



**TEST METHOD FOR  
MEASUREMENT OF HOT CREEP IN  
POLYMERIC INSULATIONS**

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## Foreword

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Suggestions for improvements in this publication are welcome, and should be sent to ICEA at the address below.

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## Scope

This test method provides a procedure, which is suited for determining the relative degree of crosslinking of polymeric, electric cable insulations.

### Summary of Method:

**Elongation Test:** A specimen is subjected to a constant load stress while suspended in an air oven at a specified elevated temperature for a specified time period. At the end of the time period the increase in elongation of the specimen is determined.

**Set Test:** Immediately after the elongation test has been completed on a specimen, the same specimen with the load stress removed, will be subjected to an additional time period in the oven at the same elevated temperature. The specimen is then removed and allowed to cool. The set of the specimen, based on original length, is then determined.

### Significance:

The test method has a consistent reproducibility, which makes it particularly suitable as a quality control test for determining relative degree of crosslinking. This method has been found more reproducible than the other methods in current use such as heat deformation. Also, it corresponds more closely to service conditions than a solvent-extraction procedure.



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## **Section 1 Apparatus**

### **1.1 AIR OVEN**

The oven shall have a minimum interior size of not less than 12 by 12 inches (304.8 by 304.8 mm), (width and depth) by 20 inches (508 mm) (height) and shall be equipped with an observation window. The heating medium shall be air circulated at atmospheric pressure such as to obtain uniform heating throughout. The temperature shall be controlled to within  $\pm 2$  °C of set point by means of a thermostatic control.

### **1.2 SPECIMEN SUPPORT**

The specimen support apparatus shall suspend the specimen vertically between a fixed upper jaw and an unrestrained lower jaw assembly without touching any part of the oven or the support apparatus. A scale will be attached to the support apparatus and positioned such that the specimen elongation can be measured. The lower jaw assembly shall be provided with the means to hold small increment weights in the form of pellets or other suitable materials added to attain the specified stress (see Figure 1 for a typical apparatus).

## **Section 2 Specimen**

Three specimens shall be prepared from a selected sample. If a non-insulating covering is applied directly to the insulation, such coverings shall be removed prior to testing.

### **2.1 TUBULAR SPECIMENS**

For wire and cable having a nominal insulation thickness of 60 mils (1.53 mm) or less or wire and cable smaller than 6 AWG (13 mm<sup>2</sup>) and having a nominal insulation thickness of 90 mils (2.3 mm) or less, the specimen may be either the entire cross-section of the insulation or a partial cross-section. When the full cross-section is used the specimen shall not be cut longitudinally. When a partial cross-section is used it shall comply with 2.2.

### **2.2 DIE-CUT SPECIMENS**

The test specimen shall be prepared using either Die B, C, D, or E, as described in ASTM D 412, and shall have no surface incisions and shall be free from other imperfections.

For all other wire and cable, a specimen with a cross-sectional area not greater than 0.025 in<sup>2</sup> (16 mm<sup>2</sup>) and uniform in cross-section throughout the specimen's length shall be prepared from the insulation.

All surface irregularities, such as corrugations due to stranding, shall be removed such that the specimen will be smooth and of uniform thickness throughout its length.

Determine the cross-sectional area of the specimen by one of the applicable methods described under "Calculation for Area of Test Specimen" in ICEA Standard T-27-581 or by other suitable means.

## Section 3 Procedure

### 3.1 ELONGATION TEST

One specimen shall be tested and the other two held in reserve.

An unstretched specimen shall be marked with gauge marks 1.0-inch (25.4 mm) apart and shall be placed in the jaws of the support apparatus. Maximum distance between jaws shall be 4.0-inches (101.6 mm).

Sufficient weight shall be added to the lower jaw assembly such that the total weight of the holder and small-increment weights provide a stress of 29.0 psi (0.20 MPa or 20.4 g/mm<sup>2</sup>) on the specimen cross-section.

Calculate the required total stress weight using one of the following:

$$(1) \text{ Stress Weight (lb)} = \text{Cross-sectional Area (in}^2\text{)} \times 29.0 \text{ (lb./in}^2\text{) Stress}$$

$$(2) \text{ Stress Weight (g)} = \text{Cross-sectional Area (mm}^2\text{)} \times 20.4 \text{ (g/mm}^2\text{) Stress}$$

The support apparatus with the attached specimen shall be placed in the air oven which has been preheated to 150 ± 2°C.

After 15 minutes exposure, and without removing the specimen from the oven, measure and record the distance between gauge marks using the scale attached to the support apparatus. The recorded value ( $D_e$ ) will be used for the calculation of the Hot Creep Elongation.

Hot Creep Elongation -Calculate as follows:

$$C = \frac{100(D_e - G)}{G}$$

Where: C = Hot Creep Elongation in Percent

$D_e$  = Distance between Gauge marks after 15 minutes exposure in air oven

G = Original Distance between gauge marks 1.0 inch (25.4 mm)

### 3.2 SET TEST

The set test is performed on the same specimen and at the same temperature as the elongation test in 3.1, immediately following the elongation test and without removing the specimen from the oven.

The lower jaw assembly shall be removed from the specimen as quickly as possible to prevent heat loss and cooling of the specimen.

Leave the specimen in the oven for 5 minutes, then remove the specimen and allowed to cool at room temperature for at least 1 hour.

Measure the distance between the gauge marks ( $D_s$ ) and record.

Hot Creep Set -Calculate as follows:

$$S = 100 \frac{(D_s - G)}{G}$$

Where: S = Hot Creep Set in Percent

$D_s$  = Distance between Gauge marks after cooling for 1 hour

G = Original distance between gauge marks 1.0 inch (25.4 mm)

NOTE: The result can be positive or negative.

## **Section 4 Report**

The report shall include the following:

Adequate description of the material tested

Cross-sectional area of the specimen,

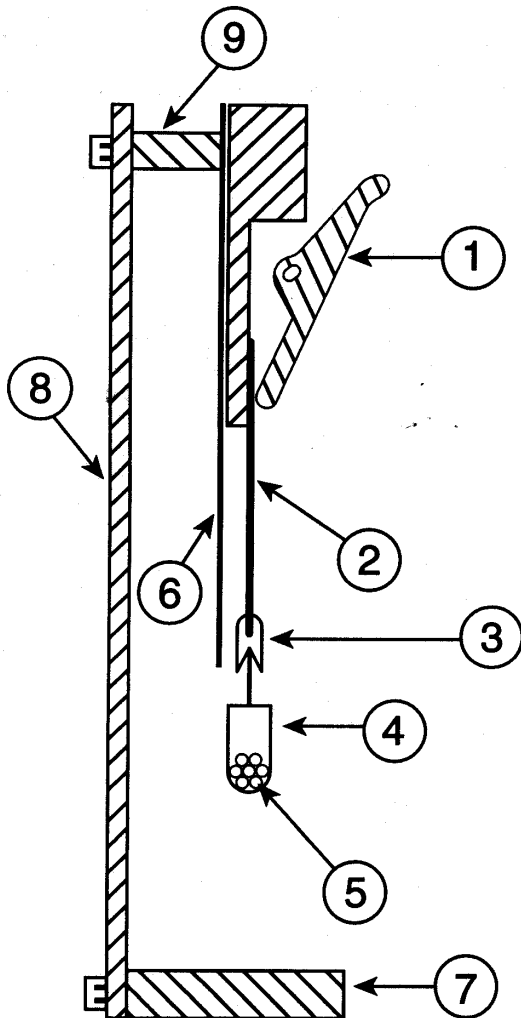
Percent Hot Creep Elongation

Percent Hot Creep Set

For the properties cited above, the values obtained from one specimen tested shall be reported. If either the Hot Creep Elongation or the Hot Creep Set does not meet specified requirements when one specimen is tested, both tests are to be repeated on the two remaining specimens. Then, for both properties the average of the three readings shall be reported.

**FIGURE 1**

**Specimen Support Apparatus**



TYPICAL PARTS LIST

1. Upper Jaw
2. Specimen
3. Lower Jaw
4. Basket
5. Small increment weights
6. Scale - 0.10" (2.54 mm) increments recommended
7. Base
8. Vertical Support - 1½" X 15" (38.1 X 489 mm) Steel
9. Spacer - 2" X ½" (50.8 X 12.7 mm) OD Steel Tube