

Soil Index Properties

Soil index properties are used extensively by engineers to discriminate between the different kinds of soil within a broad category, e.g. clay will exhibit a wide range of engineering properties depending upon its composition. Classification tests to determine index properties will provide the engineer with valuable information when the results are compared against empirical data relative to the index properties determined.

Determination of Liquid Limit

The condition of a soil can be altered by changing the moisture content. The liquid limit is the empirically established moisture content at which a soil passes from the plastic to the liquid state. A knowledge of the liquid limit allows the engineer to correlate several engineering properties with the soil. Two main types of test are used. The Casagrande type which has been used for many years and the cone penetrometer method which is now the definitive method specified in BS 1377.

Casagrande Method

- Satisfies International Standards
- Motorised versions with integral blow counter available

Particular design features of the instrument include a positive action horizontal lead screw which is rapidly adjustable and rigidly fixes the height of cup in relation to the base during the test procedure. The cam mechanism and cup suspension assembly have been designed to withstand constant use with minimum re-adjustment.

Ordering Information

Casagrande Method BS 1377, EN DD ENV 1997-2

EL24-0410
Hand operated Liquid Limit Device BS, with revolution counter. Complete with metal grooving tool and test gauge.
 Weight 5 kg

EL24-0417/01
Motorised Liquid Limit Device. Complete with revolution counter and motor. Weight 8.5 kg
 For 220 – 240 V AC, 50 – 60 Hz, 1 ph.

Accessories

- EL24-0425** Grooving Tool and Gauge Weight 145 g
- EL24-0430** Glass Plate 500 mm square x 10 mm thick. Weight 145 g

Casagrande Method ASTM D4318; AASHTO T89

EL24-0434
Liquid Limit Device complete with revolution counter. Supplied less grooving tool. Weight 3.0 kg

EL24-0443/01
Motorised Liquid Limit Device. Supplied less grooving tool. For 220 – 240V, 50Hz, 1ph. Weight 5.1 kg

Accessories

EL24-0461 AASHTO Casagrande Grooving Tool
 Weight 85 g

Spares

EL24-0453 ASTM Metal Grooving Tool.
 Weight 100 g



Liquid Limit Device with accessories

Phases of Soil and the Atterberg Limits

Phase	Solid State	Semi-Solid State	Plastic State	Liquid State	Suspension
Water	← Water Content Decreasing →				
Limits	Dry Soil	Shrinkage Limit SL	Plastic Limit PL	Sticky Limit Liquid Limit LL	
		Plasticity Index - PI			
Shrinkage	Volume Constant	← Volume Decreasing →			
Condition	Hard to Stiff	Workable	Sticky	Slurry	Water-Held Suspension
Shear Strength (kN/m ²)	← Shear Strength Increasing →			Negligible to Nil	
Moisture Content	0	SL	PL	PI	LL

Cone Penetrometer Method

BS 1377, 1924-2, EN DD ENV 1997-2

- **Reduces operator error**
- **Applicable to a wide range of soils**
- **Gives reproducible test results**
- **Provides direct measurement of penetration**

The method is fundamentally more satisfactory than the Casagrande method as it is essentially a static test depending on the soil shear strength. The test is based on the relationship between moisture content and the penetration of a cone into the soil sample under controlled conditions.

Specification

Dial indicator	150 mm diameter graduated in 400 x 0.1 mm divisions, indicator point incorporates friction/gear system
Height adjustment	Rapid, using integral clamping mechanism
Cone release	Manual
Cone	1 x 30°, 35 mm test cone included
Base	Cast aluminium, adjustable leveling feet
Weight	6 kg

Ordering Information

EL24-0540
Cone Penetrometer

Accessories

- EL24-0546** **Test Gauge.** For checking the condition of the Cone Point. *Weight 30 g*
- EL24-0548** **Penetration Test Cup.** 55 mm diameter by 40 mm deep, with the rim parallel to the flat base. *Weight 100 g*

Spares

- EL24-0544** **Penetration Test Cone.** Stainless steel, 35 mm long with smooth surface at an angle of 30°. *Weight 100 g*

Right: EL24-0545/01 Semi-Automatic Penetrometer, shown with optional Test Cup

Below: Penetration Test Cone and Test Gauge



Semi-Automatic Cone Penetrometer

Ordering Information

EL24-0545/01

Semi-Automatic Cone Penetrometer. Specification same as EL24-0540 but incorporates Digital Automatic controller which releases the plunger head and ensures free falling of the penetration device during the test. The time set is displayed by a bright easy to read display. *Weight 8.6 kg*
For 220 – 240 V AC, 50 – 60 Hz, 1 ph

Determination of Plastic Limit

BS 1377, 1924-2, EN DD ENV 1997-2; ASTM D4318; AASHTO T90

The plastic limit is defined as the lowest moisture content of a soil that will permit a sample to be rolled into threads of 3 mm diameter without the threads breaking.

The test procedure has remained, in principle, the same since 1932, when Casagrande proposed to define the various limits by relating the moisture content characteristics of soil under certain conditions. The apparatus required is simple yet effective.

The majority of the apparatus required for this test is standard laboratory equipment, for full details see the Laboratory Equipment section of the catalogue.

Ordering Information

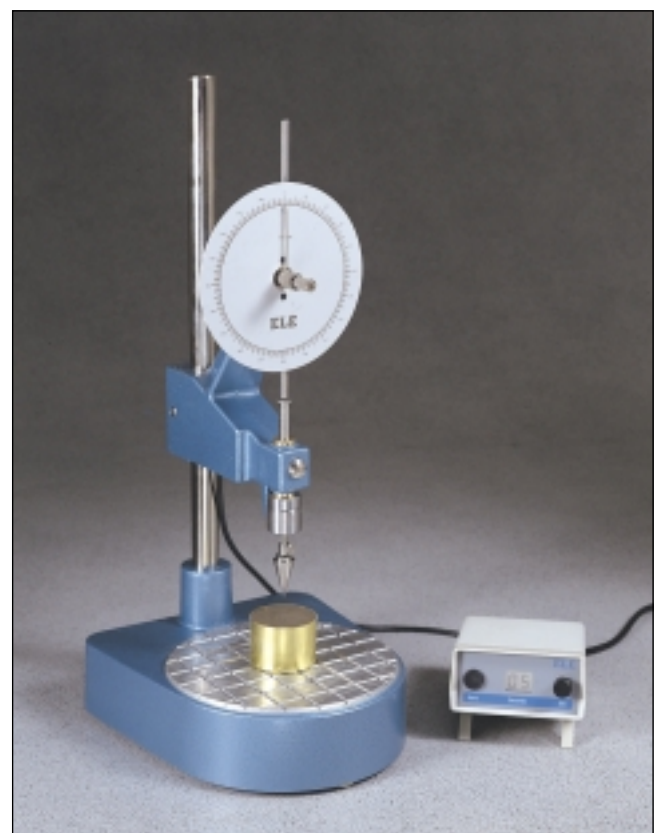
EL24-0811
Rod Comparator

Spatula

see General Section

Glass Plate

see EL24-0430



Determination of Shrinkage Characteristics

When the water content of a fine-grained soil is reduced below the plastic limit, shrinkage of the soil mass continues until the shrinkage limit is reached. Shrinkage can be significant in clays but less so in silts and sands.

The equipment listed below enables the engineer to determine a number of important parameters, including shrinkage ratio, volumetric shrinkage and linear shrinkage.

Volumetric Shrinkage

BS 1377; ASTM D427; AASHTO T92

This method of test covers the determination of the shrinkage limit, shrinkage ratio, volumetric shrinkage and linear shrinkage.

Ordering Information

EL24-1500

Prong Plate. Made of acrylic plastic fitted with three prongs, nominal 76 mm square and 2.4 mm thick. Weight 30 g

EL24-1550

Shrinkage Dish. Monel metal, nominal 42 mm diameter x 12 mm deep. Weight 60 g

EL24-1600

Glass Cup. Nominal 70 mm diameter x 50 mm deep. Weight 40g

Accessories

Measuring Cylinder see Laboratory Equipment section

Evaporating Dish see Laboratory Equipment section

Linear Shrinkage BS 1377

This test covers the determination of linear shrinkage of soils and indicates the plastic properties of soils with a low clay content.

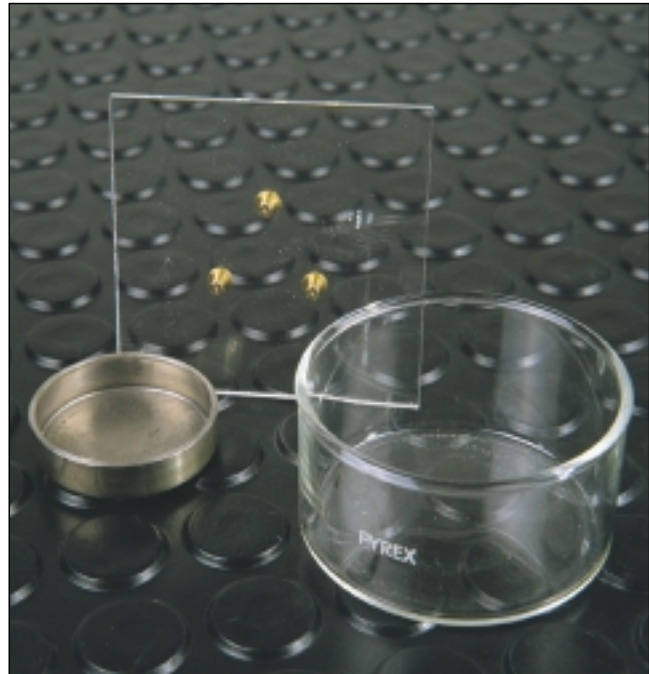
Ordering Information

EL24-1800

Shrinkage Mould. To produce a specimen 140 mm long x 12.5 mm radius. Weight 300 g

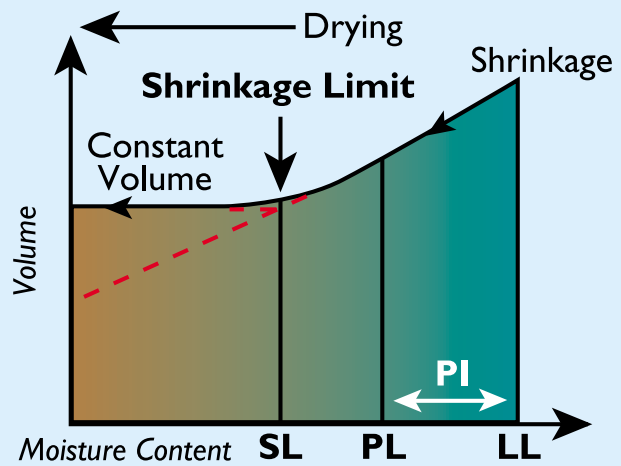
Accessories

Vernier Calipers see Laboratory Equipment section



Volumetric Shrinkage with Prong Plate, Dish and Glass Cup

Shrinkage Curve for Clay Soil



EL24-1800 Shrinkage Mould



**Determination of Density,
Particle Density and Specific Gravity**

The term density refers to mass per unit volume. The density of a mass of soil is of interest to the engineer for a variety of reasons including the design of earthworks and foundations and in slope stability analysis.

Particle density or specific gravity is a measure of the actual particles which make up the soil mass and is defined as the ratio of the mass of the particles to the mass of the water they displace. A knowledge of the particle density is essential in relation to other soil tests. It is used when calculating porosity and voids ratio and is particularly important when compaction and consolidation properties are being investigated. The majority of apparatus used for the various tests is general laboratory equipment.

Gas Jar Method BS 1377, EN DD ENV 1997-2

This method is suitable for soils containing up to 10% of particles retained on a 37.5 mm BS sieve.

Ordering Information

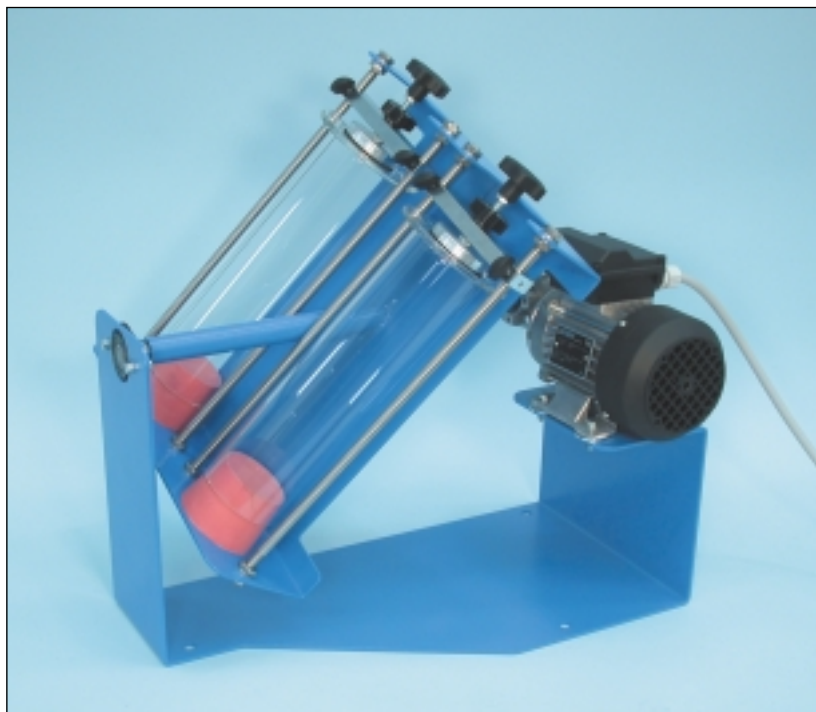
EL24-2830

Gas Jar 1 litre capacity complete with rubber bung and glass cover. *Weight 1.4 kg*

EL24-2854/01

Mechanical End-over-End Shaker fitted with friction safety device, capable of rotating two EL24-2830 Gas Jars at approximately 50 rpm to satisfy BS 1377. For 220 – 240 V AC, 50 – 60 Hz, 1 ph. *Weight 19 kg*

EL24-2854/01 End-over-end Shaker



**Particle Density:
Pycnometer Methods**

BS 1377, 812-2, EN 1097-7, EN DD ENV 1997-2;
ASTM D 854; AASHTO T 100

These methods are generally suitable for fine-grained soils. The larger pycnometers are not usually suitable for clay soils.

Ordering Information

EL24-2885

Pycnometer. Glass jar complete with non-corrodible cone. Capacity 1 kg

EL24-2890

Density Bottle 25 ml (Nominal capacity) Supplied complete with capillary vent stopper. Conforms to BS 733 and ISO 3507. Gay-Lussac type.

EL24-2900

Density Bottle 50 ml (Nominal capacity). Supplied complete with capillary vent stopper. Conforms to BS 733, and ISO 3507. Gay-Lussac type.

EL24-2950

Density Bottle 100 ml (Nominal capacity). Supplied complete with capillary vent stopper. Gay-Lussac type.

Density Bottles



Gas Jars



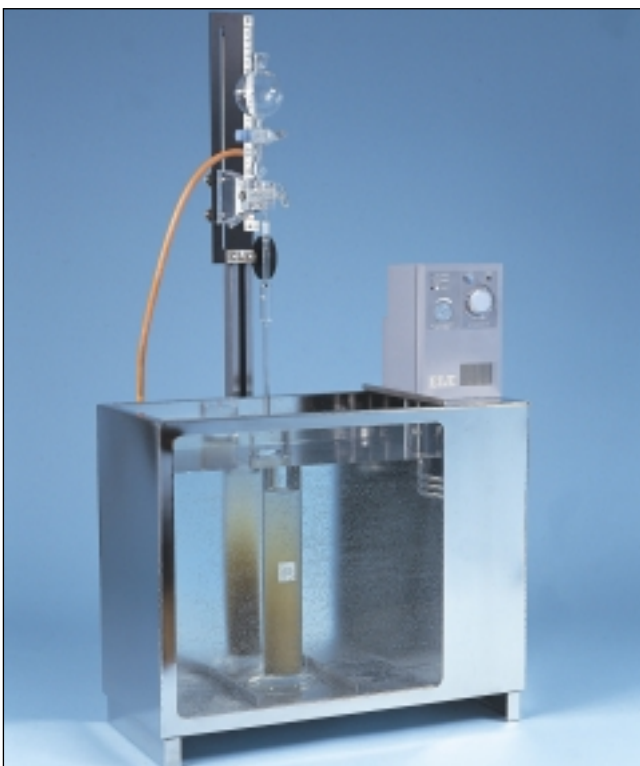
Particle Size Distribution and Sand Equivalent Value

The analysis of soils by particle size provides a useful engineering classification system from which a considerable amount of empirical data can be obtained.

Two separate and different procedures are used. Sieving is used for gravel and sand size particles and sedimentation procedures are used for the finer soils.

For soil containing a range of coarse and fine particles it is usual to employ a composite test of sieving and sedimentation procedures.

The Sand Equivalent Test serves as a rapid field test to show the relative proportions of clay-like or plastic fines and dusts in granular soils and fine aggregates.



Andreasen Pipette and Stand with Constant Temperature Bath

Sedimentation by the Pipette Method BS 1377

This method produces similar results to the hydrometer method, but is considered to be more precise. It requires delicate apparatus and greater accuracy in weighing.

Ordering Information

EL24-4851

Andreasen Pipette Stand with moving carriage assembly which can be operated with no vibration transmitted to the pipette whilst the pipette is being inserted and withdrawn from the liquid suspension. The stand is fitted with a holder for securing the pipette and is supplied with a stand for the sedimentation cylinder. Weight 9 kg

EL24-4853

Andreasen Pipette (10 ml capacity) conforming to the dimensions specified in BS 1377.

EL24-4855

Sedimentation Cylinder 500 ml with rubber bung. BS 1377. Weight 660 g

Constant Temperature Bath

Specially designed for the sedimentation testing of soils and other fine grained material, the bath is supplied with a false bottom to assist in circulation of the bath liquid. Adequate clearance is provided when the tank is used with a Pipette sedimentation stand. Will accommodate 6 EL24-4855 Sedimentation Cylinders and 3 EL24-4700 Hydrometer Sedimentation Cylinders

Specification

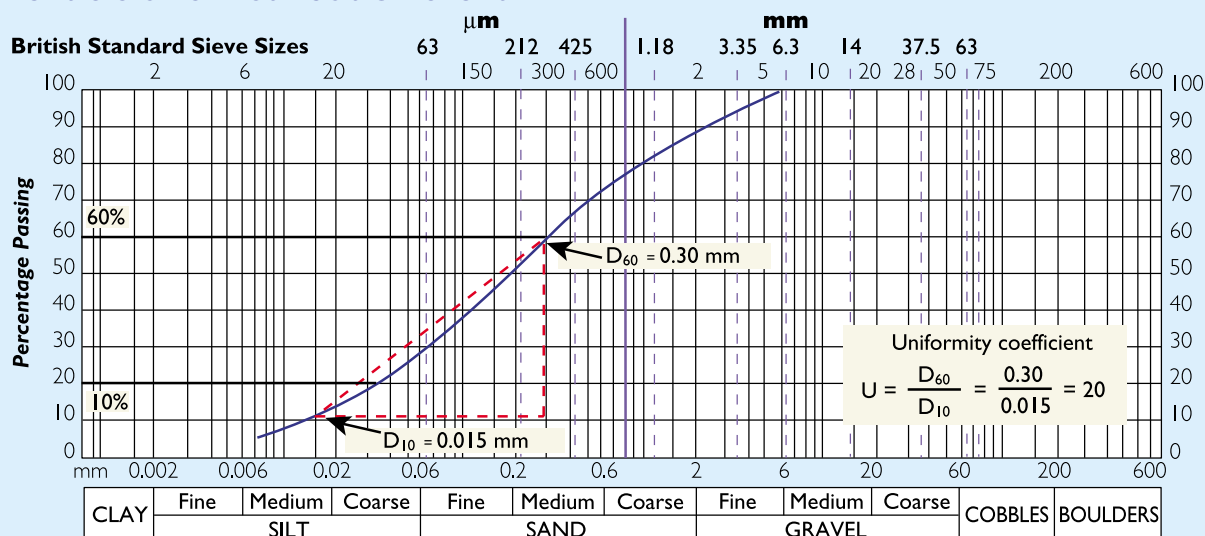
Dimensions (l x w x h)	535 x 210 x 610 mm external
Capacity	Holds upto 6 sedimentation cylinders
Construction	Stainless steel with toughened glass front
Temperature control	Heater/Thermostat/Circulation Unit with Digital Controller
Power	1 500 Watts
Weight	12 kg

Ordering Information

EL24-4865/01

Constant Temperature Bath For 220 – 240 V AC, 50 Hz, 1 ph

Particle Size Distribution chart



Sedimentation by the Hydrometer Method

BS 1377; ASTM D422; AASHTO T88

This method determines particle size distribution in a soil from the coarse sand size down to clay size (about 2 µm). The test does not require the weighing accuracy necessary for pipette sedimentation and is suitable for use in site laboratories.



EL24-4865/01 Constant Temperature Bath and Hydrometer Analysis

Mechanical Analysis Stirrer

ASTM D422; AASHTO T88

This compact, bench-top stirrer is used for dispersing soil samples in water for hydrometer analysis. The stirrer is supplied complete with Mixing Paddle and Dispersion Cup. *Weight 4 kg*

Ordering Information

EL24-4125/01
Mechanical Analysis Stirrer
For 220 – 240 V AC, 50 – 60 Hz, 1ph

Accessories

EL24-4145 **Sodium Hexametaphosphate, 500 g**
Constant Temperature Bath
see EL24-4865/01

Spares

EL24-4125/10 **Mixing Paddle** for EL24-4125/01
EL24-4125/11 **Soil Dispersion Cup and Baffle**
for EL24-4125/01

A comprehensive range of test sieves, sieve shakers and associated equipment is detailed in the Laboratory section of the catalogue for the determination of particle size distribution by sieving methods.

EL24-4125/01 Mechanical Analysis Stirrer

Soil Hydrometers

BS 1377, EN DD ENV 1997-2;
ASTM D422, E100; AASHTO T88

Ordering Information

EL24-4620
Soil Hydrometer BS/EN DD ENV
graduated 0.0995 to 1.030 g/ml.

EL24-4640
Soil Hydrometer ASTM/AASHTO (152H)
graduated –5 to +60 g/litre.

EL24-4650
Soil Hydrometer ASTM D422 (151H)
graduated 0.0995 to 1.038 g/ml.

Hydrometer Sedimentation Cylinder

BS 1337; ASTM D422; AASHTO T88

Ordering Information

EL24-4700
Hydrometer Sedimentation Cylinder 1000 ml capacity
complete with rubber bung.

Accessories

EL24-4800 **Nomographic Chart** for the
determination of Stoke's Law



Soil Hydrometers



Sand Equivalent Value

EN 933-8; ASTM D2419; AASHTO T176

Set Includes:-

- 4 Plastic measuring cylinders
- 1 Carrying case
- 1 Weighted foot assembly
- 1 Irrigator tube
- 1 Rubber tubing complete with pinch clip
- 1 Funnel

EL24-4915 Sand Equivalent Apparatus



Left: EL24-4950/01. Right: EL24-4945/01



Ordering Information

EL24-4915
Sand Equivalent Apparatus EN 933-8

EL24-4919
Sand Equivalent Apparatus ASTM D2419

Accessories

EL24-4925 **Syphon Assembly** with 5 litre polythene bottle. Supplied without rubber tubing.

EL24-4930 **Calcium Chloride** 2.5 kg.

EL24-4932 **Formaldehyde** 40% solution, 2.5 litres.

EL24-4934 **Glycerol Analar** 2.5 litres.

Spares

EL24-4915/15 **Plastic Measuring Cylinder** dual graduations suitable for EN and ASTM test methods.

Mechanical Sand Equivalent Shaker

Recommended for use in laboratories performing a large number of tests, these shakers provides a consistent and repeatable oscillation, minimising variation in test results.

Ordering Information

EL24-4945/01
Mechanical Sand Equivalent Shaker ASTM Method.

Weight 32.0 kg
For 220 – 240 V AC, 50 – 60 Hz, 1 ph

EL24-4950/01
Motorised Sand Equivalent Shaker with Interlock Guard, EN Method. Weight 30.0 kg

For 220 – 240V, 50 Hz, 1ph