

Auto-Shrink

Purpose

The **Auto-Shrink** system measures the unrestrained autogenous shrinkage of a specimen of cement paste or mortar cured under sealed conditions (ASTM C1698). **Auto-Shrink** permits evaluation of the relative autogenous shrinkage potential of different cementitious systems. Excessive autogenous shrinkage may lead to microcracking that increases the permeability of concrete.

Principle

When cement hydrates through chemical reactions with water, the volume occupied by the products of hydration is less than the original volume of cement and water. This phenomenon is known as “chemical shrinkage.” When concrete is cured under sealed conditions (no external source of moisture), the reduction in paste volume due to hydration causes internal tensile stresses that can lead to microcracking. The microcracking, in turn, reduces concrete’s resistance to penetration of water and deleterious substances.

If a specimen of paste or mortar is cured under sealed conditions and allowed to change in volume, the chemical shrinkage of the paste will cause **autogenous shrinkage** of the specimen. The **Auto-Shrink** digital dilatometer is designed for linear measurement of autogenous shrinkage in hardening cement-based materials. A special corrugated plastic mold is used to prevent moisture loss and allow the specimen to shrink freely. With **Auto-Shrink**, it is possible to measure the time dependent deformation of many different specimens simultaneously over periods of weeks or even years. **Auto-Shrink** is intended primarily for measurements after setting of cement pastes or mortars with a maximum aggregate size of 2 mm. To minimize the influence of temperature variations, the dilatometer should be used in a thermostatically controlled room. Background information on the measurement technique used in **Auto-Shrink** can be found in the following reference:

Mejlhede Jensen, O. and Freiesleben Hansen, P. “A Dilatometer for Measuring Autogenous Deformation in Hardening Portland Cement Paste,” *Materials and Structures*, 1995, 28 (181) 406-409

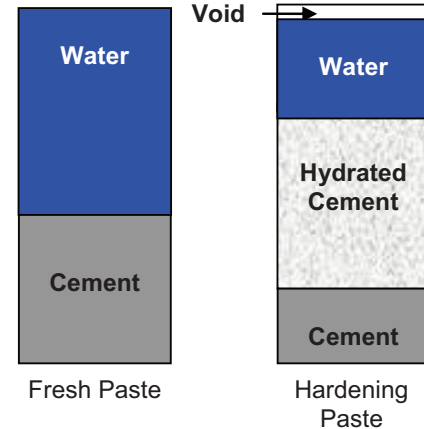
Auto-Shrink System

The **Auto-Shrink** digital dilatometer is composed of the following basic elements:

- A corrugated plastic mold with tight-fitting plugs to prepare a slender test specimen
- A rigid frame to support the specimen
- A digital dial gauge with remote control to measure change in specimen length
- A reference bar



Principal components of the **Auto-Shrink** system



The digital displacement gauge is fixed firmly to the frame with a blunted hex screw. The remote control is mounted on the side of the gauge. A lock function for the remote control is provided.

Specimens are cast vertically by using support tubes, which can be mounted to a vibrating table. To ensure that the cast specimens have approximately the same length, the corrugated mold should not be stretched or compressed during filling. The mold is filled to approximately 15 mm below the end of the tube to allow room for the top sealing plug. Before the top sealing plug is mounted, the corrugated tube is compressed slightly to bring the cement paste in contact with the sealing plug.

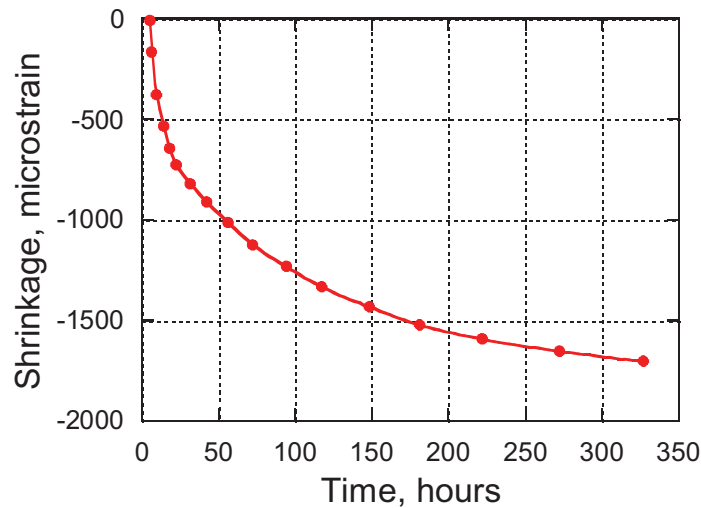
Measurements in the **Auto-Shrink** dilatometer are conveniently done relative to a reference bar. To ensure optimal measuring accuracy, the reference bar as well as the specimens should be placed in the frame in the same orientation during each measurement. A line mark with permanent ink at one end of the corrugated tube may be used to indicate the proper orientation of the specimen during measurement in the dilatometer.



Testing Example

In 2009, ASTM adopted a standard test method based on the **Auto-Shrink** system: "Test Method for Autogenous Strain of Cement Paste and Mortar," ASTM C1698.

The following graph is an example of autogenous strain measured over 2 weeks on a cement paste ($w/cm = 0.25$) with 10 % silica fume cured at 30 °C. Time is measured from the addition of water. The strain has been defined as 0 at the time of final setting of the paste (from Mejlhede Jensen and Freiesleben Hansen, 1995).



Auto-Shrink Ordering Numbers

Item	Order #
1 Dilatometer support frame with stop pin	AS-1000
1 Digital displacement gauge including remote control	AS-1010
1 Reference bar	AS-1020
1 Spanner 15 mm	AS-1030
1 Hex key 2½ mm	AS-1040
50 Corrugated tubes	AS-1050
100 Sealing plugs	AS-1060
1 Support tube for casting	AS-1070
5 grooved support racks each for 10 specimens	AS-1080
2 pairs of gloves	AS-1090

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