

did not influence the measurements, it was necessary for Frensdorff to use a much smaller 0.0035 in. copper-constantan couple.

(2) The problem of heat transfer between sphere and bath involves not only the initial sudden heating of the surface to the bath temperature but even more important the effect of temperature difference at the bath-sphere interface during the total experimental run. The measured  $K$  values were observed to be a pronounced function of not only the bath temperature but also the bath fluid (Fig. 2). This effect was explained by considering that the total resistance to heat transfer was due to the combined heat resistance of the sphere itself and of the contact film at the bath-sphere interface. The heat resistance at the bath-sphere interface was assumed to be proportional to the viscosity of the bath liquid, as was verified by the linear correlation of the reciprocal of the measured  $K$  values versus the bath viscosity, (Fig. 3). From Figure 3, the measured  $K$  values were corrected to zero bath viscosity (equivalent to zero heat resistance at the interface) giving the absolute values for the thermal diffusivity of the rubber. Figure 3 shows that when water is used as the bath liquid, as was the case for Rehner, Gengrinovich and Fogel, and Frensdorff, the interfacial heat resistance is eliminated. It is recommended that a wetting agent is added when water is used as bath fluid. For measurements at higher temperatures, simulating more nearly the actual vulcanization temperatures, and where silicon oil is used, the bath temperature should be increased until there is no noticeable effect on the measured  $K$  values. This is recommended rather than correcting the values to zero viscosity as done by Mac Rae and Zapp. For both water and oil baths the agitation should be increased until this effect is also eliminated. The rubber stocks consisted of Butyl 215 plus 80 parts Thermax carbon black, except for the data of Figure 1, where the carbon black was Kosmobil 66.

#### References

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DONALD R. MAC RAE

Division of Ferrous Metallurgy  
Royal Institute of Technology  
Stockholm, Sweden

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### *Calibration Device for an Extensometer*

An extensometer is an instrument used for measuring the elastic properties of metals and plastics. There are several types of extensometers, but the one used in these laboratories is the microformer type. The microformer is essentially a variable differential transformer with a moveable core which varies the magnetic coupling between the primary winding and two balanced secondary windings in each microformer. These secondary windings are connected in phase opposition so that the output voltage from each microformer will vary linearly with the position of the core. Furthermore, this movement of the transformer core induces a change of the output of the transformer, upsetting the balance between it and a similar microformer in the recorder. This unbalanced signal is amplified and drives a Servo motor which in turn activates an X-Y recorder. In operation, the microformer type extensometer is attached to a plastic specimen by means of a pair of knife edges (one at each end of the gage length) which are held in contact with the flat surface of the specimen by coiled springs. The specimen

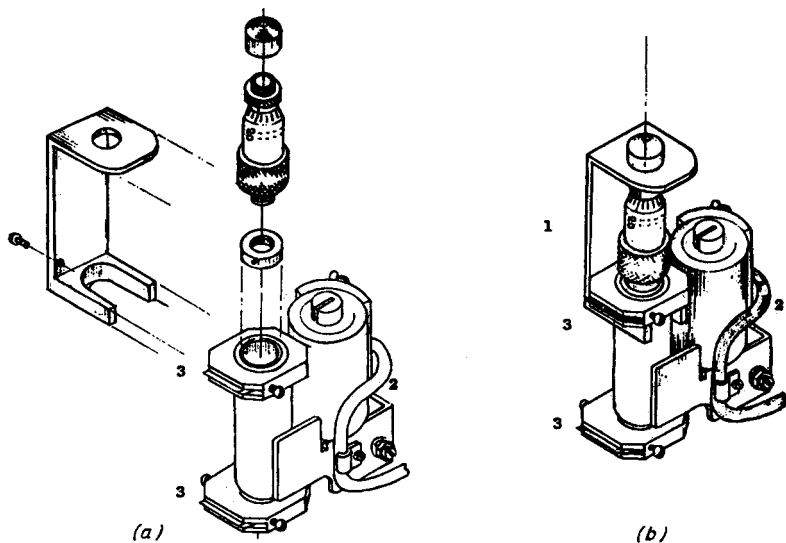


Fig. 1. Calibration device for an extensometer. (a) Exploded view of calibration device. (b) Device attached to extensometer. 1. Calibration device, 2. Extensometer, 3. Knife edges of extensometer.

is attached to the jaws of an Instron instrument for testing. Minute deformation of the specimen produces a minute separation of the edges. This movement simultaneously produces movement in the movable core of the transformer and is in turn recorded as the  $X$  axis of the  $X$ - $Y$  recorder while the stress is recorded on the  $Y$  axis. Before studying stress-strain relationships in a polymer, it is necessary to calibrate the extensometer.

A simple compact calibration device for a microformer type extensometer has been developed in these laboratories. The calibration device is constructed from a micrometer caliper. An exploded diagram is shown in Figure 1a and the assembled device attached to the microformer extensometer with one screw is illustrated in Figure 1b. The device is adjusted to zero by moving the knurled nut at the top or by adjusting the over nut. When the device is properly in position, the bottom adjustable nut fits snugly against the movable interior portion of the extensometer. Then the device is ready for the calibration.

L. W. GAMBLE

Esso Research Laboratories  
Humble Oil & Refining Company  
Baton Rouge, Louisiana

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### *A Remark on the Hydrogen Bond Breaking Action of Urea*

It was found that the addition of urea to concentrated solutions of poly-methacrylic acid prevents gel formation and turbidity upon heating.<sup>1</sup> This was explained as being due to an increase of solubility of the polymer as a result of the hydrogen bond breaking action of urea. This explanation cannot be reconciled with the observation that urea decreases the reduced specific viscosity of dilute solutions of poly-methacrylic acid in