

**SETTING SHRINKAGE OF ELS and Tetric Evo Ceram  
DETERMINED IN THE ACTA DILATOMETER**

A.J. de Gee<sup>1</sup>, J.A. Rezende<sup>2</sup> and A.J. Feilzer<sup>3</sup>

Research number 2005.007R1 Shrinkage

May 3, 2005

By order of Saremco

- 1) Chemist, PhD
- 2) Chemical Analyst
- 3) DDS, PhD

© 2005

Academic Center for Dentistry Amsterdam (ACTA)

Department of Dental Materials Science

Dental Materials Research Foundation / ACTA

Louwesweg 1, 1066 EA Amsterdam, The Netherlands

e-mail: a.degee@acta.nl

fax: + 31 20 669 2726

## **Introduction**

This study concerns polymerization shrinkage measurements on the composites ELS (Saremco) and Tetric Evo Ceram (Ivoclar Vivadent ) with the ACTA dilatometer. Saremco gave the order by letter of January 12, 2005 and by E-mail of March 31, 2005. ELS was received on January 24, 2005 and Tetric Evo Ceram was purchased by ACTA. Preliminary results were sent on May 1, 2005. The experiments were performed in the period as mentioned in table 1.

## **Materials and methods**

Table 1. Materials tested for volumetric polymerization shrinkage in the ACTA dilatometer.

<b>Material</b>	<b>Code</b>	<b>Exp. period</b>	<b>Batch/Shade/Exp date</b>
ELS	ELS	March 2005	01/A2/2009-11
Tetric Evo Ceram	Tetric Evo Ceram	March 2005	G24606/A2/2008-10

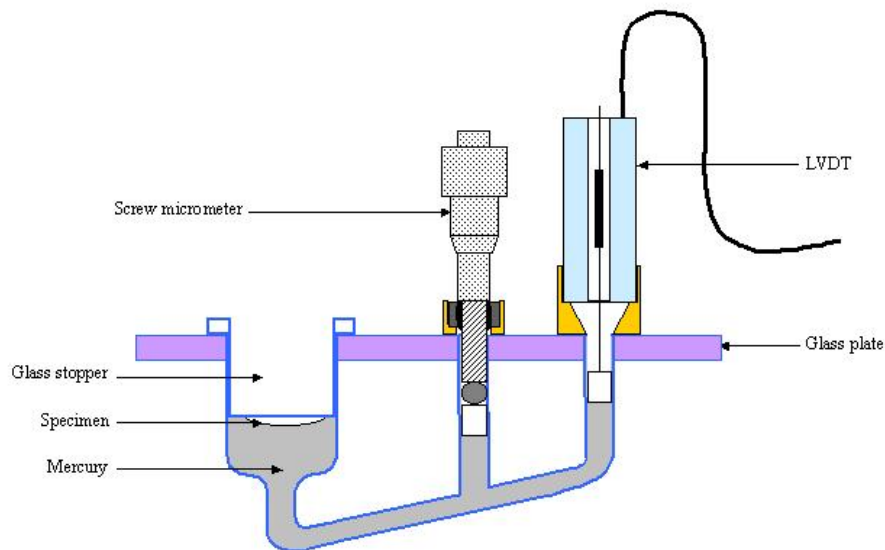
ELS = Extra Low Shrinkage

### **Setting shrinkage measurements**

Setting shrinkage measurements were recorded continuously over a period of 4 hours at 23 °C with a mercury dilatometer (Fig. 1). The electronic parts were renovated. The standard procedure and operation of the ACTA dilatometer (Fig. 1) was as follows:

1. A layer of high vacuum grease (Dow Corning Co, USA) was applied on the flat surface of the glass stopper for separation.
2. An amount of approximately 300 mg of a composite paste was applied on the greased surface of the stopper and flattened to a thickness of approximately 1.5 mm.
3. After the stopper was inserted into the dilatometer the specimen was light activated with an Elipar Highlight (Espe) for 40 s in Standard mode (750 mW/cm<sup>2</sup>). Recording was started at the moment that the light source was switched on.
4. The temperature of the dilatometer was 23.0 °C.
5. Of each material from table 1 three specimens (n = 3) were measured over a period of 4 hours.

6. After the specimens were removed from the dilatometer, the grease was washed-off in ether and the density measured with the special equipment for density measurements of a Mettler Toledo (Mettler AT 261 Delta Range Mettler Instruments AG).



Below the glass plate the dilatometer is placed in thermostated water ( $T \pm 0.05^\circ\text{C}$ ). At standard conditions  $T = 23^\circ\text{C}$ .  
The glass stopper is open at the top to allow access of the light guide of the light source to light cure the specimen.  
The specimen is positioned underneath the glass stopper.  
The micrometer screw is for calibration.  
The core inside the LVDT floats on the mercury. The LVDT is connected to the computer for continuous recording of the shrinkage.

Figure 1. Renovated ACTA mercury Dilatometer.

## Results

Table 2 shows the average volumetric polymerization shrinkage and standard deviations at selected time periods ( $n = 3$ ). Table 3 shows the used average specimen size (mg) of the materials and the average densities ( $\text{g}/\text{cm}^3$ ) determined after the shrinkage measurement. Figure 2 shows the average polymerization shrinkage curves of a complete measurement of 4 hours and figure 3 the average curves of the first 60 seconds, which include the period of light-activation (40 sec) and 20 sec thereafter.

Table 2. Volumetric polymerization shrinkage (vol %) of the investigated materials at selected time points (n = 3).

	<b>ELS</b>	<b>Tetric Evo Ceram</b>
1 min	1.3 (0.05)	1.3 (0.12)
5 min	1.8 (0.07)	1.7 (0.11)
10 min	1.9 (0.07)	1.8 (0.10)
15 min	1.9 (0.07)	1.8 (0.08)
30 min	2.1 (0.09)	2.0 (0.05)
60 min	2.2 (0.08)	2.1 (0.06)
120 min	2.3 (0.09)	2.2 (0.06)
180 min	2.4 (0.09)	2.3 (0.05)
240 min	2.5 (0.10)	2.4 (0.06)

Table 3. Average density ( $\text{g/cm}^3$ ) of the investigated materials and the average specimen size (mg) used in the experiments (n = 3). Standard deviations between brackets.

	<b>ELS</b>	<b>Tetric Evo Ceram</b>
Density ( $\text{g/cm}^3$ )	2.08 (0.02)	2.13 (0.01)
specimen size (mg)	349 (36)	312 (9)

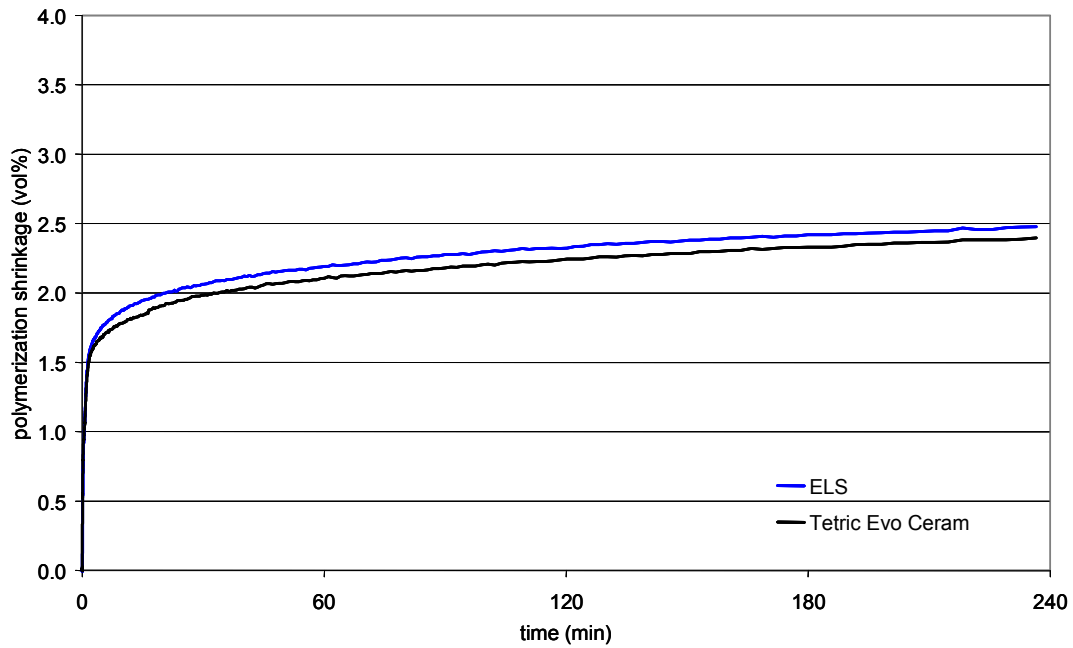


Figure 2a. Polymerization shrinkage curves of the investigated materials measured for a period of 4 hours. The Elipar Highlight was used in standard mode to light cure the materials for 40 s ( $750 \text{ mW/cm}^2$ ).

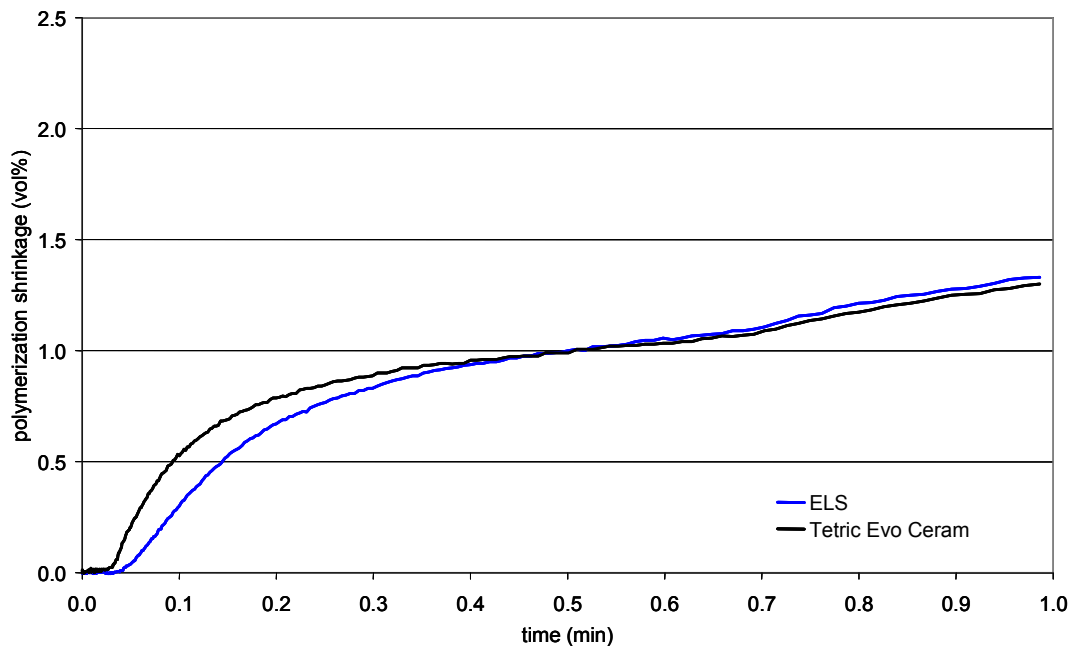


Figure 2b. Polymerization shrinkage curves of the investigated materials displayed for a period of 60 s. The Elipar Highlight was used in standard mode to light cure the materials for 40 s ( $750 \text{ mW/cm}^2$ ).