

► **SWC-150**  
**Fredlund SWCC Device**



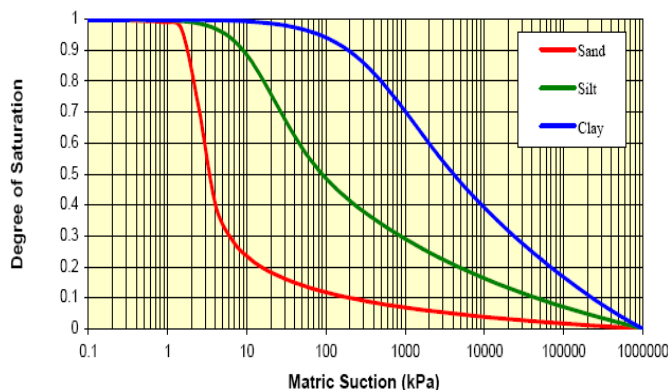
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- **In situ overburden pressure can be applied during the test**
- **Compression (volume change) & water content measurements**
- **Applied suctions up to 1,500 kPa**
- **Both drying (desorption) and wetting (adsorption) pressures can be measured**
- **Dual pressure gauges and regulators for precise pressure control**
- **Null-type initial suction measurements using axis-translation technique**
- **Flushing ability and measurement of diffused air**
- **Pressure compensator on the loading ram**
- **Complete documentation and testing guide**

**DESCRIPTION**

The Fredlund SWCC Device is a simple unsaturated soil testing apparatus with great flexibility for applying matric suctions while following various stress paths. The device can be used to obtain the complete soil-water characteristic curve, SWCC, for a soil. This device allows you to control matric suctions from near zero values up to 1500 kPa (i.e., 15 bars), and is capable of applying one-dimensional loading,  $K_0$ , to a specimen with a diameter up to 71 mm. The device is economically priced and is a complete 'turn-key' system constructed of stainless steel. SWCCs can be performed on 'as-compacted', 'initially slurried', or 'undisturbed' specimens, starting with either dry or wet conditions. The pore-air pressure,  $u_a$ , at the top of the specimen is controlled through the use of dual pressure regulators and precise gauges.

The stainless steel cell is constructed with simple knobs and screws for fast soil specimen setups. The



device includes a pressure panel with dual gauges and regulators for increased precision in the low-pressure range. The apparatus also includes the necessary plumbing and valves for periodic flushing and measuring of diffused air. Several different high-air-entry-value (HAEV) ceramic stones can be easily interchanged. HAEV ceramic stones rated at 100, 300, 500, and 1500 kPa are available. The appropriate ceramic stone can be selected depending on the soil type being tested. During a test, the soil specimen can either be subjected to a token vertical load, or a load similar to the overburden pressure in the field. The in situ overburden pressure can be applied with this apparatus by simply adding dead weights to the weight plate.

The application of a token pressure (e.g., 10 kPa) helps provide a positive contact between the soil specimen and the ceramic stone. The contact between the soil and the ceramic stone is essential for efficient water migration to and from the soil specimen. Alternatively, larger normal pressures can be applied to the specimen using a loading frame equipped with a pneumatic loader, a pressure gauge, and an air regulator.

There is a pressure compensator on the vertical loading ram. This means that the load applied to the specimen is directly related to the applied load and there is no tendency for the piston to move upward due to the air pressure within the soil specimen chamber. This design provides increased safety, particularly when operating the device at high pressures. Water released or absorbed by the soil specimen can be quantified using the volume tube readings, which enables the computation of water content at any given time. There is no need to dismantle the apparatus after equilibrium at each applied pressure increment, to determine the water content. The apparatus allows the use of a single soil specimen to obtain the entire SWCC with any number of data points.

In addition, the volume change can be monitored by measuring the change in sample height (provided the soil specimen does not separate from the sides of the steel ring). It is important to independently monitor total



Miniature Heater



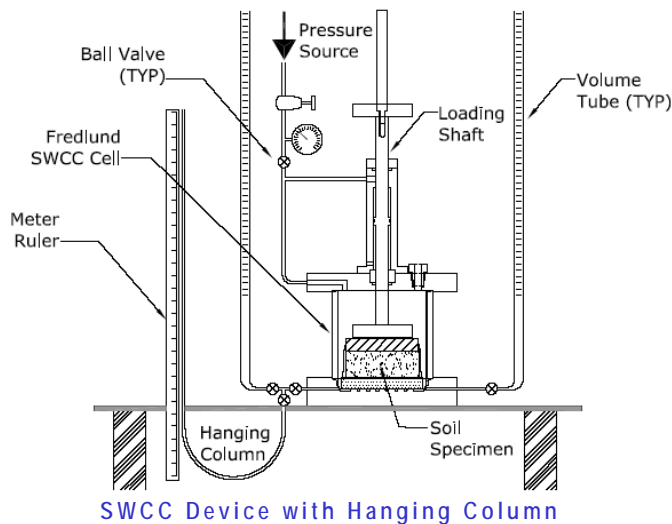
Pneumatic Loading Frame & Hanging Colum



volume change and water content change when desiring to compute the degree of saturation throughout the test.

The Fredlund SWCC device can be equipped with a miniature heater and a control panel that can maintain the chamber temperature constant and slightly above ambient temperature. This optional feature helps prevent condensation of water vapor.

Another optional feature available with the device is the “hanging column” accessory, which enables the application of low suctions to soil specimens. This feature is illustrated in the schematic diagram shown below.



If the available air compressor does not have enough capacity, use of bottled nitrogen gas may be necessary to apply suctions up to 1,500 kPa. Non-relieving pressure regulators are available as an option to minimize gas losses and to extend the life of the nitrogen gas bottle. As the name indicates, non-relieving pressure regulators require an extra valve to relieve or vent the pressure (chamber pressure is held even if the regulator is turned down). This extra valve is included with the non-relieving regulators option.

## SPECIFICATIONS

### 1) SWC-150 Fredlund SWCC Device

Unsaturated soil testing system used to obtain the complete soil-water characteristic curve (SWCC) of any soil. The Fredlund SWCC Device allows you to control suctions up to 15 bars and is capable of applying one-dimensional loading to specimens with a diameter of up to 71 mm. This device includes a pressure panel with dual gauges and regulators for increased precision at low-pressure ranges and a miniature heater to prevent water vapor condensation. It also includes the necessary plumbing and valves to measure the diffused air. Several different High-Air-Entry-Value (HAEV) ceramic stones are available and can be easily interchanged. Normal loads can be applied to the specimen using dead weights or, using a loading frame. Requires clean, dry compressed air or nitrogen bottle.

#### 1.1) SWC-PCA Pressure Cell Assembly

Stainless steel SWCC cell with a load piston to apply normal stresses and/or measure specimen volume change. Accommodates soil

specimens with up to 71-mm in diameter and up to 50 mm in height. The assembly includes load balance pressure compensator for uplift forces on normal load piston.

#### 1.2) SWC-PCP Pressure Control Panel

Complete pressure control system for direct control of pore air pressure,  $u_a$ , at the top of the soil specimen with dual pressure regulators and gauges for precise measurement and control of soil suctions. 1,500 kPa high range and 200 kPa low range with manual valve range selection and low range overload protection. Note: Option 3 should be used if the intended air supply is a nitrogen bottle.

#### 1.3) SWC-112-63 Specimen Cutting Ring

Stainless steel ring provided with the system for 63-mm diameter and up to 25-mm high specimens. Other sizes (25, 38, 50, and 71 mm) are available as options.

#### 1.4) SWC-CSM-05 Mounted Ceramic Stone

5-bar HAEV ceramic stones mounted on stainless steel ring for quick installation/removal. Provided with the system. 1, 3, and 15-bar ceramic stones are available as options.

#### 1.5) SWC-HCON Heat Control Accessory

Miniature heater for maintaining the chamber temperature slightly above ambient temperature. This option helps prevent condensation of water vapor inside the chamber.

## OPTIONS

### 2) SWC-FRM Pneumatic Loading Frame

Small 2-column standing load frame with stainless steel columns and hard-anodized aluminum top and bottom plates. Includes double-acting Bellofram diaphragm air cylinder with 10-kN capacity and 50-mm stroke. Also includes pressure regulator and gage for manual application/control of normal load.

### 3) SWC-NAR Non-Relieving Air Regulators

The two standard air regulators on the pressure panel are replaced with non-relieving air regulators when the pressure source is a nitrogen bottle. This will eliminate unnecessary leakage of nitrogen. However, when dismantling, the chamber pressure should be relieved manually opening a vent, which is included with this option.

### 4) SWC-CSM Additional Mounted Ceramic Stones

SWC-CSM-01, SWC-CSM-03, SWC-CSM-05, and SWC-CSM-15. HAEV ceramic stones rated 1, 3, 5, and 15-bar mounted on stainless steel rings for quick installation and removal.



**Mounted and Unmounted Ceramic Disks**



**5) SWC-CSU Unmounted Ceramic Stones**

SWC-CSU-01, SWC-CSU-03, SWC-CSU-05, and SWC-CSU-15. Unmounted HAEV ceramic stones rated 1, 3, 5, and 15-bar with holder rings. User is expected to mount the ceramic stones properly using epoxy, and test the bubbling pressure prior to use.

**6) SWC-107 Disk Holder Ring**

Ceramic stones are mounted to disk holder rings using epoxy. This option is required when ordering unmounted ceramic stones.

**7) SWC-EPX Epoxy Kit**

4-ounce epoxy kit for gluing unmounted ceramic stones to holder rings.

**8) SWC-112 Additional Specimen Rings**

SWC-112-25, SWC-112-38, SWC-112-50, SWC-63, and SWC-112-71. Cutting/holding specimen ring made of stainless steel. Available ring inside diameter: 25-mm, 38-mm, 50-mm, 63-mm, and 71-mm. Please specify diameter when ordering.

**9) SWC-HCA Hanging Column Accessory**

For application of low suctions between 1 and 5 kPa to soil specimens. Contact GCTS for details.

**10) SWC-MTOP Cell Top for Suction Sensor Calibration**

Top for SWCC-100 Cell with 5 sealed electrical feed-through connectors to calibrate up to 5 Fredlund suction sensors inside standard Fredlund device.

**11) PCP-PBOOST Pressure Booster**

2:1 Air pressure amplifier and holding tank with a 2000 kPa (290 psi) pressure maximum outlet pressure capacity. Includes pressure booster, inlet and outlet pressure gages, inlet pressure adjusting knob, and fiberglass-wrapped aluminum tank with 3.8 liter (1 gallon) capacity.

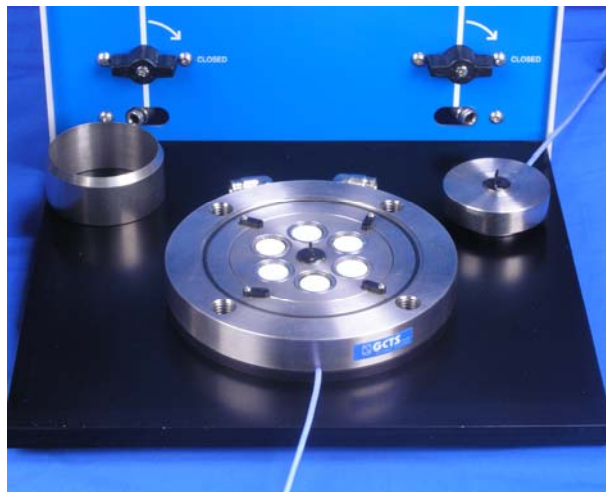
\* Requires compressed air source operating at 800 to 1,000 kPa (115 to 150 psi) pressures.

**12) SWC-BENDER SWC Platens with Bender Element sensors**

Top and bottom SWC platens with bender element sensors for measuring shear wave velocity in soil. Also includes 6 HAEV ceramic disks rated for 1, 5, 10 or 15 bars (please specify at the time of ordering).

**13) ULT-100 P & S Ultrasonic Velocity Measurement System**

Ultrasonic Velocity test system for automatic measurements of P & S wave velocities through soils, rocks or concrete specimens. Includes 8-channel programmable data acquisition system to record stress, strain or other signals.



SWC Platens with Bender Elements

**WARRANTY**

One (1) year parts and labor.

**SHIPPING**

Standard shipping volume: 3.9 m<sup>3</sup>  
Standard shipping weight: 45 kg

