What Impacts Transfer Efficiency?

Powder Transfer Efficiency Guide

Q. ***My supervisor asked me to measure our current transfer efficiency (TE) and provide information on ways to improve. We have 10 automatic guns that are about five years old and are doing okay. I've done the maintenance as recommended by the spray gun supplier. I followed directions that you recommended from a previous column and weighed the parts, racks, and powder before and after spraying. Based on this, I believe we are averaging around 45% TE. Some of our tests were better than others but we had a low of 41% and a high of 52%. Is this normal? Is it good? How do I enhance my transfer efficiency?***

Transfer efficiency is defined as the ratio between the amount of powder deposited on the part to be coated and the amount of powder sprayed. This efficiency is usually expressed as a percentage, and the amounts of powder are usually determined by weight.

First, let's address what is "normal" or good TE. Many things influence efficiency including the part, how it is racked, how good the equipment is and how good the overall setup is. For example, first pass transfer efficiency (FPTE) on a wire basket is going to be substantially lower than it is when spraying flat panels. There is more air and less part surface. FPTE with black powder is likely going to be higher than white powder because it takes a thicker coating with the white to get full hiding and therefore less powder is sprayed during the black application. This is a general rule, but it serves as an example of why your TE could be 41% on one run and 52% on another. So, there is no normal TE we could point to with consistency. However, your average TE could be and should

be above 50% based on the industry average for equipment quality and other variables.

The other part of your question is the “how do we get there” part. We know that higher efficiencies will lower your overall costs, reduce equipment wear (fewer spare parts), lower maintenance costs, improve finish quality and provide higher production capacity.

The following is a list of items to use for higher TE. We have talked about a lot of this before, but it bears repeating.

- **Gun voltage/amperage settings** – Typical voltage range is from 20 to 100 kV. Higher voltages will generally produce heavier powder deposition. Micro-amps can vary but 10 to 20 micro-amps is often the optimum current draw for good deposition, especially if the part has some complex shapes that require penetration into Faraday areas.
- **Pneumatic controls** – Concerning air pressures, typically the lower the pressure, the higher the transfer efficiency. This allows greater exposure to the corona field, more consistent film thickness, less abrasion to wear parts and less likelihood of orange peel.
- **Gun positioning** – As the gun gets closer to the part, voltage will decrease, and current draw will increase. As the gun current exceeds optimum levels, more ions are created and they flow faster to the part, possibly resulting in back ionization.
- **Part shape** – There is a difference between simple and more complex surfaces. What is the air to surface ratio is part of the challenge? Gun adjustments are needed for shape. Use of factory settings for Faraday and recoat can be useful. Testing of overall gun settings are recommended for complex shapes.
- **Rack design, part position and line density** – The right part presentation will affect transfer efficiency. Your primary coating surface should be within five degrees of vertical, and multiple parts should be on the same plane, and where necessary, the same level. Consistent and accessible positions are critical to high TE. Loading the conveyor with as many hangers as possible and hanging them as close as possible will increase transfer efficiency if the amount of surface in the spray zone is simple to see and access for the spray guns. Overloading so that parts touch or the amount of surface exceeds what can be covered effectively as the parts move through the booth is not a good idea. Obviously, if this is done correctly, there is more surface and less air in the target zone.

- **Booth air velocity** – Booth airflow is critical to great transfer efficiency. Booth airflow must be high enough to eliminate powder migration from the booth but not so high that it creates turbulence and interference with application.
- **Nozzle type** – Different nozzles affect transfer efficiency. A fan spray nozzle has a large pattern with more forward velocity. Conical nozzles have a softer forward velocity with different pattern sizes dependent on the diameter of the nozzle. Select the nozzle that best fits the part size and geometry. Experiment with different nozzles to see which one is best for your application.
- **Operator technique** – If manual application is used then the operator needs to be trained in how to set-up and operate the gun: Automatic set-up is also critical to high TE and requires formal training and experience to achieve good TE.
- **Gun movement/triggering** – Gun movement and triggering will increase transfer efficiency by depositing powder when and where it is needed. Gun movement will enhance your film thickness consistency, allowing more repeatable results and optimization of your gun setting. Gun triggering will reduce overspray and edge film build and result in higher transfer efficiencies. Sensors and automation provide substantial improvement in the accuracy of triggering.
- **Atmospheric control** – Humidity and temperature can affect TE. Consistent results require control of the atmosphere within a reasonable range. Humidity can cause the powder to clump and resist flow and very low humidity can cause unwanted static charge. Excess heat can cause the powder to lose chemical stability. Both will greatly affect transfer efficiency.
- **Grounding** – One of the most critical aspects of efficient powder coating is a proper connection to earth ground. All substrate components must be grounded with a resistance to ground not exceeding one megaohm. Make sure all contact points are free of cured powder and making good contact with the parts. Poor ground causes inconsistent film builds and more light and heavy coating.
- **Powder particle size** – Proper particle size distribution is important for effective powder deposition. Smaller particles can be difficult to fluidize and may not have enough charge to be strongly attracted to the part. Larger particles can lead to thicker film builds and more orange peel. Control particle size by consuming reclaimed powder as fast as you generate it and work with your powder vendor.

As you can see, there are numerous variables that affect transfer efficiency. Accurate and consistent adjustment of these variables can provide good efficiency and consistent measurement. I hope this helps you understand your system a little better and leads to greater efficiencies.