

**SETTING SHRINKAGE STRESS OF
ELS and Tetric Evo Ceram**
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By order of Saremco

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Introduction

This study concerns polymerization shrinkage stress measurements on the composites ELS (Saremco) and Tetric Evo Ceram (Ivoclar Vivadent). 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 March 19 and May 1, 2005. The experiments were performed in the periods as mentioned in table 1.

Materials and methods

Table 1. Materials tested for polymerization shrinkage stress.

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

ELS = Extra Low Shrinkage

Setting shrinkage stress measurements

The test setup shown in figure 1 was placed in an Instron 6022 Tensilometer. Composite paste was inserted between the glass plate and the flat surface of the steel bolt head and adhered to both these surfaces. During light curing and a period of 30 min following, the shrinkage stress development was measured, while the distance between the glass and the steel bolt head was kept constant. This simulated a restoration in a fully rigid situation where the cavity walls cannot yield to the contraction forces.

Technical procedures

Preparation of surface of the glass plate:

The glass plate (4 mm thick) was glued to a stainless steel tube (inner diameter approx. 3 cm), which had an outward speed to enable to screw it into the platform of the setup. The upper glass surface, on the spot where the specimen had to be adhered, was sandblasted with Al₂O₃ (50 μm) until an even “frosted” surface developed. Remaining Al₂O₃ was removed by compressed air. One drop of Ceramic Primer (3M Espe) was applied to this frosted surface and the solvent gently evaporated by an airflow. A small amount of Scotchbond MP resin (3M Espe) was blown out over the surface into a thin layer and light

cured for 20 sec. The steel tube with the glued glass plate was then mounted in the platform of the setup and fixed with a lock nut.

Preparation of the bolt head:

The bolt head (diameter $D = 3.2$ mm) was wet-ground on 600 grit SiC sandpaper and then sandblasted with Al_2O_3 (50 μm), rinsed with acetone and treated in a Silicoater (Heraeus Kulzer) to deposit a thin silica layer. A drop of fresh Silicoup (Heraeus Kulzer) was applied to silanize the surface. After drying a thin layer of Scotch Bond MP (3M Espe) was blown out over the surface, and light cured for 20 seconds. Finally the bolt was fixed in the setup of the tensilometer.

Insertion of the composite and activation:

The distance between the surfaces of the glass plate and the bolt head was adjusted to 0.8 mm, which had to become the specimen thickness (H) in the experiments. Together with the specimen diameter (D) a C-value of $C = D/2H = 3.2/1.6 = 2$ was obtained (Feilzer *et al. J Dent Res* **66**:1636-9, 1987). The LDTV's (probes) of the tensilometer were reset to zero (zero position) and the crosshead of the tensilometer was lifted to enable to apply a small amount of composite paste on the bolt head. Then the crosshead was returned to its zero position. Excess of composite was removed with a spatula. The specimens were light cured through the glass with an Elipar Highlight (3M Espe) for 40 s in Standard mode (750 mW/cm^2).

Measurement

From the start of light curing the shrinkage stress development was measured during 30 min. The axial contraction of the specimens was continuously counteracted by a feedback displacement of the crosshead to keep the thickness of the specimen constant. The average shrinkage stress of each of the composites in table 1 was determined from three measurements ($n = 3$).

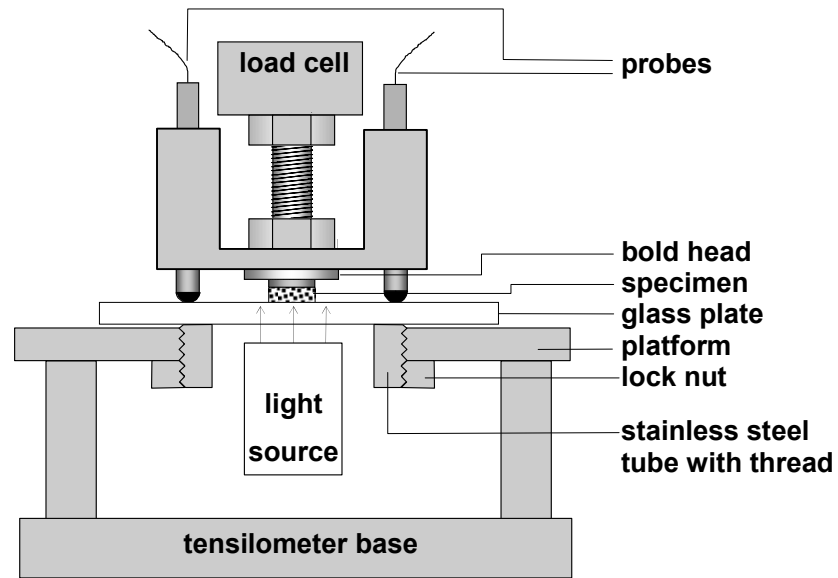


Figure 1. Setup in the tensiometer. The specimen was bonded to the flat surface of a bold head and the surface of a glass plate. Light curing was from underneath the glass plate.

Results

The results of the shrinkage stress development are given graphically in figure 2 representing the measurement period of 30 min and in figure 3 representing the first 60 sec of curing. Table 2 shows numeric data at selected time moments.

Remark

A shrinkage stress value as low as that determined for ELS was not found earlier for other commercial composites of the same class.

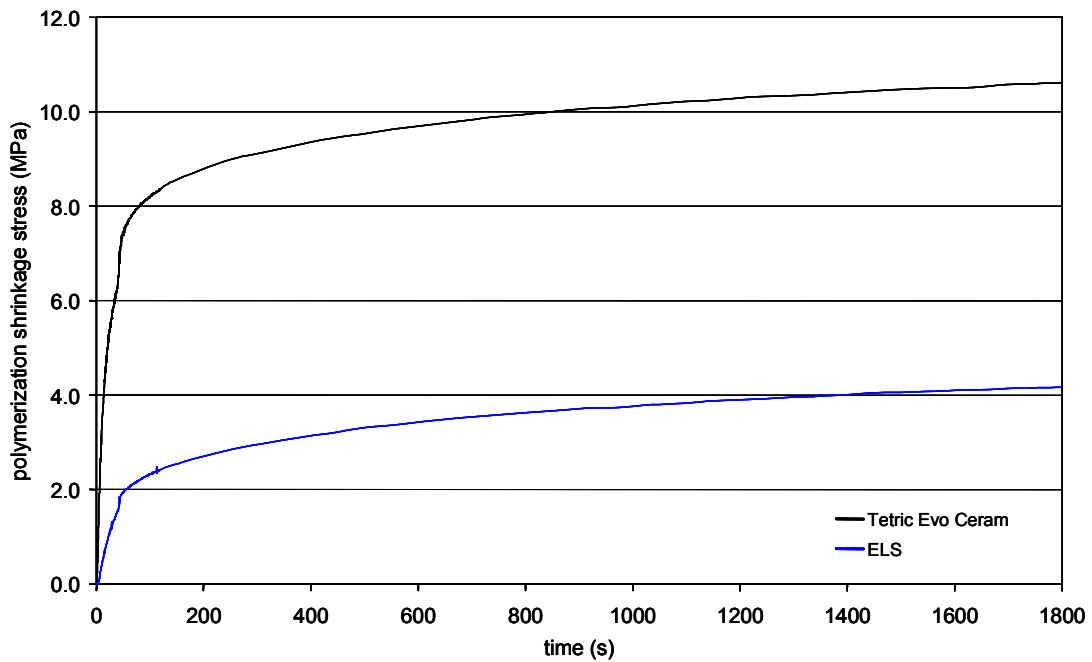


Figure 2. Polymerization shrinkage stress development (MPa) of the investigated materials (n = 3) during 30 minutes of setting after the start of light curing with the Elipar Highlight for 40 s in standard mode (750 mW/cm²).

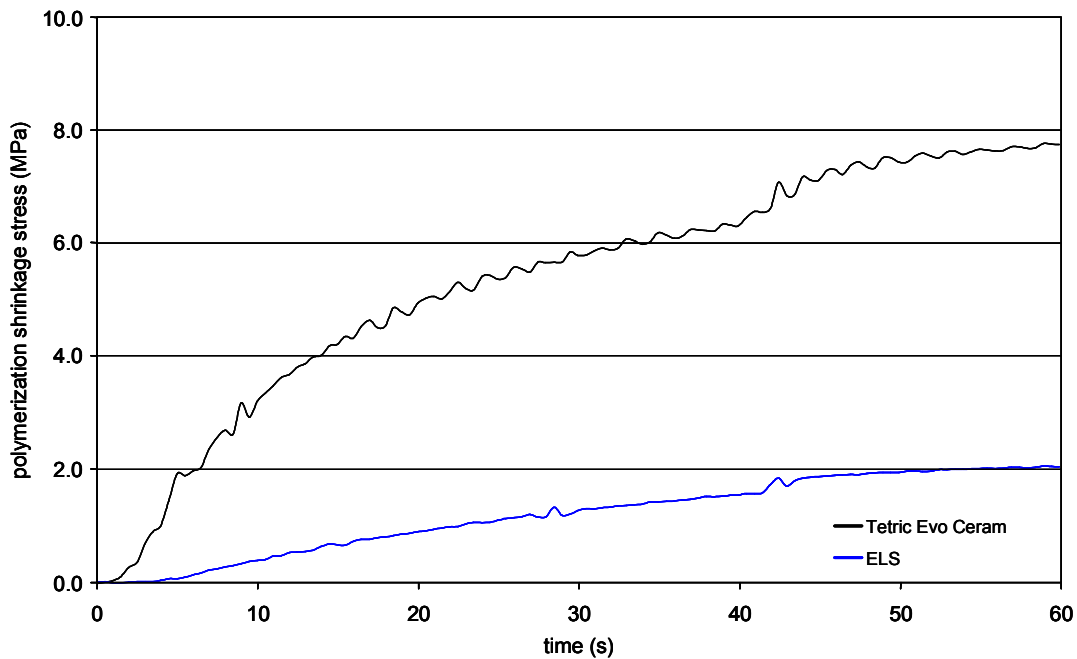


Figure 3. Polymerization shrinkage stress development (MPa) of the investigated materials (n = 3) during the first 60 seconds of setting after the start of light curing with the Elipar Highlight for 40 s in standard mode (750 mW/cm²).

Table 2. Polymerization shrinkage stress (MPa) at some selected time moments of the investigated materials light cured with the Elipar Highlight for 40 s in standard mode (750 mW/cm²). Standard deviations between brackets (n = 3).

seconds	ELS	Tetric Evo Ceram
1	0 (0.02)	0 (0.08)
5	0.1 (0.02)	1.4 (0.62)
10	0.4 (0.04)	3.2 (0.46)
15	0.7 (0.02)	4.2 (0.45)
30	1.3 (0.02)	5.7 (0.17)
60	2.0 (0.01)	7.7 (0.11)
120	2.4 (0.04)	8.4 (0.08)
180	2.5 (0.03)	8.5 (0.06)
240	2.7 (0.05)	8.8 (0.03)
300	2.9 (0.06)	9.0 (0.04)
600	3.4 (0.09)	9.6 (0.09)
900	3.7 (0.09)	10.0 (0.14)
1200	3.9 (0.09)	10.2 (0.15)
1500	4.1 (0.09)	10.4 (0.15)
1800	4.2 (0.09)	10.6 (0.15)