

## Digital Direct Shear Machine, Dead-Weight

2050-D/2050-DF

### INTRODUCTION

The Karol Warner model 2050-D Dead-Weight Direct Shear Machine is a motorized unit for direct and direct/residual shear testing of soil samples and uses a 10:1 dead-weight beam loading system to apply vertical confining pressures. These compact, self-contained units are built for harsh laboratory environments and require little floor space.

This Direct Shear Unit has a strain rate of 0.0001–0.3in/min (0.0025–7.62mm/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 while real time load settings and peak load are displayed on the digital readout. Vertical load capacity is 1,411lb (640kg) and the maximum horizontal shear force is 1,500lbf (6.67kN). Consolidation and shear displacement are measured with Displacement Transducers and displayed on a Data Readout.

Shear boxes and weight sets are required and sold separately.



Digital Dead-Weight Direct Shear Machine (shown with Shear Box sold separately)

### FEATURES

- Total shear capacity of 1,500lbf (6.67kN)
- Stepper motor controls strain rates to  $\pm 1\%$  from 0.0001 to 0.3in/min (0.0025 to 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 [www.karolwarner.com](http://www.karolwarner.com) and in the chart to the right.

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

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Weight Sets are required to apply the consolidation load and are available in both Pound and Kilogram sets.

Pound Weight Sets								
Model	Total Mass	Total Load at 10:1 Beam Ratio <sup>1</sup>	Included Weight Sets					
			0.852lb (1/8tsf)	1.704lb (1/4tsf)	3.409lb (1/2tsf)	6.818lb (1tsf)	13.635lb (2tsf)	27.270lb (4tsf)
1119	54.5lb	545lbf (8tsf)	2	1	1	1	1	1
1120	109.1lb	1,091lbf (16tsf)	2	1	1	1	1	3
1121	218.2lb	2,182lbf (32tsf)	2	1	1	1	1	7

<sup>1</sup>tsf values indicate force applied to a 2.50in diameter specimen using a 10:1 beam ratio.

Kilogram Weight Sets					
Model	Total Mass	Total Load at 10:1 Beam Ratio	Included Weight Sets		
			1kg	4kg	8kg
1122	32kg	320kg	4	3	2
1123	64kg	640kg	4	5	5
1124	88kg	880kg	4	5	8

## UNPACKING & SETUP

- Inspect your Direct Shear Machine for damage, remove from the pallet.
- Review connections section and install necessary components.
- Assemble the dead-weight lever arm. Remove all packing material from arm and adjusting screw support bracket. Reposition the arm above the support bracket holes and reinstall the support bracket. Next install the 3.5in diameter counterbalance weight and the weight platform.

## CONNECTIONS

**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 Data Readout.

**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 Data Readout.

**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 Data Readout.

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

**Water Chamber** – Special care should be taken to see that the four 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 two stainless steel screws boxes. There are also four 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 create a 0.031in 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

The strain rate is controlled from the front panel thumbwheels. Machine must be plugged in to a properly wired grounded receptacle with appropriate electrical current.

## PANEL CONTROLS — POWER & SHEAR RATE

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

**Strain Rate Selector** – The strain rate is set with thumbwheel selectors. The switches are direct reading in inches/minute 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 these 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** – Momentary 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 LVDT 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**

The weight of the consolidation load arm with two upright rods lower cross arm and lower weight platform is 11.9lb. The lever arm on the right side of the device has been preset to a 10:1 ratio, select a consolidation load and apply the required weights to the weight hanger. The consolidation result is read on the Data Readout.

Refer to ASTM D3080 for consolidation calculations.

### **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 Data Readout.

3. Remove the two holding screws on the shear box to separate the top and bottom sections. Adjust the four adjusting screws 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 create 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 = 0.0001in/min).

5. Tare the horizontal displacement LVDT on channel 2 of the Data Readout. 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 Data Readout and transferred to an Excel file or the Direct/Residual Shear Data Acquisition Software on the user’s 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 Data Readout.

- 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 Data Readout.
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.

### **Digital Direct Shear Machines, Dead-Weight**

Digital Direct Shear Machine, Dead-Weight, 115V, 50/60Hz	2050-D
Digital Direct Shear Machine, Dead-Weight, 230V, 50/60Hz	2050-DF

### **Accessories**

Replacement Weight Hanger	1100-20
Shear Box Counterbalance	2000-75
Nylon Alignment Screw for Shear Boxes	20020
Direct/Residual Shear Data Acquisition Software	6756