

# VALOX\* FR1 Film

## Product Datasheet

### DESCRIPTION

VALOX\* FR-1 is a flame retardant thermoplastic polybutylene, terephthalite film offering UL94 VTM-0 performance down to 125 microns and good temperature performance. VALOX FR-1 film's outstanding dielectric strength and ease of fabrication (ie: thermoforming, embossing, clean-edge die-cutting, folding and bending) make it very suitable for a wide range of electrical, electronic and medical applications.

### Typical Property Values<sup>1</sup>

| Property                                      | ASTM Test Method      | Units (USCS)                  | Value  | ISO Test Method | Units (SI)               | Value |
|---|-----------------------|-------------------------------|--------|-----------------|--------------------------|-------|
| <b>Mechanical</b>                             |                       |                               |        |                 |                          |       |
| Tensile Strength                              |                       |                               |        |                 |                          |       |
| @ Yield                                       | ASTM D882             | psi                           | 7200   | ISO 527         | MPa                      | 49.7  |
| Ultimate                                      | ASTM D882             | psi                           | 6000   | ISO 527         | MPa                      | 41.1  |
| Tensile Modulus                               | ASTM D882             | psi                           | 277000 | ISO 527         | MPa                      | 1910  |
| Tensile Elongation at Break                   | ASTM D882             | %                             | 57     | ISO 527         | %                        | 57    |
| Gardner Impact Strength at 0.03 in. (0.75 mm) | ASTM D3029            | ft-lb                         | 7      | ISO 6603-1      | J                        | 10    |
| Tear Strength                                 |                       |                               |        |                 |                          |       |
| Initiation                                    | ASTM D1004            | lb/mil                        | 1.46   |                 | kN/m                     | 255   |
| Propogation                                   | ASTM D1922            | g/mil                         | 102.8  |                 | g/mil                    | 102.8 |
| Puncture Resistance (Dynatup)                 | ASTM D3763            | ft-lb                         | 9      |                 | J                        | 12    |
| Fold Endurance (MIT)                          |                       |                               |        |                 |                          |       |
| 0.007 inch (0.175 mm)                         | ASTM D2176-69         | double folds                  | 2000   |                 |                          |       |
| 0.025 inch (0.625 mm)                         | ASTM D2176-69         | double folds                  | 83     |                 |                          |       |
| <b>Thermal</b>                                |                       |                               |        |                 |                          |       |
| Coefficient of Thermal Conductivity           | ASTM D5470            | Btu/hr/ft <sup>2</sup> /°F/in | 1.35   |                 | W/m <sup>2</sup> K       | 0.17  |
| Coefficient of Thermal Expansion              | ASTM E831             | (x 10 <sup>-5</sup> /°F)      | 3.1    | ISO 11359       | (x 10 <sup>-5</sup> /°C) | 5.7   |
| Specific Heat @ 40 °F (4 °C)                  | ASTM E1269            | Btu/lb/°F                     | 0.3    |                 | KJ/Kg-°C                 | 1.31  |
| Glass Transition Temperature                  | ASTM D3417/D3418      | °F                            | 183    | ISO 11357       | °C                       | 84    |
| Vicat Softening Temperature, B                | ASTM 1525-00 Modified | °F                            | 346    |                 | °C                       | 174   |
| Heat Deflection Temp. by TMA at 1.8 MPa       |                       | °F                            | 418    | ISO 75 Modified | °C                       | 214   |
| Shrinkage at 302 °F (150 °C)                  | ASTM D1204            | %                             | 0.40%  |                 | %                        | 0.40% |
| Brittleness Temperature                       | ASTM D746             | °F                            | -211   |                 | °C                       | -135  |

### UL Flammability Rating / Performance Levels

| Thickness                                   | Rating    | HWI | HAI |
|---|-----------|-----|-----|
| > 0.003" (0.075 mm) and < 0.005" (0.130 mm) | UL94VTM-2 | -   | -   |
| > 0.005" (0.130 mm) and < 0.010" (0.250 mm) | UL94VTM-0 | -   | -   |
| > 0.020" (0.500 mm) and < 0.025" (0.625 mm) | UL94VTM-0 | 4   | 0   |
| 0.025" (0.625 mm) and greater               | UL94V-0   | 4   | 0   |
| CTI: 2 HVTR: 4 D495: 6                      |           |     |     |
| File Number                                 | E61257    |     |     |

### Manufacturing Specifications

| Nominal Gauge Ranges          | Min./Max Limit of Nominal |
|-------------------------------|---------------------------|
| 0.003-0.010" (0.075-0.250 mm) | ± 10%                     |
| 0.015-0.030" (0.375-0.750 mm) | ± 5%                      |



<sup>1</sup> These are typical properties and are not intended for specification purposes. If minimum certifiable properties are required, please contact your local GE Advanced Materials, Specialty Film & Sheet representative or the GE Advanced Materials, Specialty Film & Sheet Quality Services Department. Reported values are based on 0.010" (0.250 mm) thickness unless otherwise noted.  
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# GE Advanced Materials Specialty Film & Sheet

| Property   | ASTM Test Method          | Units                | Value       | ISO Test Method | Units             | Value  |
|--|---------------------------|----------------------|-------------|-----------------|-------------------|--------|
| <b>Physical</b>  |                           |                      |             |                 |                   |        |
| Density  | ASTM D792                 | slug/ft <sup>3</sup> | 83.3        | ISO 1183        | kg/m <sup>3</sup> | 1335   |
| Water Absorption, 24 hrs.  | ASTM D570                 | % change             | 0.48        | ISO 62          | % change          | 0.48   |
| Surface Energy (1st surface / 2nd surface)                                   | ASTM D5946-01             | -                    | 36/35       |                 |                   |        |
| Surface Tension (1st surface / 2nd surface)                                  | Dyne Pens                 | Dyne                 | >44 / 34-36 |                 |                   |        |
| Pencil Hardness  | ASTM D3363                | -                    | 2b-b        |                 |                   |        |
| <b>Optical</b>   |                           |                      |             |                 |                   |        |
| Light Transmission   | ASTM D1003                | %                    | 15          |                 |                   |        |
| Yellowness Index   | ASTM D1925                | %                    | 49          |                 |                   |        |
| Haze   | ASTM D1003                | %                    | 103         |                 |                   |        |
| Gloss over Flat Black min/max @ 60°  | ASTM D523-60              | -                    | 5           | ISO 2813        | -                 | 5      |
| <b>Electrical</b>  |                           |                      |             |                 |                   |        |
| Dielectric Strength in oil, short time<br>@ 72 °F (23 °C), 10 mils (0.25 mm) | ASTM D149-97a<br>Method A | kV/mil               | 1.09        | IEC 60243       | kV/mm             | 43     |
| Dielectric Constant<br>@ 60 Hz   | ASTM D150                 | -                    | 3.3         | IEC 60250       | -                 | 3.3    |
| @ 1,000,000 Hz   | ASTM D150                 | -                    | 2.8         | IEC 60250       | -                 | 2.8    |
| Dissipation Factor<br>@ 60 Hz  | ASTM D150                 | -                    | 0.0015      | IEC 60250       | -                 | 0.0015 |
| @ 1,000,000 Hz   | ASTM D150                 | -                    | 0.01        | IEC 60250       | -                 | 0.01   |
| Volume Resistivity   | ASTM D257                 | Ω-cm                 | 1E+17       | IEC 60093       | Ω-cm              | 1E+17  |
| Surface Resistivity  | ASTM D257                 | Ω/square             | 1E+16       | IEC 60093       | Ω/square          | 1E+16  |
| Arc Resistance, Tungsten Electrodes  | ASTM D495                 | s                    | 21          |                 |                   |        |

## % Gloss by Gauge: (ASTMD 523-85)

| FR1                           | Gauge             | Angle              | Matte              |
|-------------------------------|-------------------|--------------------|--------------------|
|                               | 0.003" (0.075 mm) | 85°                | Minimum<br>Maximum |
| 0.006-0.030" (0.150-0.750 mm) | 85°               | Minimum<br>Maximum | 0.1<br>17          |



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