

## Transfer Efficiency - Issues & Methods

Many manufacturers of industrial coating application equipment often cite efficiencies of their spray equipment in terms of transfer efficiency (TE). While useful in comparing different types of equipment (conventional, HVLP, airless, etc.), its value as a tool in evaluating real-world situations is questionable.

This article is not intended to be a full discussion of the methods for testing spray equipment efficiency. It reviews the primary methods of testing and related issues.

The entire issue of spray equipment transfer efficiency has at its roots, "\$\$". What we are in reality looking for is - which type of equipment will use the least amount of coating and still achieve the desired quality of finish and film thickness? Different kinds of spray equipment may have a higher TE rating, but yield a lower quality finish with a higher minimum film thickness than desired.

By definition, Transfer Efficiency is as follows:

"The percentage of total coating solids employed by a coating applicator which adheres to the object being coated" -- *Ohio EPA*

The ratio of the weight of paint solids deposited to the weight of the paint solids sprayed, expressed as a percent. -- *American Society for Testing and Materials*

Note that the key to the above definitions is "coating solids". In order for an end-user to evaluate the TE of a piece of equipment, the amount of solids per gallon by weight would have to be known and a way of accurately measuring the object and materials before and after coating a production piece would have to be available. Even if the test was completed accurately, would it match the production conditions under which the device would be used?

The following issues would have to be addressed in order to assess the validity of the efficiency claim:

- What was the required quality of the finish? (sheen, orange peel, gloss etc.)
- What was the required mil thickness?
- What was the size of the part?
- What was the spacing of the part?
- What was the line speed?
- Was proper spray technique used?
- What type of coating was used?
- What was the viscosity of the coating?
- What was the ambient air temperature?
- What was the spray booth air flow?
- What air & fluid pressures were used?

As seen, any correlation between efficiency testing claims and actual results in the field are usually haphazard at best.

Three methods of testing spray equipment coating efficiency will be discussed.

1. Transfer efficiency testing.
2. Cost per square foot applied
3. Cost per part applied.

## Transfer Efficiency

Each spray equipment manufacturer has developed their own method of testing for TE. While valid for comparing equipment inside the spray equipment manufacturer's facility, any relationship to information needs of the end-user and their manufacturing process is questionable.

The following are methods for establishing TE for a piece of coating spray equipment.

## ASTM Method

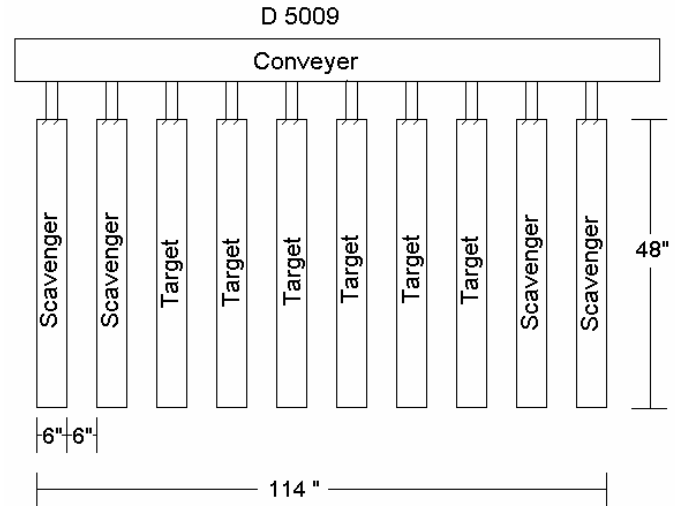
The American Society for Testing and Materials has established standards for testing TE in both the laboratory (D-5009) and production (D-5286) conditions.

### D-5009

#### Laboratory Conditions.

Six inch metal panels covered with pre-weighed aluminum foil and conveyed through a spray booth past a fixed spray gun. The coated foils are then baked to remove volatile matter. The transfer efficiency is calculated on a weight basis using the solids content and quantity of the paint sprayed and the amount of solids on the coated aluminum foil target.

Note: The 6" wide panels are hung similar to a picket fence. Since this may not represent the typical product in the manufacturing environment, the TE calculated may not be representative. In addition, the validity issues expressed earlier may skew the TE percentage even farther from reality.



### D-5286

#### Field Conditions: 2 methods

##### Weight Method:

The weight solids content of the paint material is determined and used to calculate the paint solids sprayed. The transfer efficiency is calculated by dividing the weight of the paint solids deposited by the weight of the paint solids sprayed.

Note: This method involved weighing the production parts being sprayed, in many cases impractical.

##### Volume Method:

The volume solids of the paint material is determined and used to calculate the paint solids sprayed. The transfer efficiency is calculated by dividing the volume of the paint solids deposited by the volume of the paint solids sprayed.

Note: This method required an accurate way of measuring dry film thickness (DFT) on the production parts and assumes a uniform film build on the entire part and from part to part.

## Full Deposit Method

The weight solids content of the paint material is determined and used to calculate the paint solids sprayed. The transfer efficiency is calculated by dividing the weight of the paint solids deposited by the weight of the paint solids sprayed.

Note: This method requires a flat sheet of aluminum foil approximately twice the height of the spray pattern and approximately 3 feet long. The entire spray pattern is deposited on the foil. Both the coating container and foil are weighed before and after to determine TE. As in all other weight methods, the percentage of solids must be taken into account when determining solids usage.

All things being equal, this will represent the true transfer efficiency (read maximum) of the spray gun with the coating being used with the set of spray parameters established for the test. This method of calculating TE, as with the others, may not reflect the actual spraying conditions used during the manufacturing process.

## **Cost per square foot applied**

In the cost per square foot applied method, a given production run with a specified set of product to be sprayed is run for a predetermined amount of time with a fixed number of products. The operator, equipment, booth flow, air temperature etc. needs to be identical for all types of equipment tested. The longer the test, more pieces run, the more accurate the test.

By measuring the total coating usage along with the calculated square feet of the products sprayed, the cost per square foot as applied is easily determined.

## **Cost per part applied**

If the calculation of square footage proves to be a difficult task, then the same procedures used in the cost per square foot method would be used, only with identical parts. For the purpose of determining a cost, this method would yield a satisfactory cost comparison. Keep in mind, that the ability to transfer the cost to a different item other than the one tested would be subjective.

## **Summary**

The benefit of gathering T.E. data for spray equipment is of value only if the conditions for testing were uniform. The basis for making a decision on spray equipment can only be made using equipment in a controlled environment using simulated examples from the workplace.

The results of testing have little value if the specifications and criteria of the finish do not correlate to the spraying application.