

IN FOCUS

glass analysis
stress measurements

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Determination of stress in glass using the strain slab method

**Method Description**

The velocity of a plane polarised light wave in glass under stress is dependent on the direction of the polarisation direction and the stress direction. In general the polarised wave is split into two plane polarised components as the light enters the glass. These have different velocities in the glass so that when they emerge there is a phase difference. Interference effects between the two waves can be produced, resulting in variations in light intensity or, if white light is used, in colour differences. From this optical effect the phase difference can be measured which is proportional to the stress.

Two pieces of glass, the sample and the standard, are sealed and cooled down in a well-defined way. If there is a difference in the expansion coefficient between the two glasses stress will develop in the seal region. The magnitude of this stress is linearly related to the differences in expansion coefficient and will result in a birefringence effect. The resulting optical path difference per unit of sample thickness can be measured with a polarisation microscope.

Measurements are done using the appropriate standard glasses. These standard glasses are related to well-defined reference glasses.

Measured Quantity

Optical path difference as a result of birefringence.

Derived Quantity

The stress resulting from sealing the sample glass to a reference glass:
S in nm/cm against standard glass.

Measuring Range

Determined by the range of standard glasses, but the expansion coefficient difference between the standard and the sample glass should not exceed $1 \times 10^{-6}/^{\circ}\text{C}$.

Precision

$S < 100 \text{ nm/cm}$, $\sigma < 10 \text{ nm/cm}$.
 $S > 100 \text{ nm/cm}$, $\sigma < 20 \text{ nm/cm}$.

Accuracy

Values are stated against standard glass.

Possible Errors

A well-experienced operator is required. The method is sensitive for the quality of the seal, inclined or curved sealing faces, homogeneity effects, additional birefringence due to element diffusion, thermally induced cooling strain.

Sampling

At least 2 cm^3 glass.

Measuring Time

1 day.

Cost Aspect

0.5 man hour.