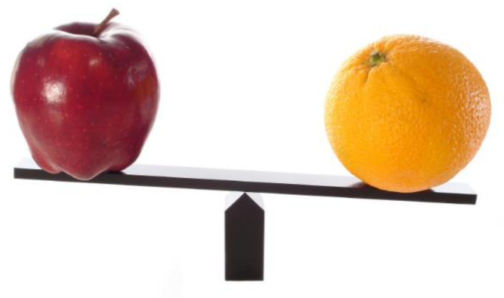
Kalcor University

Comparing the *Real* Costs of Paint
… A solid approach.

Suppose you need an important letter to be hand-delivered from New York to Los Angeles. Two people offer to help by driving your letter from coast to coast.



One says "I will do it for a price of $4.00 per gallon for the gas needed to drive there". The other says, "well, I will do it for the price of gas too, but since my vehicle requires more expensive gas, I will charge you $5.00 a gallon for the gas I use." Who should you pick? The person with the lowest priced gas? You might be unhappy to learn that he drives 12-ton motor-home that gets barely 5 miles a gallon, or a $2400 gasoline bill compared to the other guy who rides a Harley Davidson motorcycle that gets 53 miles per gallon – a tenth the price for the same trip!

The price of a gallon of paint is no more a predictor of the actual cost to paint parts than is the cost of a gallon of fuel in the example above. You will need more information to make a smart coating decision when comparing the apples and oranges that are frequently different paints. What should matter to your budget is the final applied cost per finished part required to achieve the performance you need. The good news is that you can figure this out easily with the right data and a few simple formulas.

Here at the things you will need to know to compare the applied cost of two coatings:

1. The % Solids by Volume.

Paints include both volatile and solid components. But it is the solid constituents that give a paint most of its final properties such as color, opacity, or weatherability. When paint is applied, the volatile components, including water, evaporate leaving behind these important solid materials on the surface of your part. It is the cost of the solid materials in that are critical to calculating the applied cost of your coating. The cost of the solid fraction can be calculated from information provided in the product's product or technical data sheet, which should be available from the paint manufacturer. As an example, suppose a paint costs $15 per gallon and contains 33% solids. This means that 2/3 of wet film you apply evaporates leaving behind only 1/3 of the coating as solids. On the other

2. The Film Thickness.

You will also need to know how thick a layer of solid paint you need to apply in order to get the proper appearance, or durability your part requires. Usually this is determined by experimenting with test panels of varying different (dry) film thicknesses which are then tested and compared. The goal is to optimize the film thickness for the job at hand. Obviously you don't want to put more paint on the parts than needed, since extra paint costs money without adding much value.

In the coatings industry, film thickness is typically measured in thousandths of an inch, or "mils" (.001 inches = I mils). Though sometimes film thickness is expressed in metric units called microns (where one mil = 25.4 microns). Remember that this specification is usually for the dry film thickness. A coating with a large percentage of solvent or water may require several times the wet thickness in order to yield a given dry film thickness. Typical paint (dry) film thicknesses range from 0.5 to 2.5 mils although for some specialized applications the thickness could be much thinner or thicker. To measure film thickness you can use either a destructive method (like a Tooke gauge, or shim stock) which measure the paint layer compared to the bare part surface, or with non-destructive electronic gauge that measures film thickness using electromagnetic currents, or ultrasonic waves.

3. Transfer efficiency (TE).

A quick peek into any industrial spray paint booth provides irrefutable evidence that a great deal of paint is wasted in the application process.

How much paint you need to purchase depends to a large extent on how efficiently you get paint onto the parts. The ratio of the amount of paint on the parts to the total amount of paint you consume is called your "transfer efficiency" (or TE). In practice, this transfer efficiency depends on a number of factors:

a. The efficiency of the spray gun. Some guns have much more uniform and fine atomization of paint particles than others. In practice, wide spray patterns, poor air control, nozzle wear, and other technical features make it tough to get ideal efficiency no matter how well trained the painter is. Some technologies like HVLP or electrostatics may provide better transfer efficiency than simple air spray guns.

b. Some characteristics of the paint, such as its viscosity, shear when mixing, or tendency to settle can affect how well the paint atomizes, its tendency to dry spray, and rheological properties that could affect your ability to get a uniform, well controlled coating.

c. Manual spray painting technique. Some spray painters are simply much more adept at applying a consistent film thickness than others. Providing training and feedback on film thickness can help reduce over-spray and improve TE. Of course automated spray guns with electronic or pneumatic controls also can also improve results.

d. Environmental conditions. Varying temperature or humidity in the spray zone can cause paint particles to behave unpredictably and reduce transfer efficiency. A well regulated paint room with environmental controls is a safeguard against a number of paint related defects.

e. Housekeeping and maintenance. Keeping spray guns in working order, replacing spray booth filters as they load up with paint, keeping electrostatic parts well grounded, and part fixtures clean helps improve your results. It is quite common to find that operators who apply paint in adverse conditions frequently do a poor job of fine tuning their work to produce optimum results.

f. Part presentation and geometry. To avoid uneven film thickness it is often necessary to present parts to the spray gun in a way that the spray pattern can be optimized. Consistent part presentation allows the staff to find settings that provide repeatable paint coverage. As students of statistical process control (SPC) know – the first step is to get the system “under control.” Only after the process is controlled, can it be methodically optimized.

g. Electrostatics. Electrostatic painting offers the carrot of high potential transfer efficiency, since a well designed electrostatic system will draw charged paint particles efficiently to well grounded parts. However electrostatic painting also poses a number of related issues such as Faraday cage areas where coverage is difficult to achieve, or erratic results due to poor grounding. It is important not to sabotage an otherwise efficient electrostatic system because of overlooked details that can result in worse TE than if no electrostatics were used at all.

Given the number of things that can, and do go wrong – along with unavoidable forces of nature, (Like gravity pulling on paint droplets, it’s unreasonable to expect that you could ever achieve 100% transfer efficiency. Typical transfer efficiencies reported by spray equipment suppliers vary widely due to the kind of factors described above. But the table below provides a rough estimate of TE that you might expect with various spray technologies. Of course your actual TE should be verified for your own installation by measuring the amount of paint sprayed and that which is wasted.

Conventional	Air Assisted	Airless	HVLP	Electrostatic
25%-35%	30%-60%	30%-50%	50-65%	65%-90%

4. It's Time to Calculate!

No that you are armed with the percent solids by volume of each paint, the desired film thickness to get results with each paint, and your transfer efficiency estimates, you are ready to calculate the theoretical coverage of a gallon of each paint:

$$Theoretical\ Coverage\ (square\ feet) = \frac{1604\ x\ \%Solids\ x\ \%TE}{Film\ thickness\ \ (mils)}$$

So, Let's try an example:

Suppose a paint costs $15.00 a gallon. It is 45% solids by volume, you believe you can apply it at 55% transfer efficiency, and your trials show that you need a dry film thickness of 2.0 mils to meet your specs. Now, just plug in the numbers

$$Coverage\ (square\ feet) = \frac{1604\ x\ .45\ x\ .55}{2.0}$$

And you get a theoretical coverage of 198.5 square feet per gallon. If each part has 3 square feet of surface then you can paint 198.5 / 3 or a total of 66 finished parts per gallon. At $15.00 per gallon that's $0.23 per finished part.

Suppose another paint supplier offers you a "less expensive" paint costing only $12.00 per gallon. Is that really a better choice? Using your mathematical skills you find that if that "bargain" paint is 30% solids by volume you will get only 132.3 square feet of coverage, capable of finishing just 44 parts per gallon for an applied cost per part of $0.27 per part. This "deal" costs you an extra four cents for every part you produce.

A note of caution should be added here. You might not want to assume that you can simply use the same film thickness or TE numbers for this situation. It may be that a less costly paint requires a higher dry film thickness to get the right performance or appearance. It could also be that this paint sprays poorly and the TE is a few percentage point lower. This would make the value of this deal even less attractive. That's the apples-to-oranges problem again.

So, there it is. Equipped with the right information and a few simple calculations you can determine which coating is actually more costly on the basis of applied coating cost. Often a paint that has a higher price per gallon is actually much more profitable once work through the numbers to get to a real comparison. This approach will allow you to make an informed decision every time.