Using Electrostatic Voltmeters

By Dr. Kelly Robinson
Contributing Editor

Static problems are challenging to solve because static dissipaters, such as ionizing strings or static bars, should be located to treat the side of the film with static. An electrostatic voltmeter provides detailed information on the location, the amount, and the polarity of static. Specifically, an electrostatic voltmeter can verify which side of a film has static, and it can reveal when a film has suffered static discharges in previous operations.

When using an electrostatic voltmeter to diagnose a static problem, or when selecting a voltmeter for a specific application, three performance measures are important: measurement range, spatial resolution, and response time.

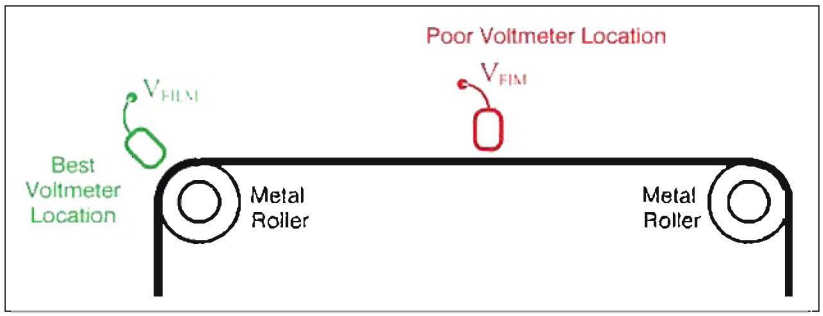

Figure 1. The voltage (V_{FILM}) with the film wrapped on a metal roller is a direct measure of the static charge density on the exposed film surface.

Measurement Range | The film voltage or surface potential is measured in volts. The best location for an electrostatic voltmeter measurement is where the film is wrapped on a grounded metal roller as in **Figure 1**. Here, the film voltage (V_{FILM}) measures the static charge (σ_{FILM}) only on the exposed surface of the film. The voltage also varies with the film thickness (d_{FILM}) and the relative dielectric constant (κ_{FILM}) of polymer as in **Figure 2**. The dielectric constant of the film polymer is typically in the range 2–5.

Figure 2 can be used to select a voltmeter with a range that is appropriate for your products. You'll need a voltmeter that can detect static charge densities in the range 1–100 $\mu C/m^2$. For 20 µm (~0.8 mil) film, your voltmeter should have good sensitivity over a voltage range of 1–100 volts.

Spatial Resolution | Electrostatic voltmeters are valuable because they can respond to charge patterns generated by static discharges. When measuring the surface potential (V_{FILM}) with the film wrapped on a grounded metal roller, the voltmeter can respond to a spot of charge with a diameter that is approximately equal to the spacing between the voltmeter probe and the film surface. For example, with the voltmeter probe located 2 mm from the film surface, the meter can respond to a spot of charge with a diameter of about 2 mm, which is typically the charge pattern generated by static discharges.

Response Time | The response time ($T_{RESPONSE}$) of an electrostatic voltmeter measures how fast the meter responds. $T_{RESPONSE}$ is important when monitoring the voltage (V_{FILM}) on a moving film. $T_{RESPONSE}$ should be faster for higher film speeds as in **Figure 3**. For example, to detect a 1-mm static spot on a film moving at 10 m/s (about 2 Kfpm), the $T_{RESPONSE}$ should be no greater than 100 µS. A voltmeter with a slower response time will respond to charge averaged over a larger area of film.

Use your electrostatic voltmeter to measure the voltage where the film is wrapped on a grounded metal roller. The voltmeter will respond to a static spot having a diameter that is about the same as the distance of the voltmeter probe to the film surface. The response time must be faster when the film is moving faster.

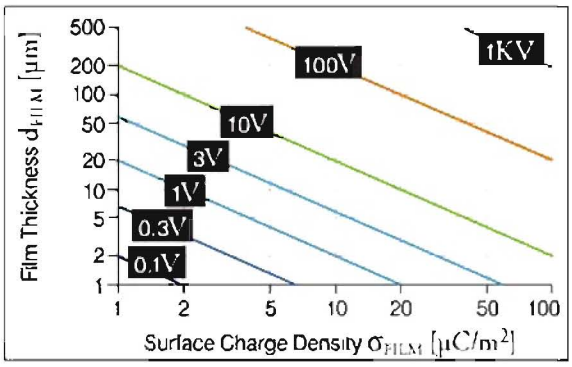

*Figure 2. **Film Voltage** | The surface potential (V_{FILM}) with the film wrapped on a grounded metal roller varies with the static charge density (σ_{FILM}) and film thickness (d_{FILM}). For this plot, the dielectric constant (κ_{FILM}) is 2.2 (polyethylene).*

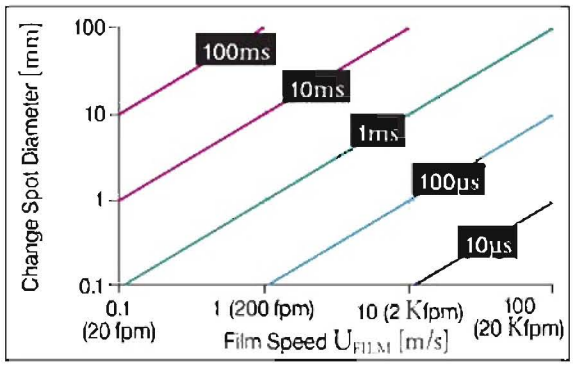

*Figure 3. **Volmeter Response Time** | The smallest spot of charge that the voltmeter can detect on a moving film depends on the film speed (U_{FILM}) and the response time ($T_{RESPONSE}$) of the voltmeter.*

Static control expert Dr. Kelly Robinson, president of Electrostatic Answers, has 27+ years of experience in problem-solving and consulting. Contact him at 585-425-8158; kelly.robinson@electrostaticanswers.com; www.electrostaticanswers.com.