Why Do We Apply Powder Coating to Parts

**Appearance**

- First impression of any manufactured part is color and finish
- Best manufactured part with poor coating appearance is perceived as low quality
- On the other hand, a very good coating can improve the perceived value
- Customers want color options
- Customers who do not have an expectation of appearance can be given one by the powder coater

**Corrosion**

- All metal oxidizes – affects perceived quality of part
- Environment that part exists in will impact rate of corrosion
- Coating “system” includes metal pretreatment
- You can coat over rust, however, it will continue to rust underneath the coating and reappear quickly
Performance Specifications

- Generally takes into consideration the “in use” environment for a part
- Weathering – natural, accelerated corrosion – neutral salt spray, cyclical
- Mechanical – impact, cross hatch, mandrel bend
- Chemical – resistance to exposure – fuel, acids, bases, etc
- You can “over engineer” the coating performance for a non essential need and increase your cost
- You can apply more powder than is required which your customer is not paying you to do
- Verify that your customer has reasonable expectations for coating performance
Indoor Use Only!

Not stable in UV exposure

Excellent corrosion properties – often used as a primer

Excellent chemical resistance

Excellent hardness and mar resistance

Excellent post forming properties

Low cure and low film builds available

Very good smoothness
Polyester – Indoor or Outdoor Use – has a curing agent

- TGIC – curing agent in powder, known mutagen – still most commonly used powder coating
  - Can be applied at higher film builds
  - Good weathering, corrosion resistance, flexibility and smoothness

- HAA – more environmentally friendly curing agent – no warning labels – only releases water
  - Becoming more popular
  - Can be applied at higher film builds
  - Excellent charging properties – wrap and Faraday cage penetration
  - Good weathering, corrosion resistance, flexibility and smoothness

- Urethane – blocked curing agent – odor & fuzz
  - Good chemical resistance
  - Can apply at low film builds
  - Very low gloss possible

- Super Durable – only means extended weathering
Fluoropolymer

- Used in monumental architecture

Metallic Effect

- Extrusion, Blend, Bond
- Bond desirable for reclaim
- Bond is highest cost

High Temperature

- Up to 1200 degrees F

Antimicrobial

- Does not kill bacteria but instead does not allow it to replicate or feed

Outgas Resistant

- Primarily for cast substrates
3 Levels of Performance in Architectural Weathering

**Gloss Retention**
Typical gloss retention after natural Florida exposure

**Color Variation**
Typical color variation (Delta E) after natural Florida exposure for two years
Severe Corrosion Environments – for these locations consider the added protection of an epoxy primer
• Metals other than aluminum
  • Wrought Iron
  • Steel
  • Galvanized Steel
  • Cast parts
What does it cost to apply powder coating
Applied Cost - Theoretical

- Applied cost takes into consideration the formulation of the powder coating, the transfer efficiency and the film thickness of the applied coating.

- Applied cost is calculated in Cost/Square Foot

- Still does not consider rework, labor, etc.

Applied Cost = **192.3 x Transfer Efficiency**

Specific Gravity x Film Thickness
Finely Divided Particles containing:

- Organic Polymers
- Extender
- Pigments
- Flow and Leveling Aids
- Additives
What does it mean – relation to water – 1.0

Powder Coatings are binder, pigments and additives

In the additives component, there are extenders – can be more or less

Extenders do not charge well like resin does

Using more extender will typically reduce the overall cost of powder coating

Conversely, less extender, means more resin – better charging & more cost

Typically will cover Faraday Cage better and provide better wrap

Less extender improves Transfer Efficiency
Specific Gravity

- Calculated value, key factor in coverage equation.
- Influenced by raw materials.
  - Fillers/extenders.
  - Pigments.
- May decrease weather-ability.
- May increase wear on application equipment.

Same Weight

1.7 SG  1.5 SG  1.3 SG
**Impact of SG on Applied Cost – spray to waste example**

- **Powder A** – 1.65 SG, 2.5 mils DFT, $3.00/LB
- **Powder B** – 1.55 SG, 2.5 mils DFT, $3.15/LB
- **Powder C** – 1.45 SG, 2.5 mils DFT, $3.25/LB
- **Powder D** – 1.35 SG, 2.5 mils DFT, $3.35/LB

For this exercise, let’s assume you are spraying to waste and TE is 70%

- From our equation, we calculate cost/square foot

Applied Cost Calculator

Instructions: Enter the specific gravity, recommended film thickness and price per lb of the chosen powder or powders. Powder comparisons, film thickness consequences and utilization effects can be evaluated using the tables below.

<table>
<thead>
<tr>
<th>Product Identification</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
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</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>A 1.65</td>
<td>B 1.55</td>
<td>C 1.45</td>
<td>D 1.35</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Coverage per lb (sq ft)</td>
<td>46.6182</td>
<td>49.6258</td>
<td>53.0483</td>
<td>56.9778</td>
</tr>
<tr>
<td>Price per Lb</td>
<td>$ 3.00</td>
<td>$ 3.15</td>
<td>$ 3.25</td>
<td>$ 3.35</td>
</tr>
<tr>
<td>Material Utilization</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>Cost per Square Ft</td>
<td>0.09193225</td>
<td>0.090678627</td>
<td>0.087521358</td>
<td>0.083992645</td>
</tr>
<tr>
<td>Cost Per 1,000,000 Square Feet</td>
<td>$ 91,932.25</td>
<td>$ 90,678.63</td>
<td>$ 87,521.36</td>
<td>$ 83,992.65</td>
</tr>
</tbody>
</table>

![Applied Cost / 1 Million Sq Ft](chart.png)
Poor line density has lots of open space

Here we see the impact

Applied Cost Calculator

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</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.45</td>
<td>1.45</td>
<td>1.45</td>
<td>1.45</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
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<tr>
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<tr>
<td>Price per Lb</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>Material Utilization</td>
<td>95%</td>
<td>70%</td>
<td>50%</td>
<td>35%</td>
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<tr>
<td>Cost per Square Ft</td>
<td>0.0595287</td>
<td>0.080788946</td>
<td>0.113104524</td>
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<td>Cost Per 1,000,000 Square Feet</td>
<td>$59,528.70</td>
<td>$80,788.95</td>
<td>$113,104.52</td>
<td>$161,577.89</td>
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</tbody>
</table>

Applied Cost / 1 Million Sq Ft

Series 1

- $200,000.00
- $150,000.00
- $100,000.00
- $50,000.00

Powder Options
Only change made to previous example was Material Utilization was changed from 70% to 95% which accounts for reclaim
In this example, we see the same SG for each option

The film thickness is the only variable

Cost/LB and Material Utilization stay the same

As expected, applied cost rises with increased film build

But the question is, how did you quote the coating cost to your customer

Are they paying you for this increased cost or are you losing profits
Impact of using a film thickness gage example

- Gage cost $5000 – non contact

- Annual spend for powder coating - $300,000

- Now, let’s see the impact of controlling film thickness

- For this example, let’s presume you are applying 3.5 mils but could be applying 2.5 mils – that’s 1 mil too much or 40%

- If you take 40% of $300,000, that’s a potential savings of $120,000

- That’s less than a 2 week payback – good investment?
Impact of Lower SG on Applied Cost for Extrusions

In this example, let’s assume we are coating an extrusion with recesses.

As you know, there typically is a difference in the film build at the outer surfaces relative to the inner surfaces.

If you have to apply 4 mils to the outer surface to reach the minimum 2 mils on the inner surface what impact on applied cost is that?

If another powder allows you to apply 3 mils on the outer surface and still reach the minimum 2 mils on the inner surface, what does that save you in applied cost?

Again, how did you quote the coating of this part, did you calculate the increases cost of powder on the outer surfaces or are you giving away those profits?
Want to save money and increase profit?

- Check film builds
  - 1.0 mil of additional coating adds cost that your customer is not paying you
- How many people have and use their film thickness gage
- Is it calibrated?
- What difference does it make?

- Let’s say it costs $1000 for a gage, what impact can that have on profit
- If you apply 3.5 mils average on parts, when the TDS says it is engineered for 2.5 mils average, that’s 40% additional coating applied
- Let’s say you spend $200,000 annually on powder coatings, reducing consumption by 40% means $80,000 in increased profit
- That seems worth the $1000 investment, right?
How does line density impact cost?

For this example, let’s assume the part is 1’ x 2’ and line speed is 12 feet per minute.

If parts are hung on 18” centers, then you could hang one part per hook.

Therefore, you could hang 8 parts per 12 feet of conveyor or coat 8 parts per minute or 480 parts per hour or 3,840 parts per 8 hour shift.

However, if you hang parts 2 high (one above the other), then you can coat 7,680 parts per 8 hour shift.

If you are charging your customer $2 to coat each part, then you can now enjoy a revenue of $15,360 per 8 hour shift versus $7,680.

For this example, that is an annual revenue of $3.8 million versus $1.9 million.

Line density can have a huge impact on potential revenue for a coating line.
Increasing the line density increases the first pass transfer efficiency

We saw from our applied cost examples, increasing transfer efficiency lowers applied cost significantly

In the last example, we coated 3,840 parts in one 8 hour shift, increasing the line density allows 7,680 parts in one 8 hour shift

If you increase the line density, you can move on to another part faster

We are all asked to reduce our time to turn coated parts around, getting parts coated faster gives you more flexibility to move on to other parts and meet your customer’s needs while still improving your cost and profitability

Spraying air instead of parts during reclaim impacts particle distribution
You know the applied cost of your coating and want to improve it further.

Obviously, first step is only apply the amount of powder that is recommended by the paint manufacturer.

But is there more, if you have determined that you are using a high specific gravity powder, then you can look for a lower one but you also have to look at the new cost/pound.

Call your powder supplier and discuss how to reduce applied cost, remember you could actually pay more in price/pound but because there is a reduction in total powder consumption, you can reduce your total spend for powder by using a lower specific gravity powder.
How do you define rework? Light sprays, contamination, etc.

It is said that rework cost can be in excess of 4 time the original cost to coat

What are the additional costs – labor to sand, stripping parts, hanging a rework part where a first run part could have hung

This also impacts shipping on time – your customer ships you 100 parts they expect 100 parts back

Can you lose parts – if so, where – washer – poor rack design

If you file the paint off a hook to get good ground, then the part moves during the wash process, do you lose your ground
Is faster always cheaper & better?

If you have a batch oven, then your profitability is significantly impacted by how many turns you can get through the oven and how densely loaded it is.

If you have an I Beam Conveyor, then everything has to be able to be processed at the same speed.

- Load & Unload
- Pretreatment – dwell time matters
- Applying powder
- Curing powder

Increasing speed then having line stops is counterproductive.

- Example – customer increased line speed but sprayers couldn’t keep up
Paint Improvement Team

Work with key personnel and pretreatment supplier team to identify opportunities for process improvement
Are you treating your paint and pretreatment suppliers as partners in your business – when have you last asked their advice?

Many people don’t help until asked and if help is offered and declined, then they don’t offer again soon……

Training – you can’t expect better from people who aren’t trained

Who is the key person in your shop impacting your customer’s perception of your performance – the person on the application gun

Reduce non productive time

Could a batch system handle the “hot rush” parts and better allow you to schedule your conveyor system for best productivity

Why do you have line stops

How can you reduce color change time
In order to improve any process, you must first measure it.

Document defects/rework based on what defect is occurring.

Here is a list of some of the potential defects:

- Seeds, Craters, Fisheyes, Lint, Bubbles, Orange Peel, Faraday Cage, Light Film, Heavy Film, Color Contamination, Metal Defects, Water Spots, Marring, Dirt

Once you document what the defect is, then attack the highest occurring ones.

Determine the root cause of the defect by “turning it on/off”.

Establish a control plan to eliminate or at least reduce the defects.
Paint Improvement

• On site training – paint application, maintenance, quality & applied cost

• Technical service on site
  ☰ Establish baseline for Paint Improvement Team
    ☰ Measure film builds over several days
    ☰ Measure line stops
    ☰ Measure line density
    ☰ Measure defects
Transfer Efficiency is affected by both the formulation of the powder and the amount of powder in the ionized cloud.

Many sprayers think more is better, “puking” powder from the gun.

Testing has shown that reducing the amount of powder significantly increases the transfer efficiency.

Low feed setting produced 95+% transfer efficiency while still building recommended film thickness.

High feed setting produced 15% transfer efficiency.

Good rule of thumb is that you should be able to see through the powder cloud.

And yes, if you are reclaiming, you catch the overspray and see that this process actually reduces the particle size.
### Assumptions
- **8,000 parts/day**
- **Typical rework cost is 4 times cost for 1st coat** - assumed $0.25/part to coat, spray to waste quantity is 110 lbs/day

### Current State

<table>
<thead>
<tr>
<th>Incumbent Yellow</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Current Price/lb</strong></td>
<td><strong>3.75</strong></td>
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<tr>
<td><strong>Current Usage</strong></td>
<td><strong>100,000</strong></td>
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<td><strong>Current Total</strong></td>
<td><strong>$375,000.00</strong></td>
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<td><strong>Rework Cost/Part</strong></td>
<td><strong>1.00</strong></td>
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<td><strong>Parts/Year</strong></td>
<td><strong>200,000</strong></td>
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<td><strong>Current Rework Total</strong></td>
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<tr>
<td><strong>Labor Cost/Man</strong></td>
<td><strong>20.00</strong></td>
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<tr>
<td><strong>Personnel #</strong></td>
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<tr>
<td><strong>Hours/Year</strong></td>
<td><strong>1000</strong></td>
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<tr>
<td><strong>Current Total</strong></td>
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<tr>
<td><strong>Spray to Waste Lbs/day</strong></td>
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<tr>
<td><strong>Days/Year</strong></td>
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<tr>
<td><strong>Price/lb</strong></td>
<td><strong>$3.75</strong></td>
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<tr>
<td><strong>Current Total</strong></td>
<td><strong>$103,125.00</strong></td>
</tr>
</tbody>
</table>

### Total annual cost to coat parts

**$758,125.00**
### Scenario 1

<table>
<thead>
<tr>
<th>Proposed State</th>
<th>Presuming same usage</th>
<th>But we hide at half of incumbent</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Supplier Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Proposed Price</strong></td>
<td><strong>Current Usage</strong></td>
<td><strong>Current Total</strong></td>
</tr>
<tr>
<td>$5.20</td>
<td>$x</td>
<td>$520,000.00</td>
</tr>
<tr>
<td><strong>Rework Cost/Parts</strong></td>
<td><strong>Number of Parts</strong></td>
<td><strong>Proposed Rework Total</strong></td>
</tr>
<tr>
<td>$1.00</td>
<td>$x</td>
<td>$20,000.00</td>
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<tr>
<td><strong>Labor Cost/Man</strong></td>
<td><strong>Number of Personnel</strong></td>
<td><strong>Hour/Year</strong></td>
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<tr>
<td>$20.00</td>
<td>$x</td>
<td>$40,000.00</td>
</tr>
</tbody>
</table>

No Spray to Waste costs

**Total Annual Cost to Coat Parts** $580,000.00

**Total Annual Savings to Convert to New Supplier** $178,125.00

Actual data recorded from monitoring line over two days - Customer applied at 6-8 mils and had 10% rejects
## Scenario 2

### New Supplier Yellow

<table>
<thead>
<tr>
<th>Proposed State</th>
<th>Actual usage based on film builds required</th>
</tr>
</thead>
</table>

#### Proposed State
- **Proposed Price**
  - 5.20

- **Current Usage**
  - 50,000

- **Current Total**
  - 260,000.00

- **Rework Cost/Part**
  - 1.00

- **Number of Parts**
  - 20,000

- **Proposed Rework Total**
  - 20,000.00

- **Labor Cost/Man**
  - 20.00

- **Number of Personnel**
  - 2

- **Hour/Year**
  - 1000

- **Total Annual Cost to Coat Parts**
  - 320,000.00

- **Total Annual Savings to Convert to New Supplier**
  - 438,125.00

---

Actual data from New supplier line trial and subsequent usage over years of time applied at 3-5 mils and less than 1% rejects.
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