







**C-Tech**  
Laboratory equipment co.,limited

# **TSZ SERIES AUTOMATIC TRIAXIAL TESTING SYSTEM**

## **PRODUCT MANUAL**



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## I. Master Loader

### Introduction



Fig.1 Master Loader

The Master Loader of the triaxial test system, with rigid, durable, low noise and smooth running characteristics, adopts the stepper motor coupled with worm gear drive system to supply the power source. It is equipped with upper and lower limit device; The axial deformation is measured and collected by high-precision displacement sensor (2 kinds of specifications for the sensor are available: 50mm measuring range, with accuracy 0.003mm and 100mm range, the accuracy is 0.1%F.S), axial load is measured by force sensors (0-10-25-30-50-60-100kN) . With overload protection device, when the axial force loaded is larger than the measuring range of the sensor, machine stops working automatically; There are 2 ways on the PLC control, the first control mode adopts LCD graphic display in English, with standard 16 keypads multifunctional keyboard input, real-time clock, calendar display, making it simple, convenient and quick operate; The second control mode adopts 5.7 inch touch screen to display and control.

The range of triaxial Master Loaders has been designed to be used as part of computer-controlled triaxial system or as stand-alone unit. The USB interface enables the Master Loaders to be used with any computer. The Master Loader is comprised of a rigid chromed steel twin column construction, for rigidity at high loads. All external parts are either stove enamel painted or chrome plated for corrosion protection. The loading platen is made from stainless steel.



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## Specification

Model	TSZ-1T	TSZ-3T	TSZ-6T	TSZ-10T	TSZ-20T	TSZ-100T
Axial Force	10KN	30KN	60KN	100KN	200KN	1000KN
Shearing rate	0.00001 – 6mm/min, 0.00001 – 9.99999mm/min			0.00001 – 6mm/min, 0.00001 – 20mm/min		
Precision	+/-0.1%F.S					
Displacement Sensor Measuring Range	0-50mm	0-80mm	0-110mm	0-150mm	0-150mm	0-300mm
Resolution	0.001mm					
Maximum Vertical Clearance	500mm (700mm)	540mm (700mm)	720mm	720mm	670mm	1500mm
Horizontal Clearance	260mm	320mm	380mm	470mm	650mm	770mm
Platen Diameter	96mm (150mm)	96mm (150mm)	148mm	148mm	258mm	248mm
Built-in acquisition system	4-channel, 16-bit AD					External
Power supply	110 or 240V, 50Hz					240 or 380V
Dimensions	400×350×8 30 (mm)	600×450×1 180 (mm)	600×480× 1450(mm)	800×520×16 60(mm)	1000×700× 2200(mm)	1135×1400× 3350(mm)
Weight	45kg	98kg	134kg	240kg	860kg	3400kg

## General Details

This section describes the general functions and usage of the Master Loader instrument.

The schematic below shows the rear end of the Master Loader and all the sockets that are available:



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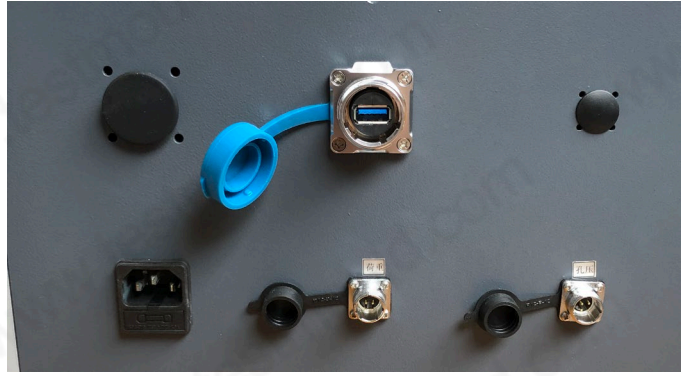


Fig. 2 Instrument Connections

## Instrument Connections

### 1. Power Supply



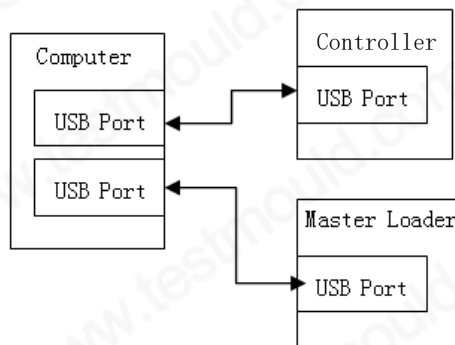
Fig.3 Power Supply

Connect 240V/50Hz (110V) power to this socket using the power cable provided. For reliable operation, it is imperative that the mains power is stable and free from any noise.

### 2. Comm. Port (USB)

For computer control, connect the computer USB port to this socket.

Please connect the USB interface on the host computer to the USB interface of the computer, and then connect the USB interface of the pressure volume controller to the USB interface of the computer.



### 3. Load Cell (External Transducer)

The 4-pin DIN socket is provided for connection of an external Load cell transducer.



Fig.4 Load cell(S-Type)

### 4. $u_w$ (External Pore Water Transducer)

The 4-pin DIN socket is provided for connection of an external Pore Water transducer.



Fig.5  $u_w$

### Front Panel Display

This section explains the operation of the Master Loader via its front panel and keypad. The following is the front view of the instrument:



Fig.6 Front view



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As can be seen clearly, the LCD graphical display is split into two sections: the top shows the Triaxial Testing Apparatus and the bottom shows rate, vertical displacement, load Confining, pore water pressure.

### Front Panel Keypad

All data entry, editing and function selections, in fact, any option, are available via the 16 key membrane keypad at the front. Please refer to the schematic above.

When key is pressed, you will hear a short bleep, indicating that the key press has been recognized. You must press and release the key for the action to take place. If a key does not provide any function in a given displayed screen, you will hear a chirping sound instead.

The control buttons on the front of panel provide fast/slow, up/down and stop commands for platen movement. A step motor membrane seals the panel and digital display from the water and dust.

A rapid approach facility is provided to reduce set-up time. The automatic datum facility returns the Master Loader to previous settings when switched on and micro switches prevent platen over travel.

### How to use the press button

#### 1. Rate

Used to set the shear speed within the range of 0.00001 - 9.99999mm/min.

When press "Rate" key, to set a constant rate, for example, you press the function key "Rate", Pressing the numeric keys, in the sequence 1,2,3,4,5,6 changes the display to read " Rate= 1.23456mm/min". Pressing the "ENTER" key then the drive motor will move forward by the speed of 1.23456mm/min.

#### 2. Stop

To make the motor stop running. Press the "stop" key, motor will stop moving.

#### 3. Fast Moving

To control the motor's moving speed and make the motor move with the maximum speed. (the max default speed is 10mm/min.)

The arrow direction indicates the motor fast move forward up or down



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#### 4. Set (Set up parameters)

Used to set time, and simply calibrate transducers (it's not suggested. Using the software to calibrate the transducer is more ideal on its accuracy and stability displayed.)

## II. Advanced Pressure Volume Controller



Fig.7 Pressure/Volume Controller

### What is it?

The Advanced pressure/volume controller is very easy to use and an ideal solution for the most modern laboratories. When used in conjunction with Master Loaders, data loggers and software they can be controlled from a computer to form part of a complete automated triaxial testing system. They may also be used as standalone units which are fully functioning with or without computer control.

In stand-alone mode the instrument is a constant pressure source which can replace traditional laboratory pressure sources such as mercury column, compressed air, pumped oil and dead weight devices. It is also a volume change gauge resolving to 1 cubic millimeter (cu. mm) or better. For example, the device is ideal as a back pressure source where it can also measure the change in volume of the test specimen. (We can use it to replace the “Bladder-type Air/water pressure assembly” and “Volume Change Transducer Assembly”, and so air compressor unit is not necessary.)

Above all, the device has its own computer interface and so can be controlled directly from a



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computer. Thus the digital controller is the essential link between computer and test cell in computer controlled testing systems as well as in computer controlled testing systems of your own devising.

The device comes complete with internal volume and pressure transducers. Both channels are pre-calibrated: it can generate pressures up to 2000kPa (20 bar) and provides a maximum volume measurement of 60cc which is readable to 0.001ml (1 cubic millimeter).

## Features

- Fitted with internal pressure transducer.
- Generates pressures up to 2000kPa (20 Bar), and displayed to 1kPa (Controls to +/-0.1%F.S).
- Pressure can be ramped up or down at a selected rate in kPa per min.
- Pressure or volume can be set, and maintained, at either kPa or ml respectively.
- Optional port for feedback from an external pressure transducer. Max. Volume capacity of 60cc, readable to 0.001ml.
- Protected transducer configuration and calibration.
- Non-volatile storage of calibration and control parameters.
- Quiet operation.
- The advanced microprocessor controls screw pump for the precise regulation and measurement of fluid pressure and volume change. The fluid is de-aired water. The advanced microprocessor based electronics includes:

Fast 16bit A/D converter,

Serial(USB) port for computer control,

240\*128 LCD display,

Keypad for instrument setup, usage and control.



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Model	TPS-PVC-1
Channel	2 Channel
Maximum Pressure	2MPa
Resolution	1kPa
Maximum Volume	60ml
Resolution	0.001 ml
Precision	+/- 0.1 % F.S.
Confining Pressure	Measuring Range: 0 ~ 2 MPa, Resolution: 1 kPa, Accuracy: +/- 1 kPa
Back Pressure	Measuring Range: 0 ~ 2 MPa, Resolution: 1 kPa, Accuracy: +/- 1 kPa
Power supply	110V or 240V, 50Hz
Dimensions	870×530×320 (mm)
weight	38Kg

## General Details

This section describes the general functions and usage.

### Main Components

#### 1. Pressure Volume Controllers(Back and Confining Pressure)

The picture above shows the back pressure volume controller and confining pressure volume controller. The back pressure volume controller and confining pressure volume controller are independent.


#### 2. Embedded system


The Embedded system includes the LCD, front panel display, front panel keypad, electrical system and so on.

### Instrument Connections



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Fig.8 The Rear End

#### 1. Power Supply

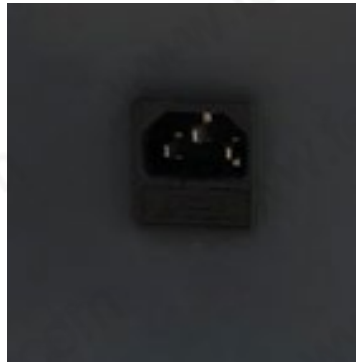


Fig.9 Power Supply

Connect 220-240V/50Hz(110V) power to this socket using the power cable provided. For reliable operation, it is imperative that the mains power is stable and free from any noise.

#### 2. Comm. Port (USB)

For computer control, connect the computers USB port to this socket.

#### 3. Inlet/Outlet

Connect with water storage tank to provide de-air water for the chamber and back/confining pressure controller, connected by silicon rubber tube.

#### 4. Cell Port



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Stainless steel quick plug, used to connect the confining-pressure controller and confining pressure interface on the chamber by high pressure nylon tube.

#### 5. Back Port

Stainless steel quick plug, used to connect the back-pressure controller and back pressure interface on the chamber by high-pressure nylon tube.

#### 6. How to join or use the chamber

The upper and lower part of the chamber are fastened by T bolts.

Each Chamber has five take off positions in the base, two for bottom drainage/pore pressure, two for drainage/confining pressure and one for top back pressure.

#### Front Panel Display

This section explains the operation of the Pressure Volume Controller via its front panel and keypad. The following is the front view of the instrument:



Fig.10 Front View

As can be seen clearly, the LCD displays: the current cell pressure and volume readings, Back Pressure and volume readings (Back Volume used for measuring the volume change of the sample).

#### Front Panel Keypad

All data entry, editing and function selections, in fact, any option, are available via the 16 key membrane keypad at the front. Please refer to the picture above.



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Each time key is pressed, you will hear a short bleep, indicating that the key press has been recognized. You must press and release the key for the action to take place. If a key does not provide any function in a given displayed screen, you will hear a chirping sound instead.

### How do you use it?

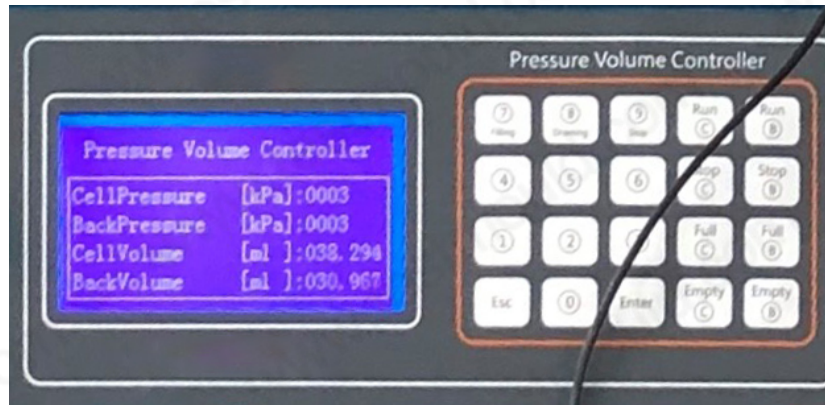


Fig.11 The liquid crystal display

The keypad is used for entering target pressure and other functions. The keypad also gives access to onboard diagnostics for checking out each of the major hardware components of the system.

#### 1. Set the Pressure Target (Run)

To set a constant pressure, for example, you press the function key "Run" (R=Cell Pressure, B=Back Pressure) and the message display will be showed. Pressing the numeric keys, in the sequence 1,2,3,4, changes the display to read " (Cell or Back) PRESSURE = 1234kPa". Pressing the "Enter" key then causes the controller to seek to the pressure of 1234 kPa. The measured pressure is also displayed.

Pressure is measured by an integral solid state transducer. Control algorithms are built into the onboard microprocessor to cause the controller to seek to a target pressure. Volume change is measured by counting the steps of the incremental motor.

#### 2. Stop the Pressure Control

To stop the pressure control, during either operation described above, press the "Stop"(R=Cell Pressure, B=Back Pressure) key and the controller will cease controlling.

#### 3. Filling the water for the pressure controller



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To request that the motor reverses, to allow water to be drawn into the internal controller, press the "Full" key (R= Cell Pressure Controller, B= Back Pressure Controller).

#### 4. Emptying the water for the pressure controller

To request that the motor moves forward, to allow water to be emptied from the internal controller, press the "Empty" key (R= Cell Pressure Controller, B= Back Pressure Controller).

#### 5. Filling the water chamber

To allow water to be drawn into the chamber, press the "Filling"(⑦) key.

**Note:** Making sure the Water storage tank must be full.

#### 6. Emptying the water chamber

To allow water to be emptied from the chamber, press the "Filling"(⑧) key.

**Note:** When the chamber is empty, you must press the "stop"(⑨) key.

#### 7. Stop the Filling or Emptying Control

To stop the Filling or Emptying control, during either operation described above, press the "stop"(⑨) key and the controller will cease controlling.

### Technical Specification

1. 2MPa/60cc Confining pressure/volume controller with USB port, built in keypad and liquid crystal display.

Automatically protected against pressure and volume overages. Volume accuracy 0.1% of measured value. Pressure accuracy 0.1% of Full Range. Volume change measured and displayed to 1cu. Mm (0.001cc). Pressure regulated and displayed to 1 kPa.

2. 2MPa/60cc Back pressure/volume controller with USB port, built in keypad and liquid crystal display.

Automatically protected against pressure and volume overages. Volume accuracy 0.1% of measured value. Pressure accuracy 0.1% of Full Range. Volume change measured and displayed to 1cu. Mm (0.001cc). Pressure regulated and displayed to 1 kPa.



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### III. Work Environment

AC power supply voltage 110~240V±20V, frequency 50Hz±5Hz. Indoor have special grounding wire, no strong electromagnetic interference.

Working temperature: 0 ~ 45°C, relative humidity is less than 85% under the conditions of use.

### IV. Triaxial System Installation Instructions

#### Machinery Installation

Connecting the Master Loader, Confining pressure/volume controller and Back pressure/volume controller.



Fig. 12 Machinery Installation

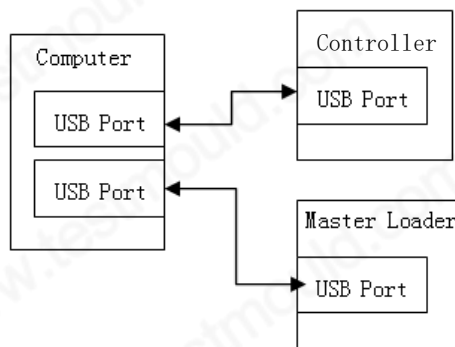


Fig. 13 USB Connection



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## Pipeline connection

There are 5 outer ball valves as the quick connector at the base of the pressure chamber, respectively corresponding confining pressure piping, back pressure piping, pore-water pressure pipeline, the exhaust pipeline of the specimen base, drain piping of the chamber. Confining pressure controller, back pressure controller, pore water pressure sensor are respectively connected with the confining pressure piping, back pressure piping and pore water pressure pipeline. Pipeline connecting adopts 2MPa quick connector, directly insert the nylon tube into the quick connector, that's OK. If you want to take down the tube, pls firstly press the ring on the quick connector inward, then pulled out the nylon tube.

## Electrical connection

Power socket:220V (110V) AC, connect with power line. There is a fuse slot at the bottom. Pull out the slot to change the fuse.


## V. Specimen Installation


The sample installation process is as follows (see Figure 14):


- (1) Install and fix the sample (Step a, b, c, d, e, f, g, h, i, j) Pass the pre-prepared latex film through the mold tube, turn both ends of the latex film outwards, let it stick to the mold tube, and then use a suction ball to inhale, make the latex film close to the inner wall of the mold tube (step a ); Put the sample to be tested into the mold cylinder (step c), and place the mold cylinder containing the sample on the pressure chamber base, and place filter paper and permeable stone between the specimen and the pressure chamber base (step c) d) Tighten and rotate the latex film, remove the die-bearing cylinder (step e), tighten the latex film with a rubber band to fix it on the pressure chamber base (step f); Install a split mold on the outside of the sample to protect the sample (step g); On the upper part of the sample, install filter paper, permeable stone and sample cap, and fix the upper part of the sample with a rubber band (step h, i); Remove the split mold (step j);
- (2) Install the pressure chamber (step k) Install the transparent cover of the pressure chamber on the base, tighten the nut, and fill the pressure chamber with airless water. Block the exhaust hole and the water inlet valve to check whether there is water leakage or air leakage.



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- (3) Connect the pressure chamber to the controller, run the triaxial test program, and start the test.  
(Please refer to the software instructions for the software part).



Fig.14 Chamber

## VI. Notes

### Notices to the Pressure Volume Controller

- The controller can only accept de-air water as its working medium, if it won't be used in a long time, please empty water from the controller;
- Avoid heavy impact on LCD screen and the top of quick connector;
- The maximum working pressure for the quick connector is 2MPa.

### Notices to the Master Loader

- Avoid heavy impact on LCD screen;
- The maximum working Load is 50kN.



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### Notices to the chamber


- a) The maximum working pressure of the chamber is 2MPa;
- b) Avoid heavy impact on plexiglass and the top of quick connector.



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