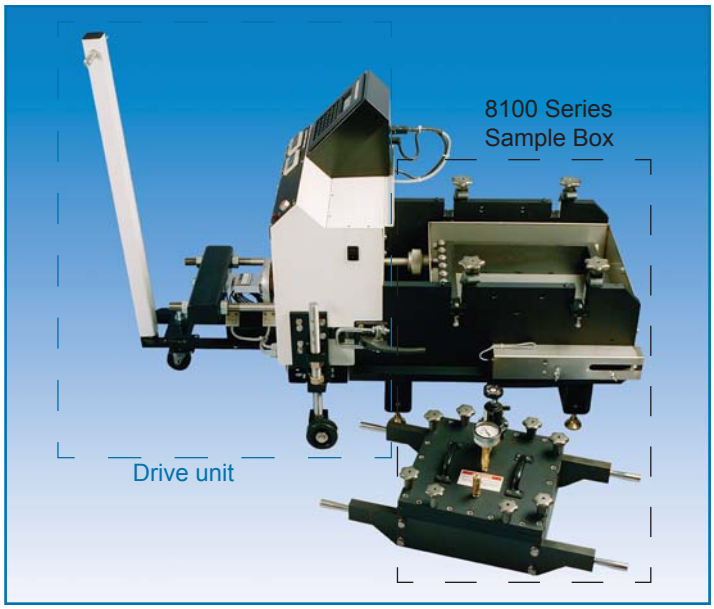


Large-scale Interface Shear Box.

Large-Scale Interface Shear Box

ASTM D 5321, D 6243

The Large-scale Interface Shear Box is used for determining the shear resistance of a geosynthetic against soil, a geosynthetic against another geosynthetic, or a Geosynthetic Clay Liner (GCL) against an adjacent material, under a constant rate of displacement. It provides a shear area of 12 x 12 inch (305 x 305 mm), a displacement of up to 4 inches (101 mm) and a wide range of normal loads. Optional accessories allow for consolidation testing.

The system features:

- A detachable drive unit which can be moved from one shear box to another, allowing the testing of one sample while another sample is being prepared in a separate box — a significant benefit when soil saturation or sample set-up is a major time factor.
- An integral tank that allows immersion of the soil sample and the shear zone to emulate field conditions.
- A choice of a standard-load or high-load sample boxes and an optional low-load attachment for either.
- Highest-quality materials and construction, designed for years of productive use.
- A digital readout for each measured parameter and optional WinSAS data collection software for the PC.

Applications

Test results obtained with the Large-scale Interface Shear Box are used in the design of structures that employ geosynthetics, such as reinforced retaining walls, embankments, and liners and caps for landfills. Testing is also used for quality control during construction of these structures.

Operation

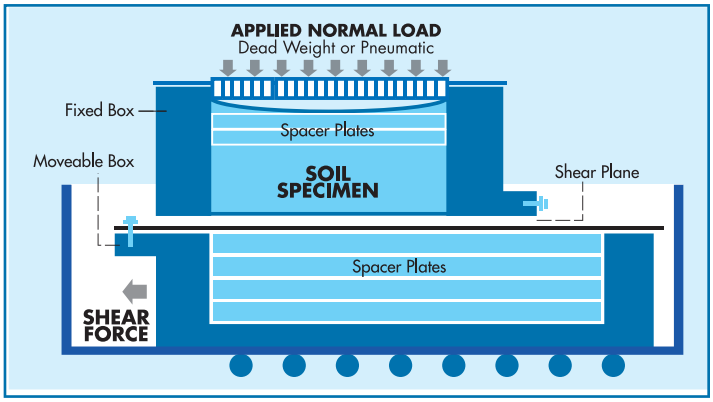
The Large-Scale Interface Shear Box comprises two modules: a drive unit and a sample box. The drive unit includes the motor, controller electronics, a control panel, a load cell and two transducer and readouts for the sensors. The sample box comprises an immersion tank, a lower box, a removable upper box, and the mechanism that applies the normal load.

In a typical test of a geosynthetic against a geosynthetic, a rigid substrate, usually in the form plastic or metal spacers, is placed in the lower box and a geosynthetic is placed over the substrate and clamped at one end. The upper geosynthetic and box are then placed atop the lower geosynthetic, and a rigid superstrate is placed on top of it.

In a typical test of geosynthetic against soil, the bottom box is filled with either spacers or a soil that is compacted to the required density. The geosynthetic is placed over it and clamped to the lower box. The upper box is then positioned and the superstrate of soil is placed, compacted to the required density. In some cases, the upper box is prepared on bench and afterwards moved into position.

With the geosynthetics and upper box positioned properly, the loading mechanism is clamped into place, and the drive unit is moved into position and attached. The parameters for the test are entered via the control panel on the drive unit. A normal load is applied for proper seating of the test materials. If the test requires immersed conditions, the immersion tank is filled with water. The height of the water can be adjusted so that up to 1 inch (25 mm) of the upper box is immersed. Some test procedures require 24 hours or more for proper conditioning of the samples. If the required load is greater than the seating load, it is also applied. When the sample reaches equilibrium, the test can begin.

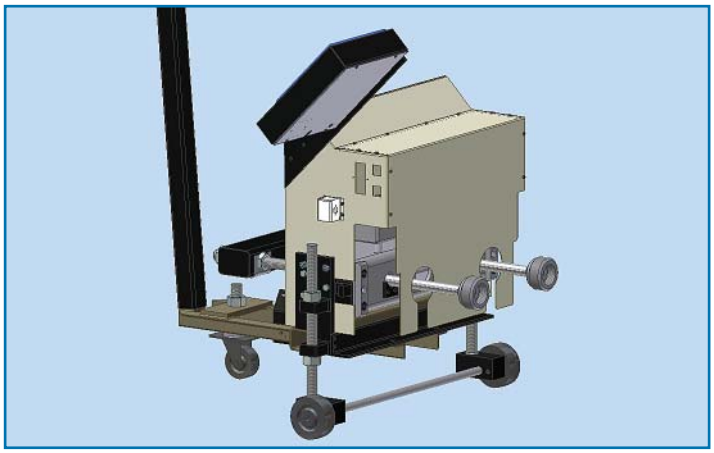
During the test, the drive unit causes the bottom box to move relative to the top box at a constant rate. The rate is specified by the engineer, but should be sufficiently slow so that no excess pore pressures develop. The relative displacement of the two surfaces produces a shear force which is measured by the load cell on the drive unit. Initially, the shear force rises with increasing displacement. The test is complete when the shear force remains constant with increasing displacement. Throughout the test, the readout units display and store data. The optional WinSAS software, running on the PC, collects the data and writes it to an ASCII file for further processing.



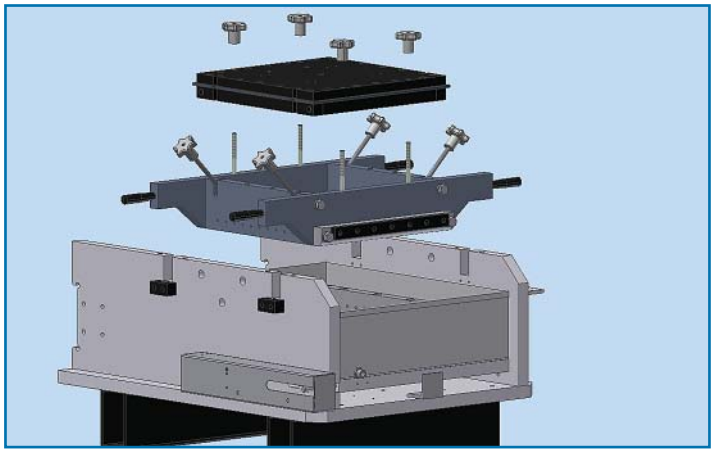
Schematic showing a typical geosynthetic and soil arrangement.

STANDARD MODULES

Drive Unit



Standard Sample Box



A major benefit of the Large-scale Interface Shear Box is derived from the modularization of drive unit and sample box which provides cost savings and operational efficiencies. A laboratory seeking to expand its testing capacity can purchase additional sample boxes and not incur the costs of additional drive units. It is an economical way to speed up the testing process by allowing for the preparation of a sample in one Sample Box while another is undergoing testing. The Drive Unit may be kept away from the sample preparation areas of the laboratory.

- The horizontal load is regulated by a precision DC servo motor control system which controls the rate of horizontal displacement — typically, a constant rate of displacement — which applies the shear force. This controlled speed is applied to the lower box, which is movable against the stationary upper box, and this causes the shearing action. In conjunction with limit switches, power, direction, and speed controls protect the system from overtravel.
- Linear bearings ensure smooth and constant horizontal movement.
- The unit includes:
  - Three digital readouts (for shear force, displacement, and pressure) with RS 485/232 outputs for data collection. The readouts require an optional software package for serial port data collection. This software, called WinSAS™ , organizes the data into a standard ASCII format.
  - One S-type load cell for measuring the shear force.
  - Two transducers (for horizontal displacement, pressure).
- The drive system is mounted on a wheeled frame to allow for easy separation from the sample box.
- An optional calibration device is offered for measuring the friction forces on the horizontal linear bearings.

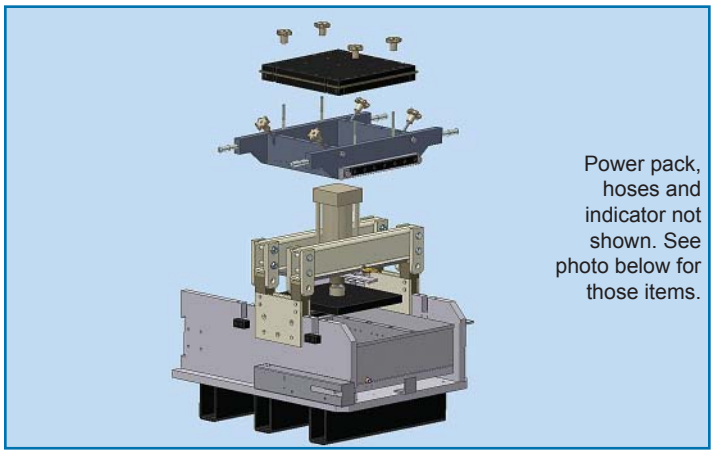
- Removable upper box (12 x 12 x 4 in [305 x 305 x 102 mm]) for easy sample preparation.
- Applied forces from 2000 lbf (9 kN) up to 14,400 lbf (64 kN). A formula is provided to convert force to load.
- The air-operated bladder attachment fits onto the stationary upper box. It has a pressure regulator and gauge to control the applied load.
- Compressed air is supplied to the bladder attachment via a single quick-disconnect fitting.
- The lower box (12 x 16 x 4 in [305 x 406 x 102 mm]) is moveable and built 4 inches (102 mm) longer than the upper box to maintain a constant friction area during testing.
- The lower box is contained within a stainless steel water tank to allow the sample to be submerged to emulate field conditions.
- The lower box rides on high-load capacity, low-friction linear bearings.
- Upper and lower box clamps have radius corners to eliminate excess stress on the geosynthetic materials.
- Optional air-operated Low-load Attachment for normal loads of up to 2000 lbf (9 kN).

The Large-scale Interface Shear Box is made from high quality materials including high strength aircraft-grade aluminum, HSLA steels, and stainless steel. All non-stainless materials are either anodized or plated for protection; hardware is either stainless steel or zinc/zinc chromate plated.

Download data sheets, manuals, and technical notes from **www.durhamgeo.com**

ACCESSORIES / OPTIONS

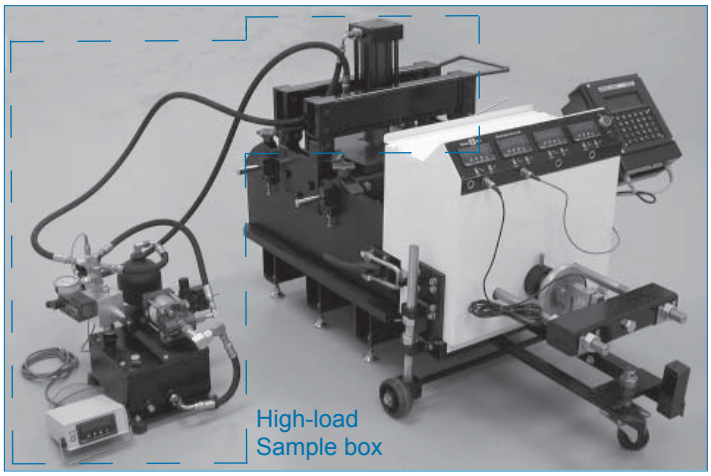
High-load Sample Box



Power pack, hoses and indicator not shown. See photo below for those items.

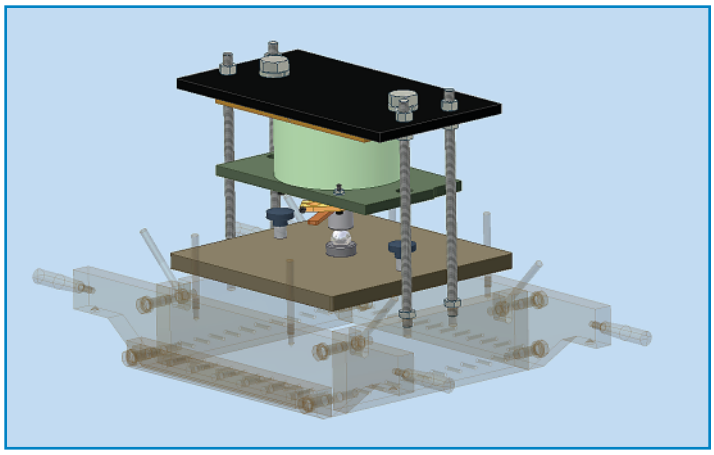
The High-load Sample Box has all the regular features of the standard box with the additional ability to apply a higher range of normal loads to the sample.

- Applied loads from 2,000 to 22,000 lbf (9 kN to 97 kN) which include the standard range plus the extended range.
- The load is applied with a hydraulic cylinder operating against a rigid upper platen.
- A simple, durable, and efficient air-operated hydraulic pump powers the hydraulic cylinder. It requires a source of compressed air.
- The power pack includes a digital readout and matching pressure transducer for measuring hydraulic pressure. (See photo below.)



High-load Sample Box shown coupled to the drive unit. The air-over-hydraulics power pack is clearly visible on the left.

Low-load Attachment



The Low-load Attachment is intended for use as an addition to the standard-load or the high-load boxes. It fits on the upper, stationary half of the shear box assembly. Compressed air is supplied to the device by connecting one line with a quick disconnect fitting. The air pressure is read to 0.1 psi (0.7 kPa) on the digital indicator located on the drive unit. A rolling diaphragm provides a constant effective pressure area which guarantees a repeatable displacement every time. Requires dry and filtered compressed air.

- Applied loads from 20 to 2,000 lbf (100 N to 9 kN). A calibration chart is supplied to convert force to load.

Spacer Blocks

The lower and/or upper boxes may be filled with spacer blocks to limit the amount of soil used. These blocks are made of plastic and come with and without drainage grooves. Aluminum blocks are offered as an alternative.

Porous Stone Block

A porous stone block is available to prevent the soil from passing into the water drainage system.

WinSAS™ Software

Data collection software for PC; comes with RS-232/485 connection to allow for ASCII data access from the digital readouts.

LDT and Readout for Consolidation

Linear displacement transducer (LDT) with 1-inch (25.4 mm) travel and matching readout for measuring consolidation on low-load and high-load attachments. Factory installation only — must be ordered at the same time as the drive unit.

Calibration Kit for Shear Box

Calibration kit to measure the resistance to shear inherent to the machine. The set includes a loading plate, four load cells and a digital indicator with summation capability.

SPECIFICATIONS

Sample Box Size	Upper Box: 12 x 12 x 4 in (305 x 305 x 102 mm) Lower Box: 12 x 16 x 4 in (305 x 405 x 102 mm)	
Shear Plane Gap	Adjustable 0 to 0.500 in (12.7 mm)	
Normal Load	Standard Range: 2,000 to 14,400 lbf (9 kN to 64 kN)	High-Load Range: 2,000 to 22,000 lbf (9 kN to 97 kN)
	Low-Range Option: 20 to 2,000 lbf (100 N to 9 kN)	
	Ranges above readable to 9 lbf (40 N)	
Shear force	100 to 10,000 lbf (44.4 kN). Readable to 1 lbf. Horizontal	
Strain rate	0.001 to 0.20 inch (0.025 to 5.00 mm) /minute	
Horizontal Displacement	Up to 4.0 in (101 mm)	
Sensitivity of Displacement Indicator	0.001 in (0.02 mm) Accuracy of 0.10% full scale	
Normal Displacement	Up to 1" (25 mm)	
Power Supply Requirement	Electric: 120 V, 50/60 Hz; Optional: 230 V, 50/60 Hz. Compressed Air for optional High-Load or Low-Load Diaphragm: 100 psi (1034 kPa) max., dry and filtered.	
Dimensions	(L x W x H)	
Drive unit	26 x 30 x 38 in (66 x 76 x 97 cm)	
Standard Box	24 x 26 x 38 in (61 x 66 x 97 cm)	
High-load Box	TBA	
Drive unit + box	On pallet: 68 x 56 x 40 in (1.73 x 1.42 x 1 m)	
Factory Calibration	*Calibration certificates provided for displacement transducer, load cell and strain rate.*	

ORDERING INFORMATION

	Drive Unit	250 lb
LG-8000E	120 V, 50/60 Hz, displays U.S. Customary Units	
LG-8000M	120 V, 50/60 Hz, displays SI units	
LG-8010E	230 V, 50/60 Hz, displays U.S. Customary Units	
LG-8010M	230 V, 50/60 Hz, displays SI units	
LG-8100	**Sample Box, Standard**	465 lb
	Sample Box, High-Load	680 lb
LG-8200E	120 / 230 V, 50/60 Hz, w/ U.S. Customary Units	
LG-8200M	120 / 230 V, 50/60 Hz, w/ metric units	
LG-11220	**Low-Load Attachment**	35 lb

Accessories:

13685	Calibration Kit for Shear Box, 120 V, 50/60 Hz. *Other power option and metric units available upon request.*
LG-11415	Porous Stone Block 12 x 12 x 1/2 in (305 x 305 x 13 mm)
LG-11409	Spacer Block, aluminum 4 x 4 x 12 in (102 x 102 x 305 mm) For upper or lower box. *Note: It takes three blocks to fill upper box; four blocks to fill lower box.*
E-311	Displacement transducer

Spacers used for filling the stationary (upper) box:

LG-11201	Spacer Block, plastic 12 x 12 x 1 in (305 x 305 x 25 mm)
LG-11203	Spacer Block, plastic with drainage grooves 12 x 12 x 1 in (305 x 305 x 25 mm)

Spacers used for filling the moveable (lower) box:

LG-11202	Spacer Block, plastic 12 x 16 x 1 in (305 x 406 x 25 mm)
LG-11204	Spacer Block, plastic with drainage grooves 12 x 16 x 1 in (305 x 406 x 25 mm)

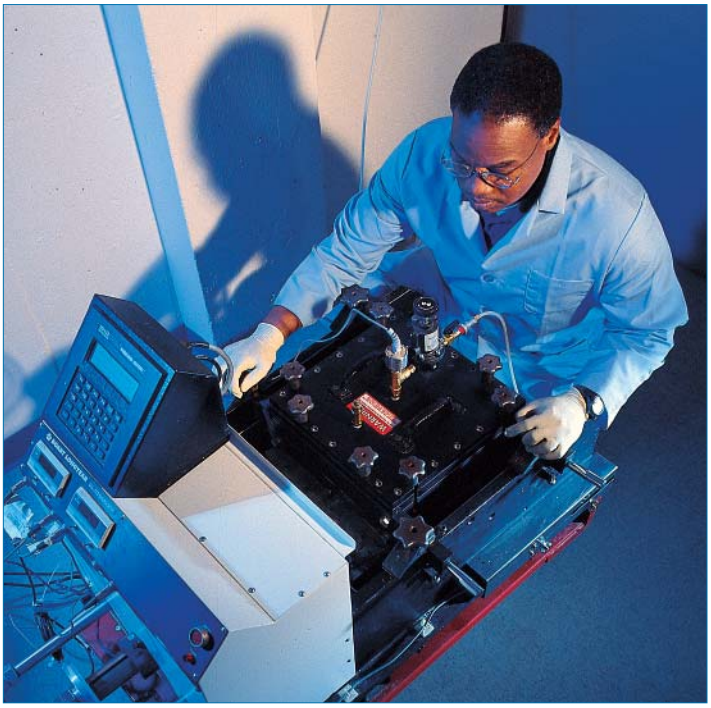


Photo provided to indicate relative size of the product, not technical details. Photo courtesy of Golder Associates (Atlanta, GA).

Partially knocked-down assembly showing the traveling, stainless-steel lower container inside which the bottom box is attached.