

# OPERATING INSTRUCTIONS

## ASTM Liquid Limit Device

**24-0434**

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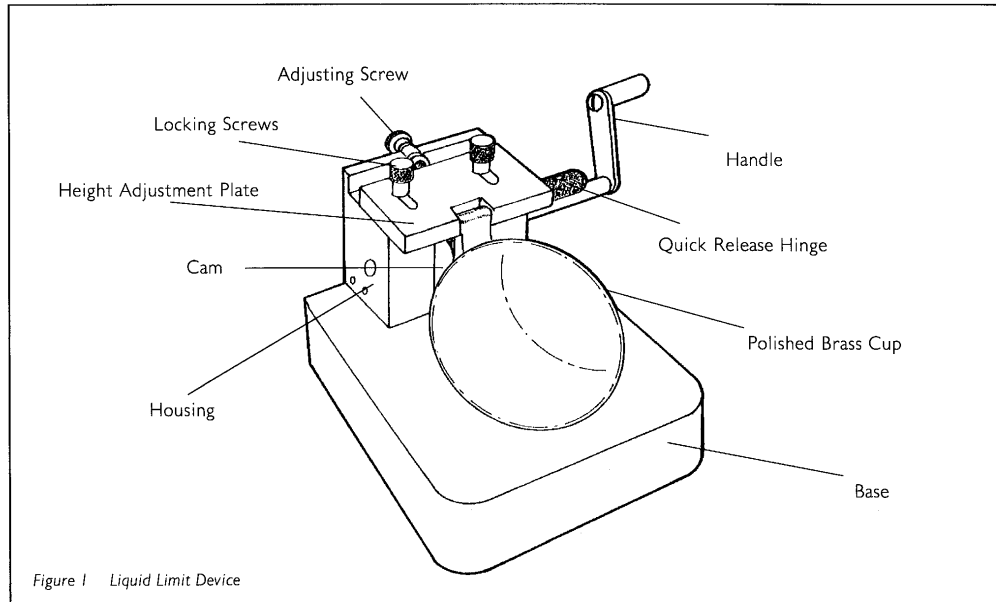
## **1 Introduction**

### **1.1 The limit tests**

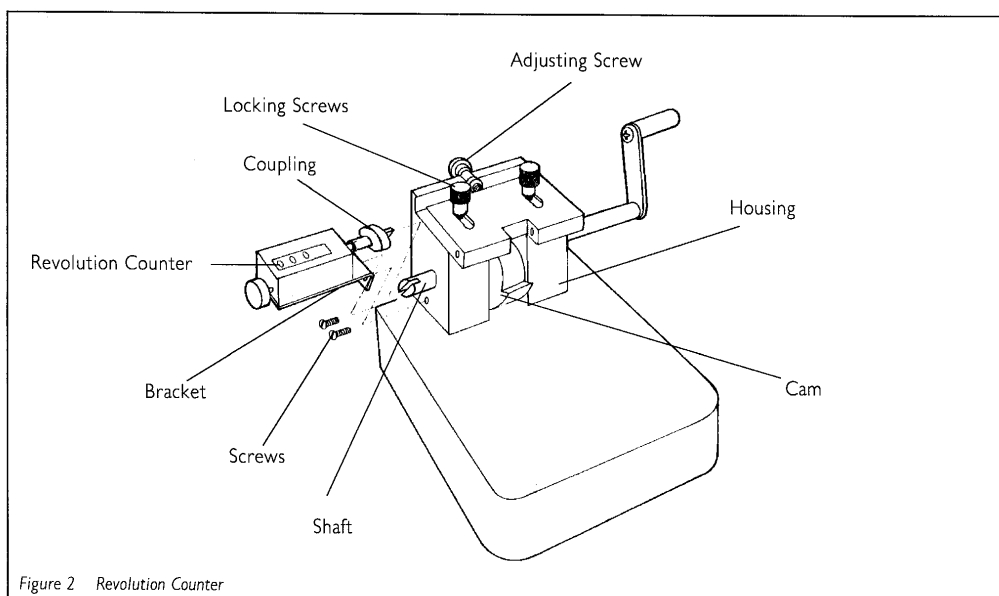
- 1.1.1 The liquid, plastic and shrinkage limits apply to fine grained soils in which the water content affects the physical properties, changing a clay soil from a solid to a liquid slurry. In 1911, A. Atterberg suggested the concept of boundaries to the four states in which a soil may exist, namely the liquid limit, the boundary between the liquid and plastic state; the plastic limit, the boundary between the plastic and semi-solid state and the shrinkage limit, the boundary between the semi-solid and solid state (Atterberg, A. 1911). These boundaries, like those between sand, silt and clay, are empirical, for the material grades imperceptibly from one state to the other and the boundaries have to be determined by a set procedure. The test for plastic limit and for shrinkage limit have remained, in principle, the same since 1932 when Casagrande proposed to define the various limits by reference to the moisture content of the soil under certain conditions (Casagrande, A., 1932).
- 1.1.2 The shrinkage limit became the moisture content at which soil, on being dried, ceased to shrink. Above the shrinkage limit, as a fine grained (clayey) soil loses moisture it shrinks. This shrinkage is due to, and is proportional to, the moisture loss; for every cubic centimetre loss in volume, the soil loses 1 gram of water. At the shrinkage limit, the water content is just sufficient to fill the voids and the soil sample is at its minimum volume obtainable by simple drying. The test consists of measuring the volume of a sample by displacement of mercury at different stages as it dries and shrinks, or measuring the linear shrinkage of a prepared specimen as it dries, calculating the moisture content from the weight of the sample, noting when the sample ceases to shrink and noting the corresponding moisture content.
- 1.1.3 The plastic limit was defined as the moisture content of a sample of soil such that when rolled out into threads of 2 mm diameter, the soil just crumbles as it reaches this diameter.
- 1.1.4 The liquid limit was originally considered as the moisture content at which 10 light jarring blows of the hand against a dish just closed the groove, previously made in the sample. The operator adjusted the moisture content by trial and error until the result was achieved (Wintermeyer, A.M., 1926). The liquid limit test as Casagrande proposed it, and similar to that now performed, is carried out by forming the groove in a pat of soil in a brass dish of certain dimensions, and by then repeatedly bumping the dish, by dropping it through a distance of one centimetre, onto a rubber base until the groove is just closed. The test is carried out by determining a series of moisture contents, each corresponding to a number of blows. A graph is then drawn on semi logarithmic paper relating blows and moisture content and the moisture content corresponding to the number of blows is read off.

## 2 The Equipment

### 2.1 Basic hand operated apparatus (Figure 1).



- 2.1.1 The base in the form of a solid rubber block is manufactured according to the appropriate Standard.
- 2.1.2 Mounted on the base is a cam support bracket which includes the cam, height adjustment plate, adjustment screws and lock nuts.
- 2.1.3 The polished brass cup is attached to the plate with a quick release hinge.
- 2.1.4 The cam is driven anti-clockwise by the handle fitted to the end of the cam shaft.



2.1.5 The counter is driven by a coupling fitted to the counter shaft and having a gear which engages with another gear on the end of the cam shaft.

2.2 Motorised unit (Figure 3).

2.2.1 A version of the apparatus is available that motorises the operation of the liquid limit device.

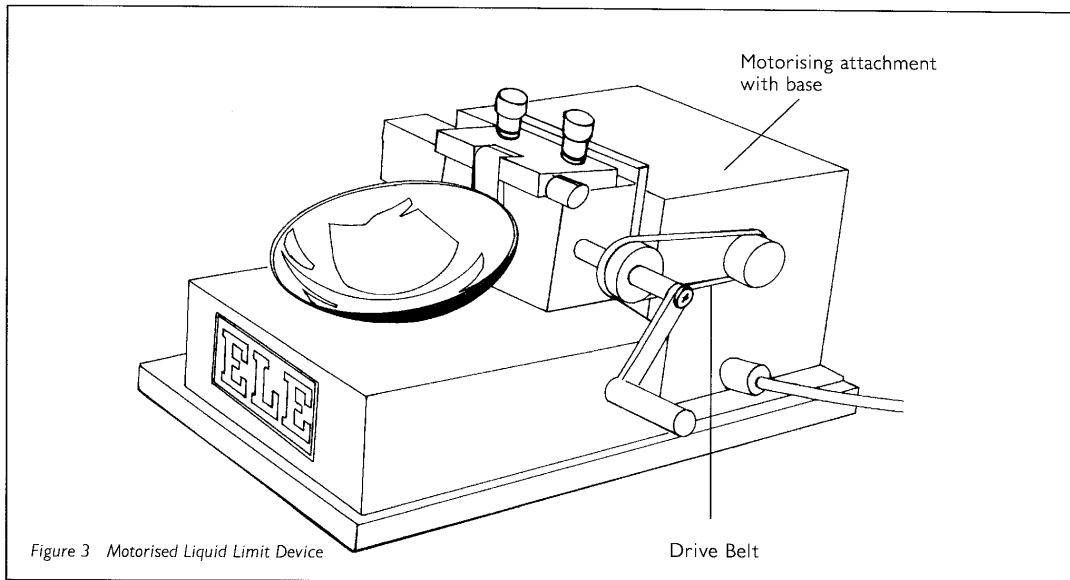


Figure 3 Motorised Liquid Limit Device

2.2.2 The liquid limit device incorporates a drive assembly with drive and follower pulleys, the latter fitted on the cam shaft of the liquid limit device. A blow counter is included in the motorised version.

**Note:** to use manual operation, slip the rubber belt off the follower pulley.

### 3 Operation

#### 3.1 General

3.1.1 This operating manual is not designed to detail precisely the individual techniques as described in various National Standards.

### 4 Maintenance

#### 4.1. Lubrication of moving parts

4.1.1 Using a light oil regularly lubricate the following parts:

- Cam surface
- Cam shaft
- Cup hinge