OPERATING INSTRUCTIONS

Combination Permeameter

25-0623

ELE International Chartmoor Road, Chartwell Business Park Leighton Buzzard, Bedfordshire, LU7 4WG England phone: +44 (0) 1525 249200 fax: +44 (0) 1525 249249 email: ele@eleint.co.uk http://www.ele.com ELE International, a division of Hach Lange Ltd.	***Distributor:***	**ELE International** Soiltest Product Division PO Box 389, Loveland, CO 80539 USA phone: +1 (800) 323 1242 fax: +1 (970) 663 9781 email: soiltest@eleusa.com http://www.eleusa.com

Contents

1 General Description

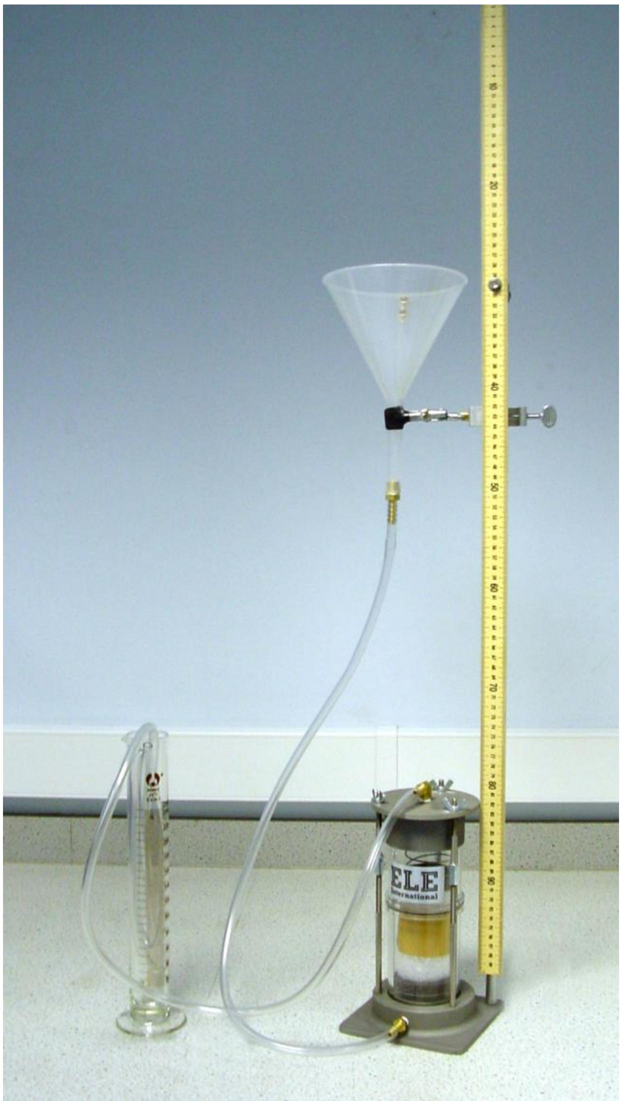
The Combination Permeameter is designed for the laboratory determination of permeability of either fine grained or coarse-grained soils. Generally soils containing 10% or more particles passing a No. 200 (75 micron) sieve are tested using the falling head assembly. More granular soils, containing 90% or more particles retained on a No. 200 (75 micron) sieve, are tested using the constant head assembly.

The permeability chamber disassembles into two sections. The bottom section only is normally used for falling head tests. It will accommodate a sample up to 2½ inches (63.5 mm) in length. When greater flow is expected, as with the constant head test, the lower chamber disassembles from the base to allow for easy placement of undisturbed or remolded samples. Chamber diameter is 2½ inches (63.5 mm) (31.65 sq.cm. area). The unit is easily converted from falling head assembly and back in seconds.

It is assumed that the Combination Permeameter will be used in a laboratory at controlled temperature conditions of 20ºC (68ºF). Temperature corrections for viscosity of water need not be considered unless temperature deviates by more than +/- 5ºC.

2 Preparation of Specimen and Test Procedure

2.1 Constant Head Test



2.1.1 Select a representative sample of air dried soil containing less than 10% of particles passing the No. 200 (75 micron) sieve and equal in amount to twice that required for filling the permeameter chamber (approximately 800 grams).

2.1.2 Mix sufficient moisture into the soil to prevent segregation of particles during placing into the permeameter. The water content should be such that the mixture just flows freely to form layers.

2.1.3 Remove the chamber cap and upper chamber from the unit by unscrewing the three knurled cap nuts and lifting the units off the tie rods. Position one porous stone on the support ring in the base of the chamber.

2.1.4 Using a scoop or funnel pour the prepared specimen in a circular manner into the lower chamber to a depth of 1.5cm so that a uniform layer is formed. Compact the layer of soil to the desired density, repeating the procedure until the sample is within 2cm (0.8 inch) of the top of the lower chamber section.

2.1.5 Replace the upper chamber section, being careful not to disturb the test specimen. Be sure to place the rubber gasket between chamber sections. Continue the sample placement operations until the level of compacted material is approximately 2cm (0.8 inch) below the top of the upper chamber. Carefully level the surface of the specimen and place the upper porous stone on the specimen. Place the compression spring on the porous stone, and replace the chamber cap and sealing gasket, securing it firmly with the cap nuts. The spring prevents change in sample length, measure and record the sample length.

2.1.6 Connect a vacuum pump or suitable aspirator to the outflow line at the top of the chamber. Assemble the constant head funnel and meter stick to the funnel rod using the special clamp provided. Adjust the constant head funnel to the desired height above the outflow port to create the desired head. Record the distance between funnel overflow port (the upper serrated fitting on the funnel) and the chamber outflow port.

2.1.7 Using a pinch clamp, seal the inflow tube at the bottom of the unit. Fill the constant head funnel with water from the source to be used while testing. (A constant flow of water into the funnel will be required.) Connect the water to lower serrated fitting.

2.1.8 Apply a vacuum of approximately 20 inches Hg (33.5 kPa) for fifteen minutes to remove trapped air in the specimen and from the voids. After evacuation, gradually open the pinch clamp and slowly allow the sample to saturate under full vacuum. Disconnect the vacuum pump when the chamber is filled with water.

2.1.9 Place a graduated cylinder to receive outflow from the chamber. Fully open and remove the pinch clamp from the inflow line and regulate the flow of water into the constant head funnel so that a stable condition with flow from both the funnel overflow port and chamber overflow line is achieved.

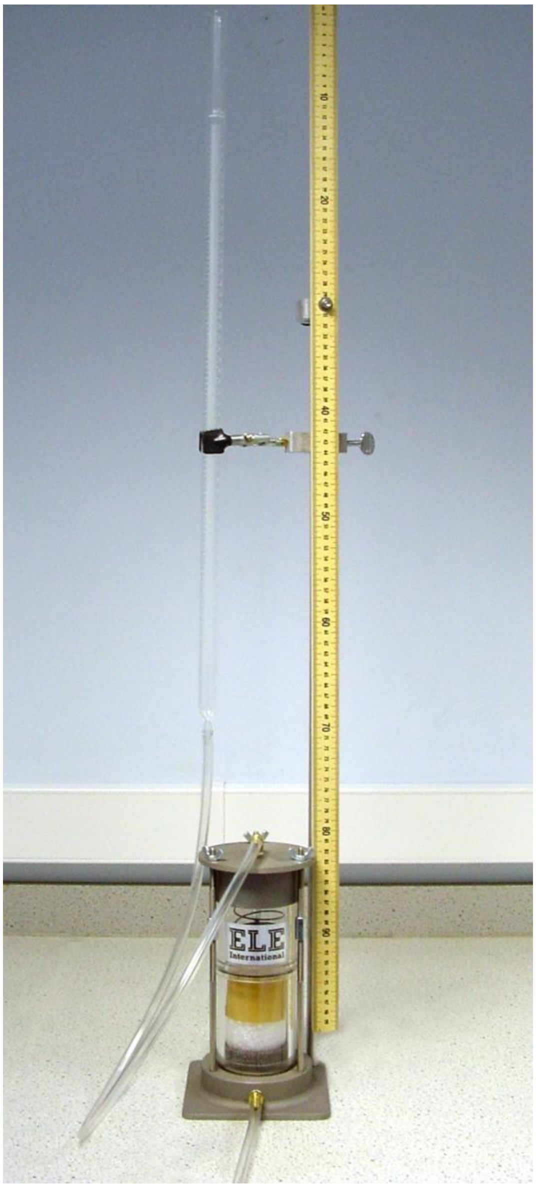
2.1.10 After equilibrium flow conditions are established, measure and record the time required for a given quantity of water to flow from the chamber. Record the water quantity.

2.1.11 Calculate the coefficient of permeability (K) using the following equation.

$$K = \frac{QL}{31.65\,th} \quad \text{or} \quad K = \frac{QL}{Ath}$$

K = Coefficient of permeability (cm per second)
Q = Quantity of water discharge in ml
L = Length of sample in cm
t = Total time for discharge in seconds
h = Vertical distance between funnel overflow and chamber outflow port in cm
A = Area of cross section of specimen = 31.65cm^2

2.2 Falling Head Test



2.2.1 Select a representative sample of the material to be tested and compact it in the lower chamber section in layers to approximately 2cm (0.8 inch) below the chamber rim.

2.2.2 Remove the upper section of the chamber tie rods, place the upper porous stone on the specimen and secure the chamber head with spring to the unit. Measure and record the specimen length.

2.2.3 Attach the falling head burette to the support rod using the clamp. Position the burette as high as practical. Position the meter stick directly behind the burette, such that the height of water in the burette above the chamber overflow port may be read. Connect the bottom of the burette to inflow tube at bottom of chamber.

2.2.4 Using a pinch clamp, seal the chamber inflow tube near the inflow port and fill the burette with water.

2.2.5 Connect a vacuum pump or aspirator to the outflow line of the chamber. Evacuate the chamber and sample with a full vacuum for approximately 30 minutes. After evacuation, gradually open the pinch clamp and allow the sample to saturate, still under full vacuum. Disconnect the vacuum pump when the chamber is full of water. NOTE: During sample saturation be sure to keep the falling head burette filled with water above the plastic tubing.

2.2.6 Allow water to flow through the specimen until a constant flow condition is observed. Fill the burette to it's top graduation and record the height of water above the chamber outflow port and the date and time. Place a moist cotton stopper in the top of the burette to prevent evaporation.

2.2.7 Allow water to permeate through the sample until a minimum of 20 ml of flow has occurred. Record the flow in the height of the water column above the chamber outflow port, and the date and time.

2.2.8 Calculate the permeability (K) using the following equation

$$K = \frac{aL}{At} \times \text{Loge} \frac{h_0}{h_1} \quad a = \frac{Q}{h_0 - h_1}$$

Or

$$K = \frac{2.3aL}{At} \times \text{Log } 10 \frac{h_0}{h_1}$$

$$K = \frac{2.3QL}{31.65t\,(h_0 - h_1)} \times \text{Log } 10 \frac{h_0}{h_1}$$

Or

$$K = \frac{QL}{13.76t\,(h_0 - h_1)} \times \text{Log } 10 \frac{h_0}{h_1}$$

K = Coefficient of permeability (cm per second)
Q = Flow in ml
L = Length of sample in cm
T = Total time of flow in seconds
h_0 = Initial height of water column above chamber outflow port in cm
h_1 = Final height of water column above chamber outflow port in cm
A = Area of cross section of specimen = 31.65cm^2