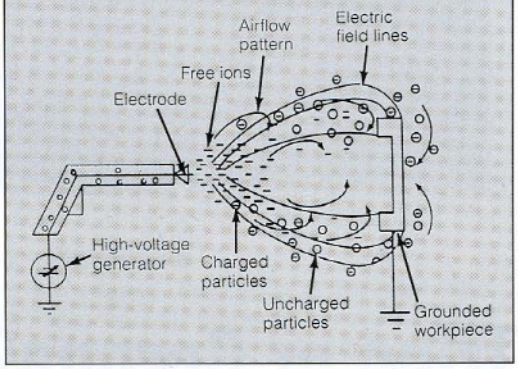
Tribo or Corona?

Here's How to Decide

Powder coating systems having either triboelectric or corona charging spray guns have been in use for many years, coating a wide variety of parts. Significant improvements have been made to both powder coatings and equipment. An important, fundamental question is: what equipment – tribo or corona – will best coat the product to specifications? To decide which is the best for your company, first, it's important to understand the basic principles of each type of equipment, and to understand the resulting differences in each type of spray gun.

FIGURE 1



Basic principles

■ **Corona Corona** charging guns work by bombarding powder particles sprayed from the gun with charged particles called ions. The corona charging process beings with a potential or voltage applied to one or more electrodes near the front of the gun. A high-voltage generator is used to produce up to 100,000 volts. For spraying most types of finishing powders, a negative polarity voltage is produced in the generator and results in the powder particles accumulating a negative charge. Positive polarity generators are also typically available as an option and are used primarily for charging nylon powders.

As the voltage on the electrode is increased, an electric field is produced between the gun and grounded part. When the electric field in the vicinity of the electrode reaches strength of about 30 kV per centimeter, the field is strong enough to break down the air in the vicinity of the electrode. This electrical breakdown of air results in the creation of charged molecules or ions in the form of a continuous discharge known as a corona discharge.

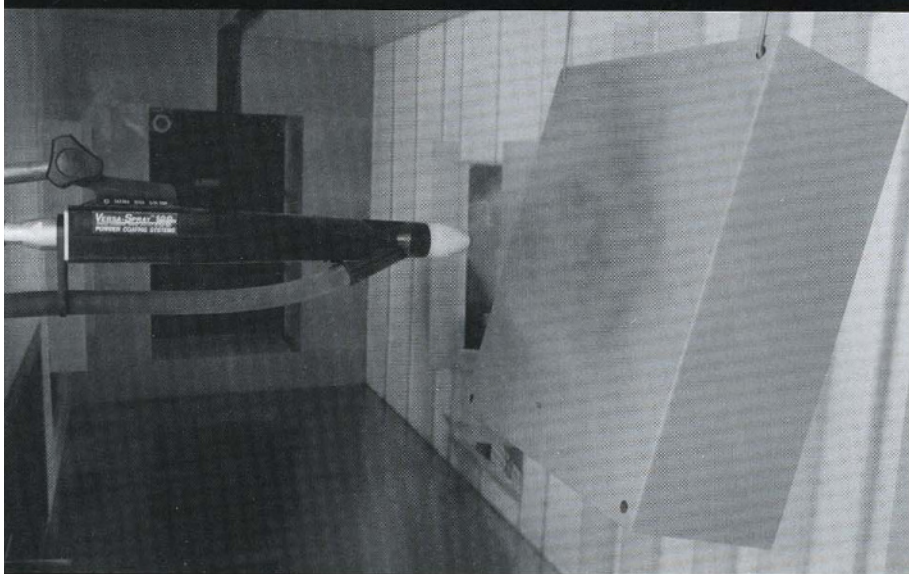
Powder particles exiting the gun travel near the electrode where many are bombarded by ions and accumulate a negative charge. These powder particles are influenced by the electric field between the gun and part and tend to follow the electric field to the part as represented by lines in Figure 1. Some powder particles may be shielded from other particles in the charging zone and therefore not accumulate a charge. For these particles, aerodynamic forces might propel them toward the part. Ions that don't become attached to powder particles in flight are known as excess ions or free ions. Ions, being charged particles, also tend to follow the electric field and many are deposited onto the part. Figure 2 shows a start-of-the-art corona gun in operation.

■ **Tribo** Tribo-charging guns charge power particles by intimate contact and subsequent separation of the powder particles from the gun walls. When two different materials are brought into contact, there is a transfer of charge from one to the other to eliminate the imbalance of charge. The magnitude and direction of the charge transfer depends on many factors, including the chemical and electronic structure of both materials.

Polytetrafluoroethylene or PTFE is typically used as the powder contact walls in a tribo gun. Powder particles, of course, are a composition of materials comprised of resin, pigment, fillers, and possibly other additives. Experience has shown that most finishing powders become positively charged by contact with PTFE. Theoretically, the gun walls will be left with a charge equal in magnitude but opposite in polarity to the charge accumulated on the powder particles. This charge on the gun walls must be conduct away or else it could build up inside the gun, which would cause the gun to stop charging and could cause it to become a shock hazard.

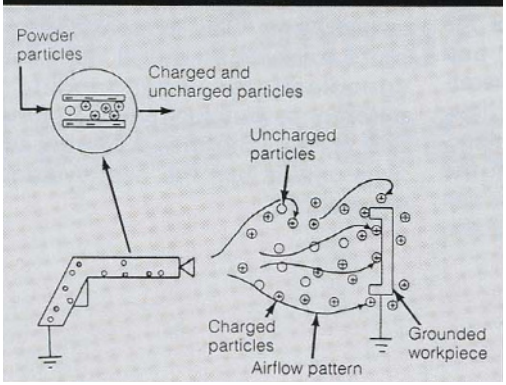
Tribo guns charge the powder particles within the gun when the powder particles contact the PTFE walls. The more contacts a powder particle makes with the walls and the harder it hits them, the greater the charge on the particle. As long as there's PTFE in the gun for the powder to contact, the powder will become charged.

FIGURE 2. STATE-OF-THE-ART CORONA GUN



Note in Figure 3 that the tribo gun does not have an electrode at high potential nor the resulting electric field between the gun and part, as does a corona gun. Therefore, airflow from the gun plays a more significant role with eh tribo gun transporting the powder particles onto the part. Figure 4 shows a tribo gun in operation.

FIGURE 3



Selection Criteria

■ **Part Geometry** Tribo-charging guns can effectively coat the widest variety of parts. Because a tribo gun doesn't have a strong electric field between the gun and part as a corona gun may have, powder sprayed from a tribo gun can easily penetrate into Faraday cage areas on parts. Because of the wide variety of sprayhead and nozzle combinations, a tribo gun can produce excellent control of the quantity of powder spray and its direction and velocity. As a result of this control, many parts can be coated automatically without any manual gun touch-up. Excellent parts for coating with tribo guns include condensers, transformers, bicycle or motorcycle frames, wire baskets, folding chairs and others.

■ **Part Material** A tribo-charging gun can coat some parts that are not highly electrically conductive without the prior application of a conductive coating. This is primarily because a tribo gun does not deposit a large quantity of free ions on a part as a corona gun might. The parts still need to be electrically grounded, but the surface conductivity of the part material or the powder coating may be large enough for effective grounding. Spray trials performed as close as possible to the actual production conditions are necessary to verify the coatability of non-metallic parts. Tribo guns may also be better for recoating parts compared to a corona gun because of the slow build-up of charge on the part.

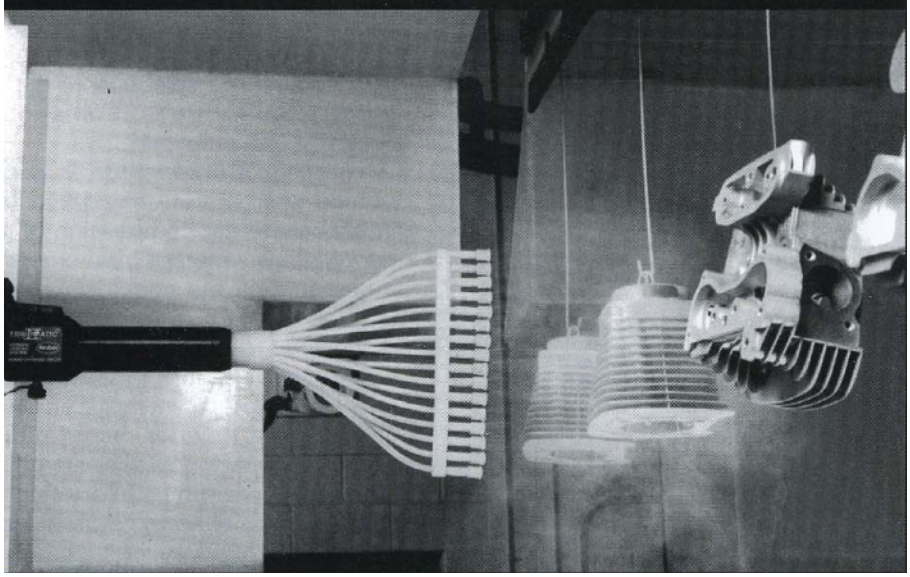
■ **Coating Appearance** The appearance of the powder coating on a part can be affected by the bombardment and deposition of the free ions from a corona gun. Because there are comparatively few free ions produced by a tribo gun, the resulting coating can be particularly smooth and blemish-free. A good application for tribo guns is putting a powder clear coat onto automobile wheels.

■ **Coating Thickness** Corona guns are particularly good at applying thin films onto parts; however, as coating thickness increases, charge cha build up on a part from both charged powder and free ions. This charge can repel incoming powder particles and limit the coating thickness. Tribo guns, however, producing few free ions, can be an excellent choice for applying thick films. A film build of several hundred microns on an unheated part in a single pass is possible with a tribo gun.

■ **Coating Uniformity** The strong electric field from the high voltage electrode on a corona gun can cause powder particles to concentrate on part surfaces closest to the gun and on corners and edges. A tribo gun's comparatively weak electric field does not cause these variations in coating thickness. Furthermore, coating uniformity might be better optimized with a tribo gun through the selection of the best sprayhead/nozzle combination for coating a particular part.

■ **Coating Composition** In general, corona charging is considered to be insensitive to the composition of powder coatings, whereas tribo charging is dependent on the composition of the surface of the powder particles. The technology for manufacturing powders that will work well in a tribo system has improved greatly in the last several years. Most powder manufacturers today formulate powders specifically for tribo application. Before finalizing your selection of a tribo system, spraying trials are high recommended.

FIGURE 4. STATE-OF-THE-ART TRIBO GUN



The abrasiveness of the powder can also be an important consideration. Charge accumulates on a powder particle as a result of its contact with the walls in the tribo gun. Harder contacts at higher velocity can result in better charging, but it can also result in higher wear rates on the powder contact parts. Frit (powdered porcelain enamel) is never sprayed with a tribo gun. Metallics are usually sprayed with a corona gun; however, some are also sprayed well with a tribo gun.

■ **Line Speed** In the past, one of the disadvantages of tribo guns was the relatively low powder output compared to corona guns. This limited tribo guns in some cases to small parts applications and low line speeds. This limitation no longer exists. Today, tribo guns have the same powder flow rate capability as corona guns.

■ **Color Change** The wetted surface (the area contacted by the powder) may be greater in a tribo gun compared to a corona gun. Therefore, color change may take longer with a tribo gun because of the larger surface requiring cleaning. How easily a gun can be disassembled is also an important factor in color change time.

■ **Equipment Construction** From a manufacturing standpoint, tribo equipment can be considered more robust and can be more reliable than corona equipment. Tribo equipment is simpler because it doesn't have a high voltage powder supply or cable, so fewer things can go wrong.

■ **Spraying Process Monitor**
The current generated in a tribo gun is typically displayed on the control console and can help an operator monitor the performance of the equipment and spray process. The current generated is proportional to the powder flow rate. Therefore, a reduction in the current can indicate a reduction in the powder flow rate, and an operator can be notified of this condition to find and correct the immediately.

Conclusion

Clearly, the decision between tribo and corona equipment is not always an easy one. Only by considering the parts to be coated and the coating specifications, understanding the differences between the equipment, and considering the necessary technical criteria can the best system be selected.