

# Digital Pneumatic Direct Shear Machine

2001-D • 2001-DF

## INTRODUCTION

The Karol Warner model 2001-D Direct Shear Machine is a tabletop unit that provides direct or direct/residual shear values for evaluating the strength and stability of soils. This device utilizes a pneumatic loading piston for applying the vertical load to the sample. A calibration chart is included for setting the high load or the low load via the Fairchild Regulator while a built-in digital readout displays the vertical load in psi.

This Direct Shear Unit has a strain rate of 0.0001—0.3 in/min (0.0025—7.62 mm/min) with a maximum shear displacement of 0.8in (20.3mm) and the travel speed is set with the thumbwheels on the left side of the unit. The residual shear force is determined by a load cell and while real time load settings and peak load are displayed on the digital readout. Consolidation and shear displacement are measured with Displacement transducers and displayed on a digital readout.

## FEATURES

- Total shear capacity of 1,500lbf (6.67kN)
- Stepper motor controls strain rates to +/- 1% from 0.0001—0.3in/min (0.0025—7.62mm/min)
- Teflon coated anodized aluminum water chamber with drainage port included.
- Meets requirements for ASTM D3080 and AASHTO T 236

## REQUIRED ACCESSORIES (purchased separately)

- Direct shear boxes are sold separately and are available in a wide range of inch and metric sizes with round or square shapes. See all options at karolwarner.com and in the chart.
- A constant supply of compressed air at 90psi (6.2 bar) is required for use.
- A computer or laptop for connecting to the data readout.



2001D

Direct Shear Boxes & Accessories				
Size	Shear Box	Cutters	Extruders	Porous Stones
<b>Round Direct Shear Boxes</b>				
1.93 in (49mm)	20050	-	-	50191014
1.97in (50mm)	20049	20149	2049DE	50195314
2.0in (50.8mm)	20051	20151	2050DE	50198514
2.36in (60mm)	20057	20157	2057DE	50234514
2.42in (61.5mm)	20052	20152	2052DE	50240014
2.5in (63.5mm)	20053	20153	2053DE	50248514
2.76in (70mm)	20059	20159	2059DE	50274014
3.94in (100mm)	20055	20155	2055DE	50393714
4.0in (101.6mm)	20054	20154	2054DE	50398514
<b>Square Direct Shear Boxes</b>				
1.97in (50mm)	20049S	20149S	2049SE	50195314S
2.0in (50.8mm)	20051S	20151S	2051SE	50198514S
2.36in (60mm)	20057S	20157S	2057SE	50234514S
2.42in (61.5mm)	20052S	20152S	2052SE	50240514S
2.5in (63.5mm)	20053S	20153S	2053SE	50248514S
3.94in (100mm)	20055S	20155S	2055SE	50393714S
4.0in (101.6mm)	20054S	20154S	2054SE	50398514S

## UNPACKING & SETUP

- Inspect your Direct/Residual Shear Machine for damage, remove from the pallet.
- Place Direct Shear Machine on a sturdy, level surface, such as a bench top or Model 2099 Rolling Cart for Shear Machines.
- Review the Connections section and install necessary components.

Rev: 6/2023

## CONNECTIONS

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**Vertical Displacement Transducer Rod** – Screws into the top platform to the right of the rear pull-down rod.

**Vertical Displacement Transducer Clamping Arm** – Attach to the above rod.

**Vertical Displacement Transducer** – Consolidation – Attach to the clamping arm with the screw provided. Connection is made at the rear of the readout box.

**Horizontal Displacement Transducer** – Shear – Attach to the threaded rod on the angle bracket-top platform, right front. Connection is made at the rear of the readout box.

**Air Line** – A constant supply of clean, dry air is required. The air inlet air pressure should not exceed 200 psi, nor should it ever be less than 20 psi higher than the highest pressure setting. The connection is a ¼" push-to-connect fitting, located in the rear of the cabinet. Insert the tubing into the fitting until it bottoms out. With the nut finger tight, tighten the fitting 1¼ turns with a wrench. Do not over tighten.

**Pressure Transducer** – The internal pressure transducer measures the output of the pneumatic loading system. The external wire that is at the back of the direct shear unit is plugged into channel four of the Data Readout system.

**Load Cell** – Connect the load cell to the support casting at the right end of the direct shear using the two knobs. Adjust the knobs so that the load cell is as far to the right as possible. This will allow room for assembling the water chamber and the shear rings with minimum interference. Connection is made at the rear of the readout box.

**Mini USB 2.0 Port** – Connection is made at the rear of the readout box to a computer.

**Water Chamber** – Special care should be taken to see that the four (4) roller bearings between the water chamber and the base slide tracks are properly cleaned and contain a slight amount of oil during and after use. We advise using a cover over the direct shear after use to eliminate dust from entering the precision slide assembly. The main drive shaft should be at its home position. This will place the sample load pad in the center of the crossarm for consolidation.

**Shear Boxes (sold separately)** – The shear rings are held together with (2) stainless steel screws boxes. There are also (4) screws for adjusting the gap between the rings once consolidation has been reached. The gap is adjusted by turning the screws clockwise from the finger tight position. One full turn will give .031" gap. There is a line scribed on the adjusting knob for determining how much gap each screw has provided. The screws should be turned evenly to maintain a proper gap. At the bottom of each screw is a nylon glide which keeps the top shear ring from dropping during the test.

## FRONT PANEL CONTROLS

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The consolidation load settings and strain rates are controlled from the front panel. Machine must be plugged in to a properly wired grounded receptacle with appropriate electrical current.

### PANEL CONTROLS — LOAD SETTING

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**Readout and Data Acquisition** – See manual for Data Readout System. This is a four channel device for monitoring shear load (channel 1), horizontal displacement (channel 2), vertical displacement (channel 3), and pressure (channel 4) for setting the vertical load on the sample. See the load table for the proper load setting.

**Load Regulator** – A precision Fairchild regulator is used to set and maintain the air pressure to the pistons which provides load to the sample. The regulator is sensitive to 1/8" variations in water column. Select the load required from the load setting table.

*Note: The consolidation load pad, porous stone, and stainless-steel ball have not been included in the load setting calibrations.*

**High Load/Low Load Selector Valve** – This valve has two positions. The LOW LOAD position is used for loads up to 100lbs. The HIGH LOAD position is used for loads up to 1500lbs.

**Load Valve** – This valve is actuated by 90-degree rotation of the handle. When open it allows air to flow from the regulator to the pistons (HIGH or LOW LOAD) selected.

### PANEL CONTROLS — POWER & SHEAR RATE

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**Power Switch** – An indicator light is present when power is turned on.

**Strain Rate Selector** – The strain rate is set with thumb-wheel selectors. The switches are direct reading in inches/minute (or mm/min for 2001-DF) with an implied leading decimal point. Once the rate is set and the test is started, the switch setting is ignored until the stop switch is pressed or a limit switch is tripped.

**Limit Switches** – These switches are located on the platform behind the water chamber.

Adjustment of the limit switches is made by loosening the Phillips-head screws and moving the limit switch assembly in the direction desired. The home position has been set so that the load crossarm is in the middle of the shear rings.

*Note: The limit of travel of the drive shaft is dependent on the limit switch settings. Do not operate the drive motor with the water chamber disconnected because this will make the limit switches inoperable.*

**Stop Switch** – Push button to stop the motor.

**Direction Switch** – Momentary (spring loaded) switch. After setting the desired shear rate, moving the switch in the desired direction will initiate movement. This switch will then become inactive until the stop button is pressed, or a limit switch is activated. The left position will move the water chamber to the left. It will continue until the water chamber activates the limit switch. At this time, the limit indicator light will be lit. The right switch position will move the shear box to the right until the home limit switch is made. See above note...

**Residual Counter** – Two-digit thumbwheel is used for setting the number of residual shear passes required. One shear pass will allow the shear box to travel from the home position to the limit switch setting. Two passes will travel from the home position out to the limit switch and then return to the home position. Each pass completed will register on the digital readout to the right of the thumbwheels. Choose between 0-99 passes.

**Home & Limit Indicators** – Used to indicate the limit of travel of the shear box.

**Fuse** – 4 amp SLO BLO fuse located in the cabinet rear.

## **OPERATING INSTRUCTIONS**

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Read all operating instructions before performing a test and refer to ASTM D3080 or AASHTO T 236 for complete test procedures and calculations.

### **Set Up**

1. Place the shear box into the water chamber and secure the load cell shaft to the top of the shear box.
2. Tighten the two shear ring clamping knobs located on the left side of the water chamber.
3. Install the counterbalance, Model 2000-75, if necessary.
4. Tare the load cell by pressing the "Tare" button on the digital readout.
5. Adjust the top cross arm and dial gauge so there is 1/8in gap between the cross arm and loading ball. Align the cross arm pin so it is above the loading ball. Make sure the cross arm is level.
6. Adjust the LVDT by raising or lowering the indicator rod and holder so the tip of the LVDT is resting on the cross arm pin.

## **Consolidation**

1. Utilizing the provided physical or digital copies of the Load Setting Table, select a seating load. (If your test sample area differs from the one provided in the print-outs, this can be adjusted using the provided Excel spreadsheet located on the flash drive.) Set the HIGH LOAD or LOW LOAD knob to LOW and the Load Valve to "LOAD."
2. Adjust the Fairchild Pressure Regulator to the desired seating load per the load setting calibration chart, this value is displayed on the digital readout box, channel 4.
3. Turn the "LOAD" knob to "OFF" and adjust the Pressure Regulator to the desired normal load based on the load calibration chart. If reading from the "LOW" calibration chart keep the knob on the LOW LOAD position. If reading from the "HIGH" calibration chart, turn the knob to "HIGH LOAD"
4. Tare the LVDT on channel 3 before beginning consolidation.
5. Turn the Load Valve to "LOAD" to begin consolidation.
6. Load and swell readings will be displayed on channels 3 and 4 of the readout box and transferred to an Excel file or the Direct Shear Data Acquisition Software on the users connected computer.

## **Direct Shear**

1. After consolidation phase is complete, add a small seating shear load by adjusting the two knurled nuts on the load cell support.
2. Tare the shear load cell which is displayed on channel 1 of the digital readout box.
3. Remove the two holding screws on the shear box to separate the top and bottom sections. Adjust the four adjusting crews on the shear box to set the gap between the top and bottom of the shear box. One full turn of these adjusting screws will give a 0.031in (0.78mm) gap.
4. Set the shear/strain rate with the thumbwheels on the left side of the machine. Each number is set by pushing the thumbwheel button, the rate is in inches per minute (0001 = 0.0001 in/min).
5. Tare the horizontal displacement LVDT on channel 2 of the readout box. To begin shear, switch the DIRECTION toggle switch to the left towards the LIMIT light.
6. The water chamber with shear box will continue to move at the set rate until the limit switch is activated or the STOP button is pressed.

7. Load and Shear Displacement will be displayed on channels 1 and 2 of the digital readout box and transferred to an Excel file or the Direct Shear Data Acquisition Software on the users connected computer.
8. At the test completion, switch the DIRECTION toggle to the right towards the HOME light. Press the stop button when Zero load is reached on the load cell, channel 1 of the readout box.
  - 8a. If Residual Shear values are needed, these can be determined during this time.
9. Reduce the vertical load to Zero by adjusting the Fairchild Pressure Regulator until Zero psi is reached on the digital readout box.
10. The Shear Box can now be removed from the water chamber and the sample can be inspected.

## MAINTENANCE

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Special care should be taken to see that the four roller bearings between the water chamber and the base slide track are properly cleaned and contain a slight amount of oil during and after use. It is recommended to cover the Direct Shear machine when not in use to prevent dust buildup.

Empty the water chamber after each test to prevent soil and sand buildup inside the chamber. The water can be drained from the port or the chamber can be removed from the Direct Shear Machine for thorough cleaning.

## ACCESSORIES

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**Model 2099** Rolling Cart for Shear Machines

**Model 2000-75** Shear Box Counterbalance

**Model 20020** Nylon Alignment Screw for Shear Boxes

**Model 6756** Direct/Residual Shear Data Acquisition Software