



## CROSS-LINK DENSITY OF ELASTOMERS

## Application

This method is used to determine the cure state of Elastomer using a method involving solvent swell of the elastomer.

## Apparatus Required

**Vials** - 20 ml capacity borosilicate scintillation vials with screw caps. Polyethylene weighing vial with cap.

**Oven** - Air circulating, capable of maintaining 105 °C, conforming to ISO 188/ASTM E 145 type IIA normal oven 150 + 50 air changes per hour.

**Analytical Balance** - Capable of measuring out to 0.1 mg (0.0001 g).

**Razor Blades, Pipettes**

## Materials Required

Solvent Combinations for Cure State Measurements

| <u>Elastomer</u> | <u>Solvent</u>      | <u>Solvent Gravity, g/ml</u> |
|------------------|---------------------|------------------------------|
| ACM              | Methyl Ethyl Ketone | 0.8054                       |
| AEM              | Methyl Ethyl Ketone | 0.8054                       |
| NBR              | Methyl Ethyl Ketone | 0.8054                       |
| HNBR             | Methyl Ethyl Ketone | 0.8054                       |
| VMQ              | Cyclohexane         | 0.7739                       |
| FKM              | Acetone             | 0.7908                       |
| EPDM             | Toluene             | 0.8669                       |
| CR               | Toluene             | 0.8669                       |
| IR               | Toluene             | 0.8669                       |
| NR               | Toluene             | 0.8669                       |

## Conditioning and Test Conditions

All test values indicated herein are based on material conditioned in a controlled atmosphere of 23 +/- 2 °C and 50 +/- 5% relative humidity for not less than 24 hours prior to testing and tested under the same conditions unless otherwise specified.

| Date       | Action    | Revisions |
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Documents

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## Procedure

1. Cut three specimens from material to be swollen. Each specimen should be roughly 0.1000 g to 0.2000 g in weight. Tare balance and record this weight as "Initial Weight" in the laboratory book.
2. Place each specimen in a separate, numbered 20 ml scintillation vial. Record the numbers for the given material on the data sheet next to the description column.
3. Add approximately 10 ml swelling solvent to the vials using pipettes, and cap quickly. A list of appropriate swelling solvent is listed above. Ensure the total specimen is submerged in solvent.
4. Allow the specimens to swell for 96 hours at room temperature. Check specimens after 1 hour to ensure that the total specimen is still submerged in solvent. Add more solvent if needed.
5. Tare the small polyethylene vial and the snap cap on the balance.
6. Remove each swollen specimen from the swelling solvent. Quickly blot off the excess solvent with a tissue and immediately place the swollen specimen in the tared vial. Recap the vial.
7. Re-weigh the vial plus the swollen specimen to the nearest 0.1 mg (0.0001 g) using the balance. Record the value as the "Swollen Weight".
8. Return the swollen specimen to its numbered scintillation vial.
9. Using a pipette, force air into the polyethylene vial to remove any solvent left in the vessel.
10. Re-tare the vial with its cap and repeat steps 6-9 for each specimen.
11. After all the swollen weights have been measured, dry the vial with the swollen specimen in an oven at 105 °C +/- 1 °C for a minimum of 4 hours.
12. Re-weigh the dried specimens and record the weight as "Dried Weight". Remember to tare the balance before the weight is taken.
13. Perform the calculations for V2M and the percent of extraction for each specimen. Refer to the Calculation section below.
14. Calculate the average of the three specimens of V2M and record this as "State of Cure" value. Refer to the Calculation section below.
15. Calculate the standard deviation of the three V2M specimens. If the standard deviation exceeds 0.007 then the material should be retested.
16. Calculate the "Percent of Extraction". Refer to the Calculation section below.