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Adjusting Current and Voltage When Powder Coating

Q. I am a manual powder coater and want to know which gun setting is better to adjust, voltage or current?

A. Every manual powder coating operator struggles at one time or another with this question. Ultimately, you want a setting that is easy to use, avoids creating a reject, allows you to put the powder on the part correctly the first time — every time. Finding the optimum electrostatic setting is important to achieving a part that has a great-looking appearance and excellent coating thickness uniformity.

Today, you will find that the leading brand manufacturers are offering manual powder spray gun technology that is capable of adjusting current (aka "microamps - µA") independently from voltage (aka "KV"). For those coaters using "older" manual coating units, they may not have this level of control and therefore can only control the electrostatic power for their application by adjusting the KV setting. However, considering that you asked about adjusting current or voltage, I will assume that your unit has the capability for adjusting both parameters.

To start with a simple answer to your question, there is no doubt, based on field-proven results, that adjusting microamps is the ideal way to control the electrostatic power emitted by the gun. However, to understand why, let's discuss more about electrostatic charging.

Voltage and current have an inverse relationship when there is a limited amount of energy supply. This is the case with electrostatic powder coating guns. Voltage is the electrical potential to do work, while current is measuring the movement of electricity, or work being done. Once the potential is used, it becomes current; thus, there is "less potential" or energy left. Both voltage and current are useful settings and indicators for electrostatic guns.

Within our industry, the term for gun electrostatic power is represented as voltage or "KV." The gun voltage is a unit of measure indicating how much electrical charge the gun can produce. We typically refer to a gun's power by how much power it is capable of generating; and we might say 110 KV. Since 1 kilovolt equals 1,000 volts, then 110KV is 110,000 volts. On the other hand, the term current "µA" is the unit of measure indicating how much current is moving from the gun's electrode. One microampere equals .000001 ampere. That is one-millionth of an ampere, which is a very small amount of current. For a powder gun, this current travels through the gun electrode and is discharged into the air and onto the powder particles exiting the gun. Subsequently, "charging" the powder and transferring it to the part being coated.

For optimum transfer efficiency, the electrostatic parameters for the powder gun should be set to the maximum allowable amount of KV and current value available. For example, 110 KV and 110 µA. This is a good starting point to coat quickly and efficiently, as long as the part looks acceptable. If an undesirable finish is produced (i.e., poor penetration, orange peel, fatty edges, etc.), then an adjustment in electrostatic power may be a solution. I say *may*, because other variables such as grounding, gun target distance, nozzle choice, spray technique and more could be the reason for the undesirable appearance. However, for our discussion, I will focus on electrostatics. Considering that the gun settings (110 KV - 110 µA) we have too much power and created a "reject." To fix this issue, we need to lower the current, not the voltage. I recommend this action to keep the voltage at its maximum, allowing the gun to achieve its maximum transfer efficiency at any given point when possible. By controlling the current, we limit the amount of "charging power" that is pulled from the gun. As this electrostatic charge is limited, the coater can bring the gun closer to improve penetration, or use more time to coat a difficult area, thus avoiding orange peel or fatty edges.

As an example, pretend you have a very nice sports car. As such, it has a very powerful engine that goes really fast. So going down the highway on straight and mildly smooth curving roads, you can use all the power that the engine has to offer. But, if the car reaches "Dead Man's Curve" — a sharp, 90-degree turn — you cannot navigate it safely and maintain the same amount of power. Something has to change. If your car has the ability to harness and limit that power so that you safely navigate the curve and then automatically return you to full power and speed, that would be the same as you adjusting the current level on your powder gun. That is current limiting.

Likewise, if you choose to adjust KV instead of µA, that would be like taking your sports car, removing the high-performance engine and replacing it with a lawn mower engine. You would get around Dead Man's Curve, but boy oh boy, how slow and boring that would be driving along those straight and gentle curving roads that are just screaming for high performance.

Please know that a high KV gun setting generates the highest potential to charge powder, and adjusting KV may be needed in some situations, but it should only be considered when it becomes necessary due to undesirable results

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that cannot be controlled with adjusting/lowering the current setting on the gun.

Based on many other powder coaters' experiences, as well as my own, limiting the current setting on the gun is the best way to control the electrostatic charge produced by the gun. It is the optimal way to achieve high transfer efficiency while working to overcome poor penetration (aka, "Faraday Cage Effect"). When coating complex or difficult parts, the gun KV setting should be set to maximum and the current setting limited to approximately 20 µA. Understand that even lower current settings (below 10 µA) may be required for some applications where a more challenging powder material is being sprayed or a very complex geometry substrate is being coated.

The bottom line is that both voltage and current are very important factors in the electrostatic powder coating process. Using a powder gun that can monitor and adjust both of these settings is a definite advantage and gives the user maximum flexibility and control.

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