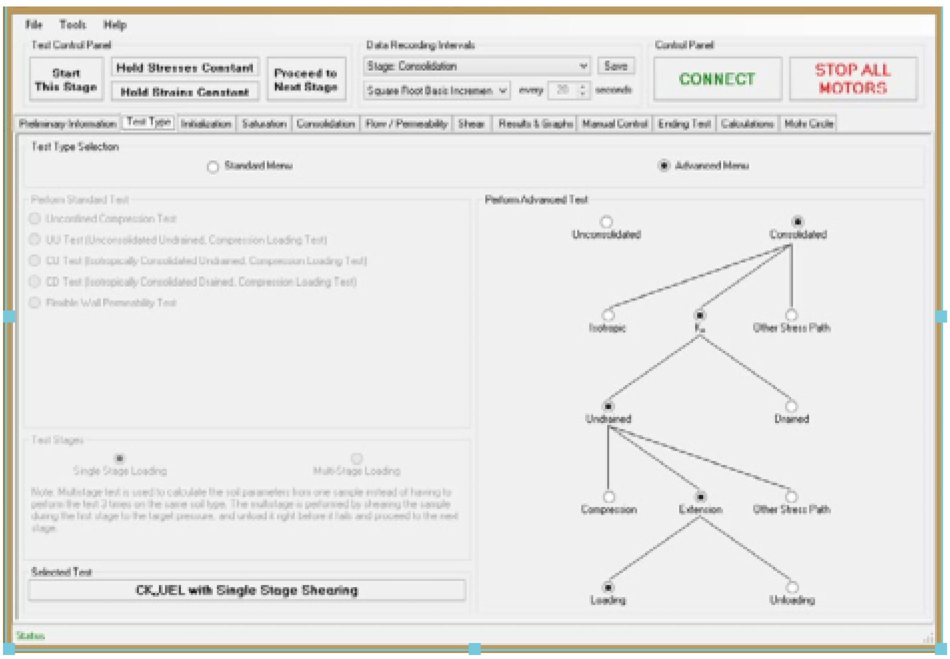
TRIAXIAL SOFTWARE : Test Type Tab



Test Type Selection:

- Select whether to have simplified menu (for standard tests) or advanced menu (for custom tests).

Perform Standard Test:

- Choose the test type from simplified selections.

Perform Advanced Test:

- Choose the test from stage-by-stage selection. This option gives the ability to perform any custom test on the sample from very wide range of functions based on international standards and findings of reliable researchers and institutes.

Test Stages:

- Select between single-stage or multi-stage tests. This option gives the ability to obtain 3 mohr circles and determine the strength parameters from a single Triaxial soil sample.

Selected Test:

- Displays the chosen test type.

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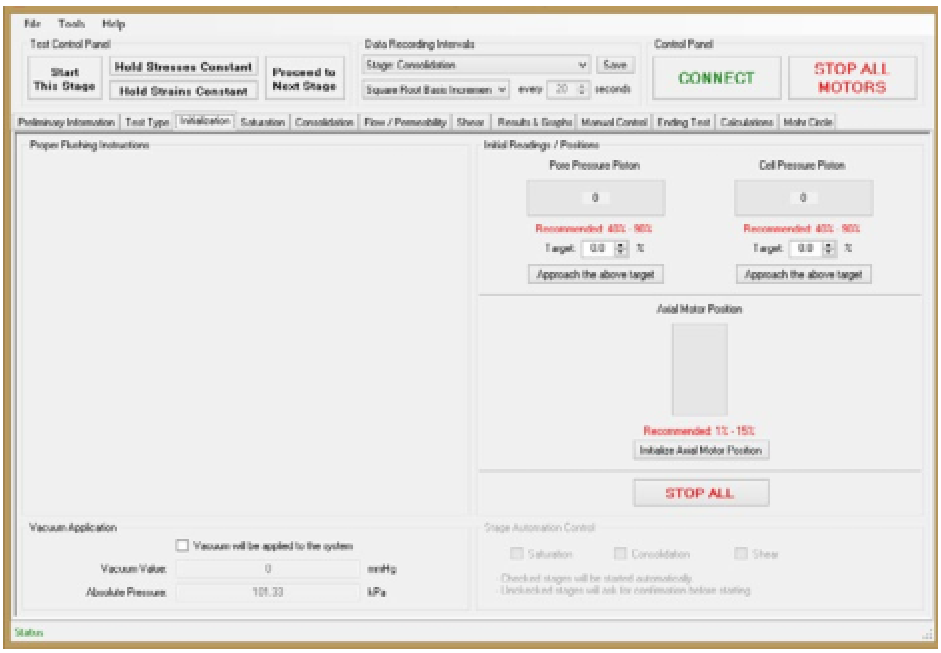
- **TRIAXIAL SOFTWARE : Initialization Tab**



Proper Flushing Instructions:

- Some instructions to perform proper flushing for the setup to avoid having air bubbles left over.

Initial Readings / Positions:

- Shows and controls the initial positions of each piston/motor to avoid over-travelling or running out of water during the test.

Vacuum Application:

- Gives the ability to include the vacuum calculations to the software if applied (used for sand samples).

Stage Automation Control:

- Gives the option to select which stage to start automatically.

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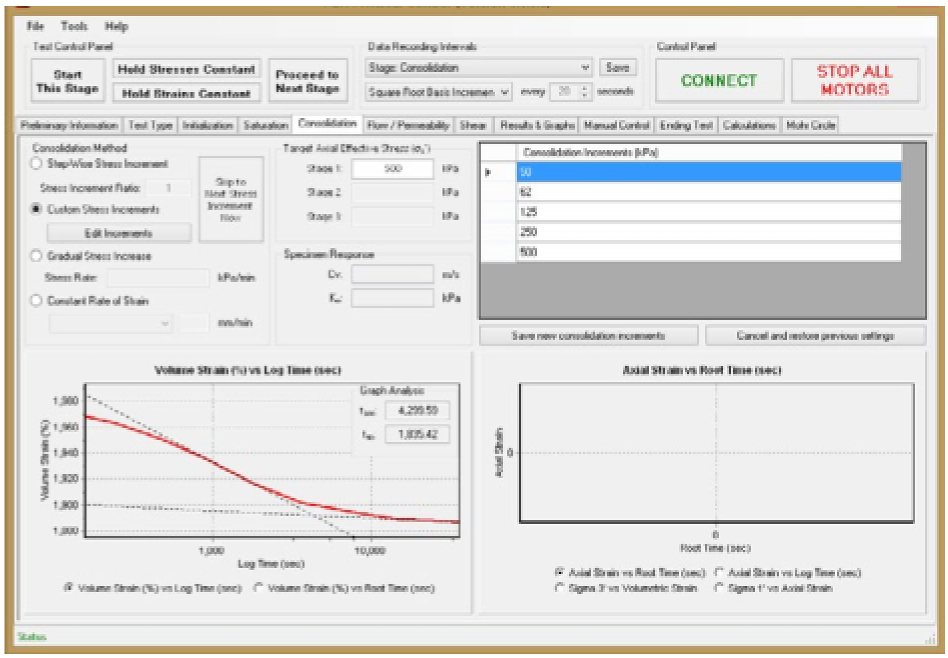
TRIAXIAL SOFTWARE : Consolidation Tab



Consolidation Method:

- Gives the ability to select which method to follow in order to consolidate the sample.

Target Pressures:

- Gives the option to target 3 consolidation pressures in multi-stage mode to obtain the strength parameters from single sample.

Specimen Response:

- Shows the consolidation value and the K0 value.

Graphs:

- Axial Strain vs σ1
- σ3 vs σ1
- Volumetric strain vs time (for t50 and t100 calculations)

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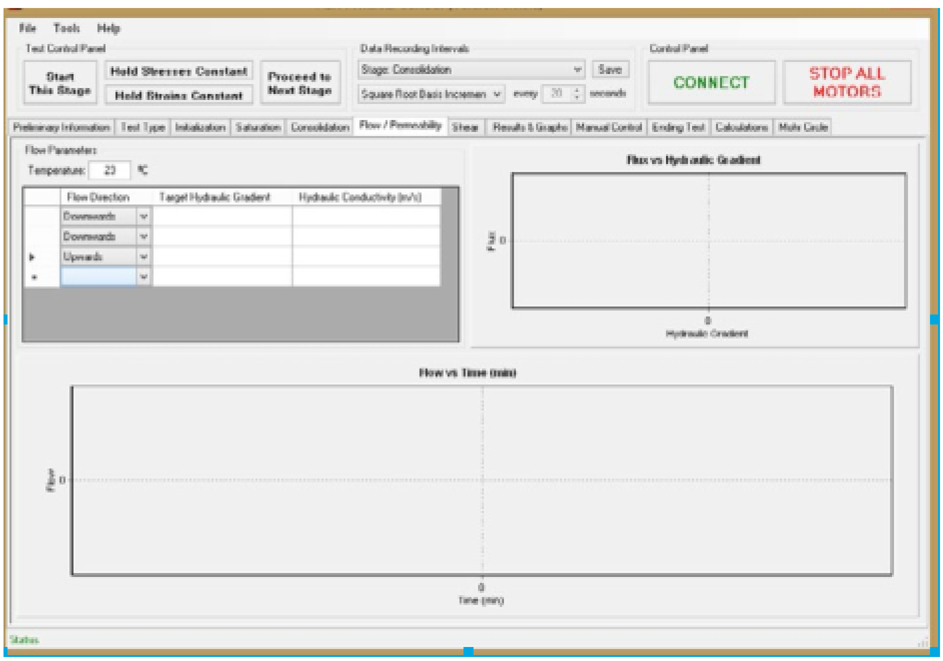
- **TRIAXIAL SOFTWARE : Flow/Permeability Tab**



Flow Parameters:

- Displays the target pressure for each stage and gives the ability to draw any custom path for the sample. The strain rate is also specified in this section.

Graphs:

- Flow vs time
- Flux vs hydraulic gradient

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- **TRIAXIAL SOFTWARE : Results & Graphs Tab**

Readings and Calculations:

- Shows the readings from all the sensors and the calculated values for each parameter simultaneously.

Graphs:

- B-Value vs Pore Water Pressure (kPa)
- a-Value vs Time (hours)
- Volume Change vs Log Time (sec)
- Volume Change vs Root Time (sec)
- Axial Strain vs Log Time (sec)
- Axial Strain vs Root Time (sec)
- Deviator Stress (kPa) vs Axial Strain
- Axial Stress (kPa) vs Axial Strain
- Volumetric Strain vs Axial Strain
- Shear (kPa) vs Total Normal Stress (kPa) (Mohr Circle)
- Shear (kPa) vs Effective Normal Stress (kPa) (Mohr Circle)
- q (kPa) vs p (kPa) (Top of Mohr Circle)
- q (kPa) vs p’ (kPa) (Top of Mohr Circle)
- Deviator Stress (kPa) vs Mean Stress (kPa)
- Deviator Stress (kPa) vs Effective Mean Stress (kPa)
- Pore Pressure (kPa) vs Deviator Stress (kPa)

TRIAXIAL SOFTWARE : Mohr Circle Tab

Mohr Circle

- The software allows the user to combine and compare tests from different samples together in one single report, draw the corresponding mohr circles and calculate the related soil characteristics.

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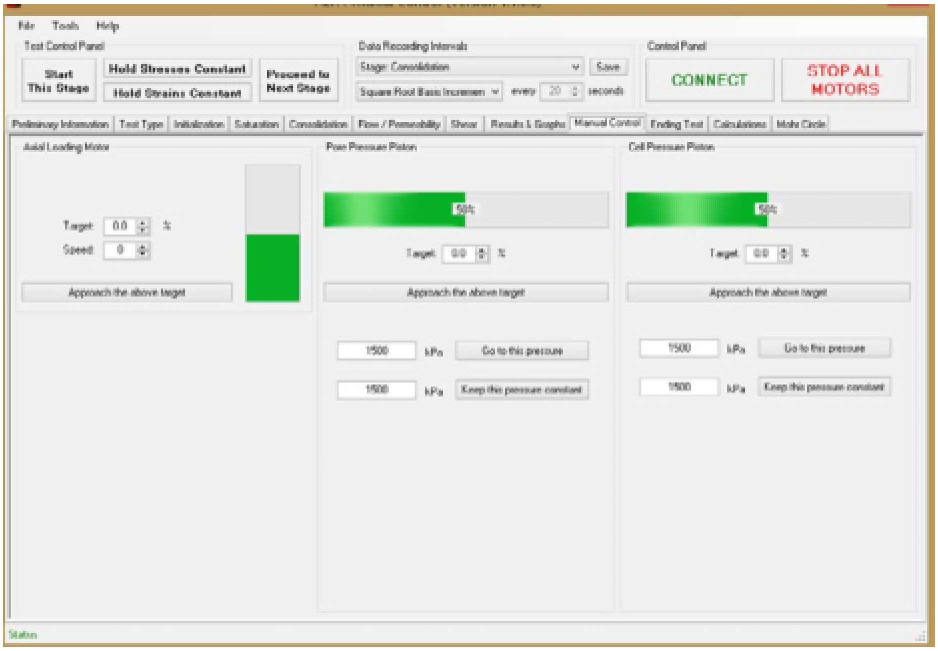
TRIAXIAL SOFTWARE : Manual Control Tab



- Provides manual control on each motor/PVA.

Ending Test Tab:

- Gives instructions on how to end the test properly and empty the cell from water … etc.

<u>**CONTENTS**</u>

Keypad and Display

Setting the Test Speed

Test Speeds are set using the numeric keypad. The position of the decimal point is fixed on the display, and as such does not need to be entered using the Numeric Keypad. To preset a speed of, for example 2.54000 mm/minute, enter 0254 on the numeric keypad. The speed will be entered on the bottom row of the display. After entering the preset speed, press the ENTER (ENT) key to set the Test Speed, which will now be shown on the top row of the display.

The A and B buttons on the keypad may be used to set any speed that is used on a regular basis, such as 1.2mm/minute for CBR or 50.8mm/minute for Marshall tests. To set the button speed enter the digits on the keypad as above and then press either button A or B to store that particular speed to that button.

Speeds in excess of 50.8mm/minute cannot be entered.

Keypad Operation

Press the UP key to start the ram moving upward at the test speed displayed. It will continue moving upward until the upper limit is reached or the STOP key is pressed.

To position the ram quickly, the UP key is held pressed. After 2 seconds, the ram speed will accelerate to 50mm/minute. When the Up key is released, the speed will revert to 5mm/minute.

Press the STOP key to halt ram travel at any time.

Press DOWN to return the ram. It will travel at the last set UP speed and continue until the Lower Limit is reached, or STOP is pressed. To change the DOWN speed, enter a new value using the keypad or press either the A or B button to use a pre-set speed.

Limit Switches

When the Upper limit on the ram assembly is encountered, will stop and will then only permit a DOWN command.

When the Lower limit is encountered, Will stop and only an UP command is permitted.

Remote Address

SL505 includes a 9 way RS232 port to enable computer command and speed setting. All commands are in the form of ASCII characters.

To go UP send the ASCII character "1" .

To go DOWN send the ASCII character "2"

To STOP send the ASCII character "0"

To read the Machine Status send ASCII "?" The SL505 will reply with a single byte to represent the status. Status may be read at any time.

ms bit	*7*	*Ready*	*0= The motor drive is ready*
	6	*Lower Limit*	*0= machine on the lower limit*
	5	*Upper Limit*	*0= machine on the upper limit*
	4	*Spare*	*always 0*
	3	*Gate*	*0= motor running 1= motor stopped*
	2	*Direction*	*0=Down or Stopped. 1= UP*
	1	*Zero current*	*0 ie Motor is energized*
ls bit	*0*	*Microstep*	*1=1,000 steps/rev 0= 10,000 steps/rev*

Speed Control by RS232

To set the Test Speed in the range 0.00001 to 9.99999 mm/min send the 7 ASCII character string "7 n n n n n n" where n is a number 0 to 9.
For example "750342" would set a speed of 5.03421 mm/min

To set speeds in the range 10 to 99 mm/min send "8 n n n n n n".
For example "8600000" sets a speed of 60.0000 mm/min

Speed may be changed while the machine is running. Note that a DOWN command via RS232 will return the machine at the current Test Speed.

Acknowledgement

UP, DOWN and STOP commands are acknowledged by echoing back the ASCII characters sent.

Speed commands echo the 6 ASCII speed numerals when the message is complete, ie after about 20 ms. If the message is incomplete after 50 ms the system times out and no reply is sent. If the 6 character message contains anything other than numerals the message is echoed but the speed remains unchanged

.

Connection is as follows:-	2	Data from AS904
	3	Data to AS904
	5	0 Volts

Specification

Controls	UP, DOWN, STOP, Upper Limit, Lower Limit all contact closures to OV.

Speed Accuracy	+/- 0.5% standard (+/- 30 ppm if required)
Stop condition	Motor energised to defeat back-drive
Speed Display	6 digit LCD with 17.8mm character height. 9
Power Requirement	5 volts at 100ma for the control circuits 35 volts at 2.5 Amps for the Motor

Maintenance

Under normal operation the does not require any special maintenance. All that is required is to ensure that the machine is stored under suitable conditions. Water and excessive humidity can cause oxidation and therefore damage to the machine. Take care that it is not accidentally damaged in any way.

Periodically clean the machine and oil parts that are not painted. Do not use solvents, which may damage the paint and made of synthetic materials.

If the machine is to be stored and not used for any length of time disconnect the electricity supply, oil the parts that are not painted and cover the machine to protect it from dust.

Should you experience any problems with your machine please contact your local distributor head office.

Triaxial Cell

Triaxial Cell Sample Accessories

Cell Construction
Impact's triaxial cells are designed to withstand corrosion, manufactured from aluminium alloy and Perspex. The cell bases are pre-drilled with 4 take-off positions. All cells are fitted with 4 no-volume change valves.

All of our triaxial cells are designed to withstand a working pressure of 1700kPa. The internal height of the cell is sufficient to allow the fitting of submersible load transducer assemblies without any modification.

Triaxial cells are available in 3 sizes as below.

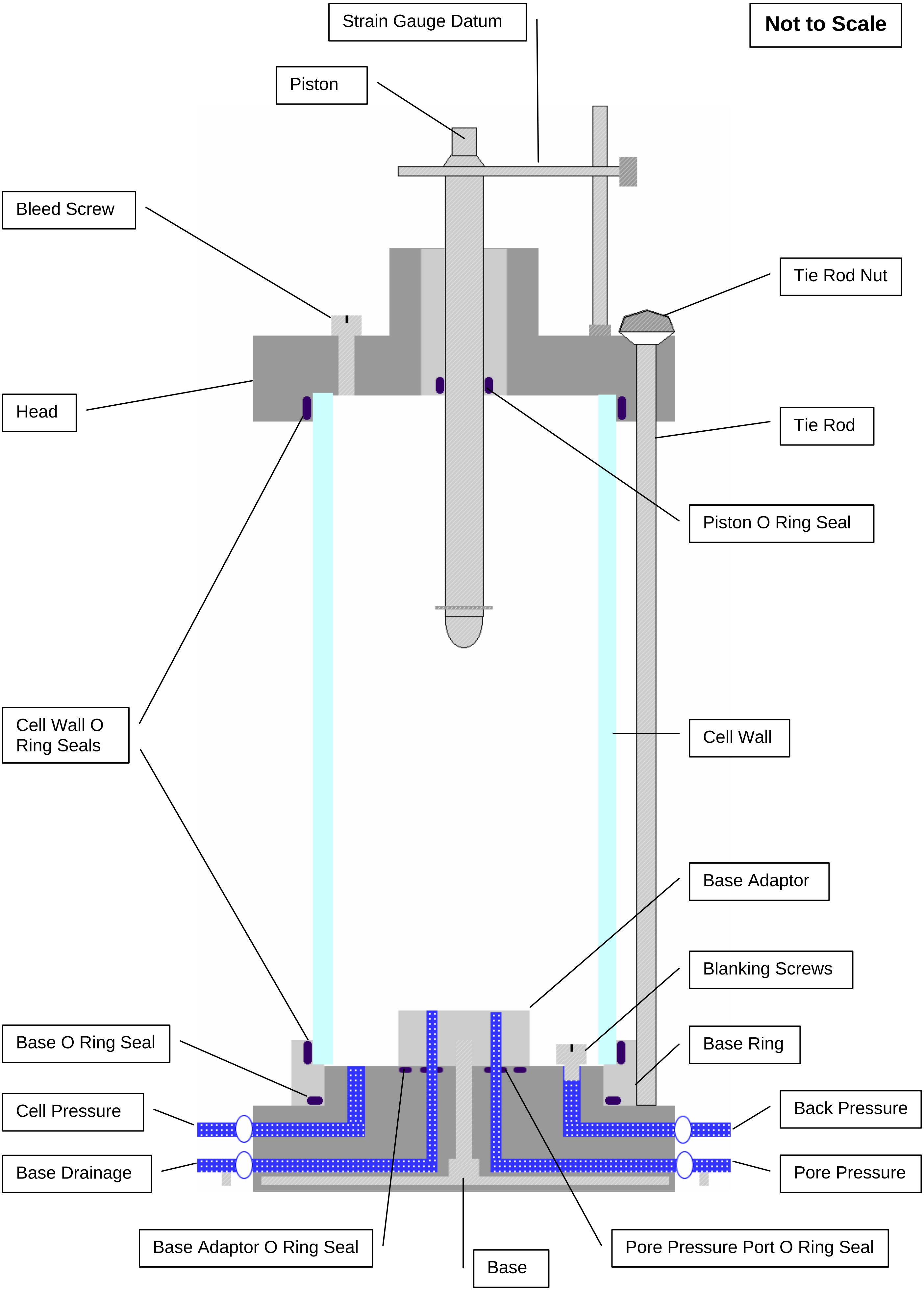
Cell Size
50mm diameter
100mm diameter
150mm diameter

Standard accessories are available to test samples ranging from 35mm to 150mm diameter. Non-standard sample accessories are available on request.

Please note
The only pressure medium that can be used with triaxial cells is water. Do not use gas or any liquid other than water.

Triaxial Cell Sample Preparation

1. Unscrew the tie rod nuts until they come clear of the drilled hole in the cell base.
2. Lift off the cell wall, complete with the head and base ring, from the base and place on a clean surface.
3. Remove, clean and inspect the base adaptor and pore pressure port ‘O’ ring seals and thoroughly clean the groove and recesses.
4. If the sealing rings are undamaged, lightly coat them with grease and refit to the base. Worn or damaged rings must be replaced.
5. Secure the required base adaptor to the base with the three socket head cap screws, taking care to tighten each screw evenly until the adaptor is contacting the base.
6. If the test requires top drainage, remove the blanking screw from the pressure pad and connect the drainage tube assembly. (Later models have two top drains.)
7. Connect the other end of the drainage tube assembly to the tapped hole in the base, having first removed the blanking screw.
8. Build up the sample on the base adaptor using the solid disc for undrained tests or porous disc for drained tests.
9. Place the porous disc on top of the sample (drained test only) and fit the pressure pad.
10. If necessary, clean the cell wall (refer to Maintenance Section).
11. Remove the base ring ‘O’ ring seal, clean the groove and underside of the base ring.
12. Clean and inspect the sealing ring and, if undamaged, lightly coat with grease and replace in the groove.
13. With the piston fully up, lower the cell wall assembly carefully over the sample, locating the base ring on the spigot of the base.
14. Lower the piston carefully to locate into the central dimple of the pressure pad.
15. Mount the cell onto the load frame platen making the required connections to constant pressure systems etc. Fill the cell with water using the bleed screw in the head to permit all air to be evacuated.
16. Raise the platen and cell until ball end of load ring engages with the central dimple in the piston. Set up the strain gauge/transducer on the datum bar.
17. Conduct triaxial test as required.


Strain Gauge Datum
Not to Scale
Piston
Bleed Screw
Tie Rod Nut
Head
Tie Rod
Piston O Ring Seal
Cell Wall O Ring Seals
Cell Wall
Base Adaptor
Blanking Screws
Base O Ring Seal
Base Ring
Cell Pressure
Back Pressure
Base Drainage
Pore Pressure
Base Adaptor O Ring Seal
Base
Pore Pressure Port O Ring Seal

Maintenance

1. Clean and dry all parts after use. The cell wall should only be cleaned with soap and water or a solution of mild detergent followed by adequate rinsing.
2. If the cell is to be left unused for long periods ensure that the drainage tube assembly is removed and blanking screws are replaced.

   Note: there is a possibility that the plasticising agent in the drainage tube will attack the acrylic cell wall if the two are allowed to come into contact for even a short period of time. Therefore this tubing must not be allowed to come into contact with the cell wall, or be stored inside it.
3. Allow the piston to drop to its lowest position to prevent exposed grease collecting dirt.