Section 01

Introduction - Advantages of Powder Vs. Liquid

Why Use Powder Coatings?

- Powder coatings meet or exceed new quality standards
- Greater choice of color and consistency of color compared to anodizing
- Excellent durability and performance from polyesters and fluoropolymers
- Impact of the green movement on coatings, especially in the architectural market
- Ease of application and low conversion costs
- Ability to use various grades of extrusions
- Higher film builds and better edge coverage
- Most powder resins that meet the requirements of AAMA 2604 specifications are produced using Super Durable Polyester systems.
- Most powder resins that meet the requirements of AAMA 2605 specifications are manufactured using the FEVE resin technology

Why Use Powder Coatings?

- FEVE, which stands for Fluoroethylene Vinyl Ether, is the second generation fluoropolymer coating technology.
- FEVE resins were developed in the 1980's as solvent durable fluoropolymers that could be used on-site for various field applications including architectural and aerospace coatings.
- FEVE resins were designed not only to overcome the limitations of PVdF resins but also to meet or exceed the weatherability performance of PVdF coatings.
- FEVE coatings are known for their high performance properties such as:

  Exceptional resistance to UV degradation

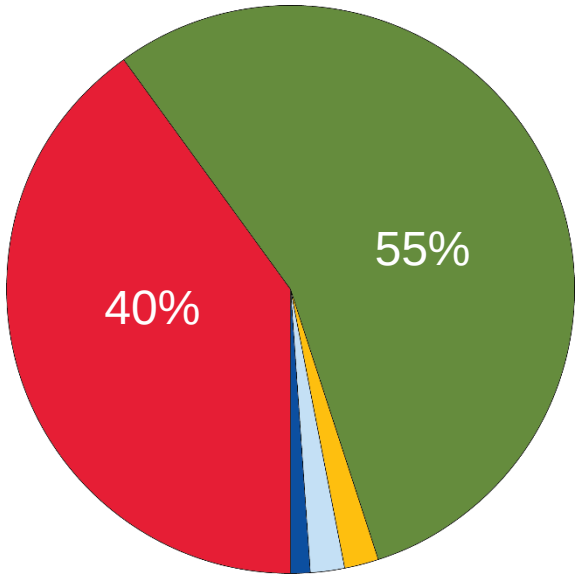
  Superior Chemical resistance

  Can be formulated to meet higher gloss specifications than PVdF coatings

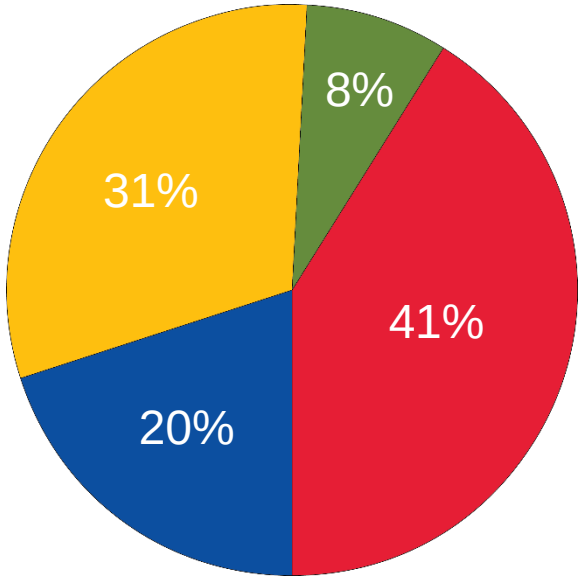
  Excellent pigment compatibility resulting in a greater choice of colors

Powder vs. Liquid

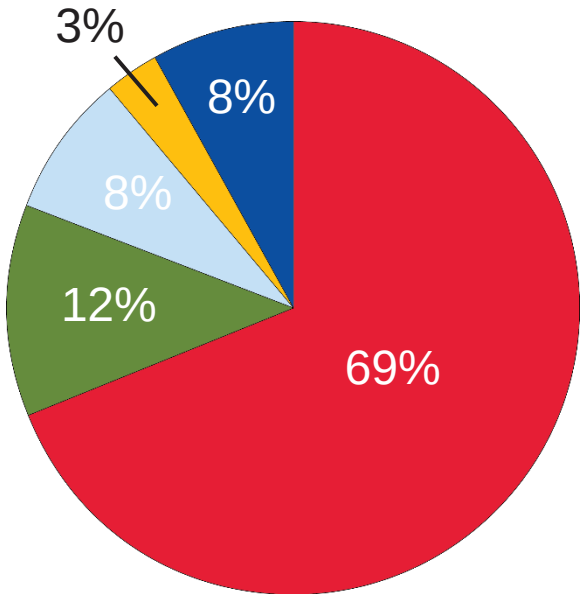
Europe



North America

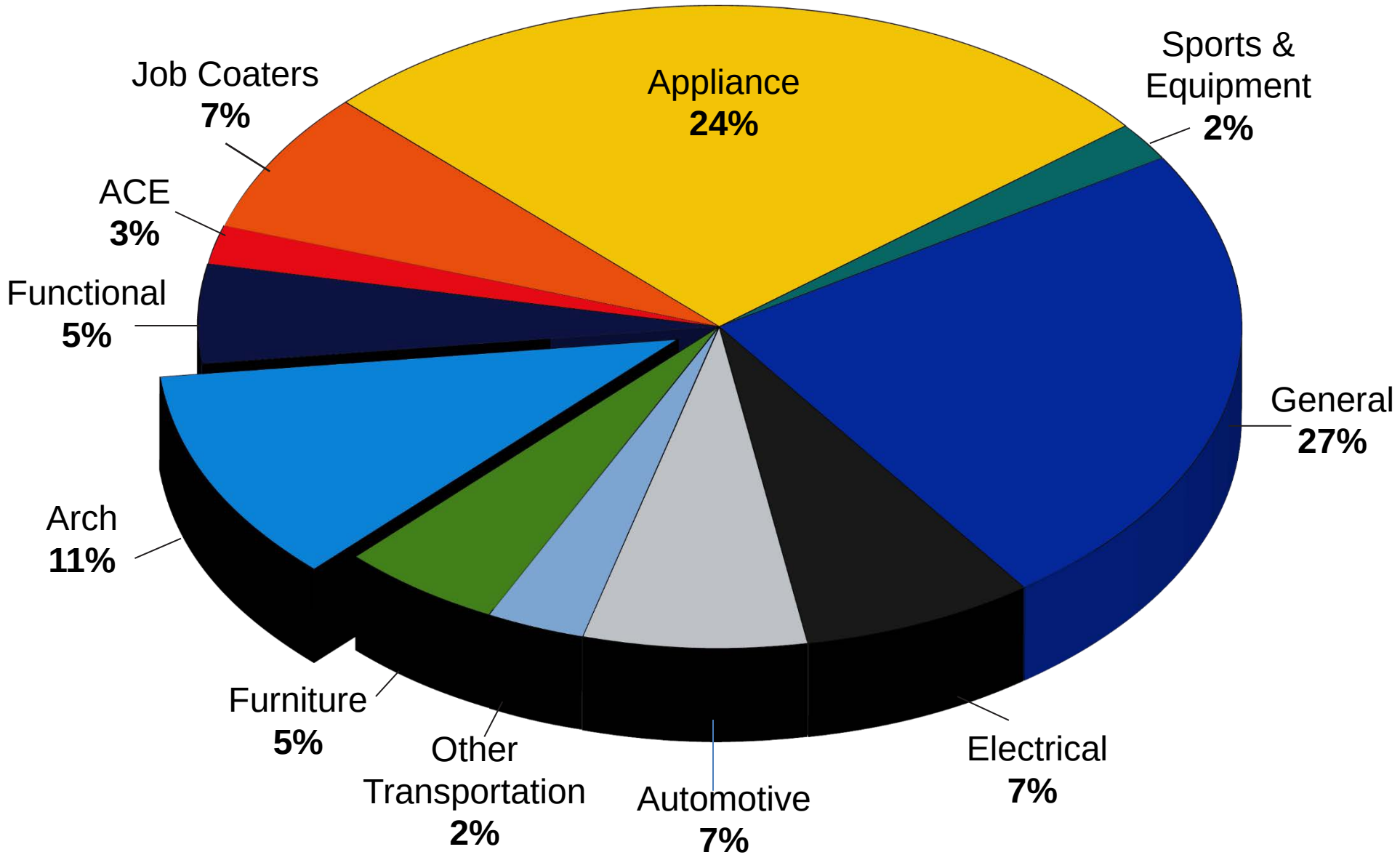


Asia Pacific

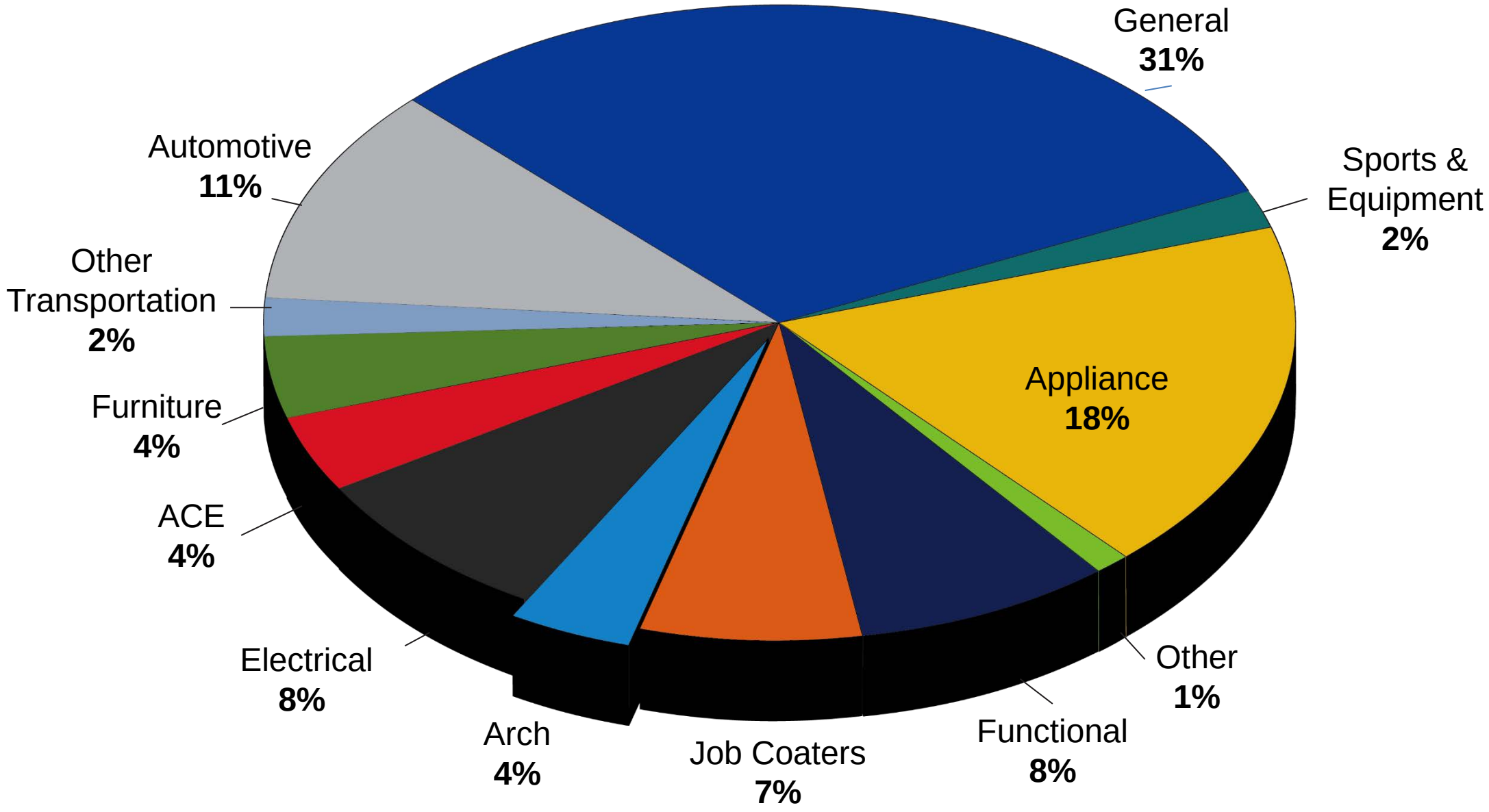


Powder Anodizing Paint PVDF Electro Paint

World Powder Consumption by Market Segment



North America Powder Consumption by Market Segment



AAMA: American Architectural Manufacturers Association

- Serving fenestration market since 1936
- Identifies performance standards and requirements on a variety of substrates
- **Current powder coating specifications:**
  - AAMA 2603-17
  - AAMA 2604-17
  - AAMA 2605-17
  - Spell out surface preparation recommendations, test methods, and voluntary performance requirements **specifically for aluminum**

American Architectural Manufacturers Association

AAMA: American Architectural Manufacturers Association

- Identifies the recommended pretreatment for each specification
- Very specific recommended performance requirements for coatings
- **Cleaning and maintenance Specification:**
  - AAMA 609 & 610-09
- **NOTE**: Specifications are voluntary and provide the market with a basic standard of performance
- Test methods require specific formulations and cover the most important aspects of coating performance

American Architectural Manufacturers Association

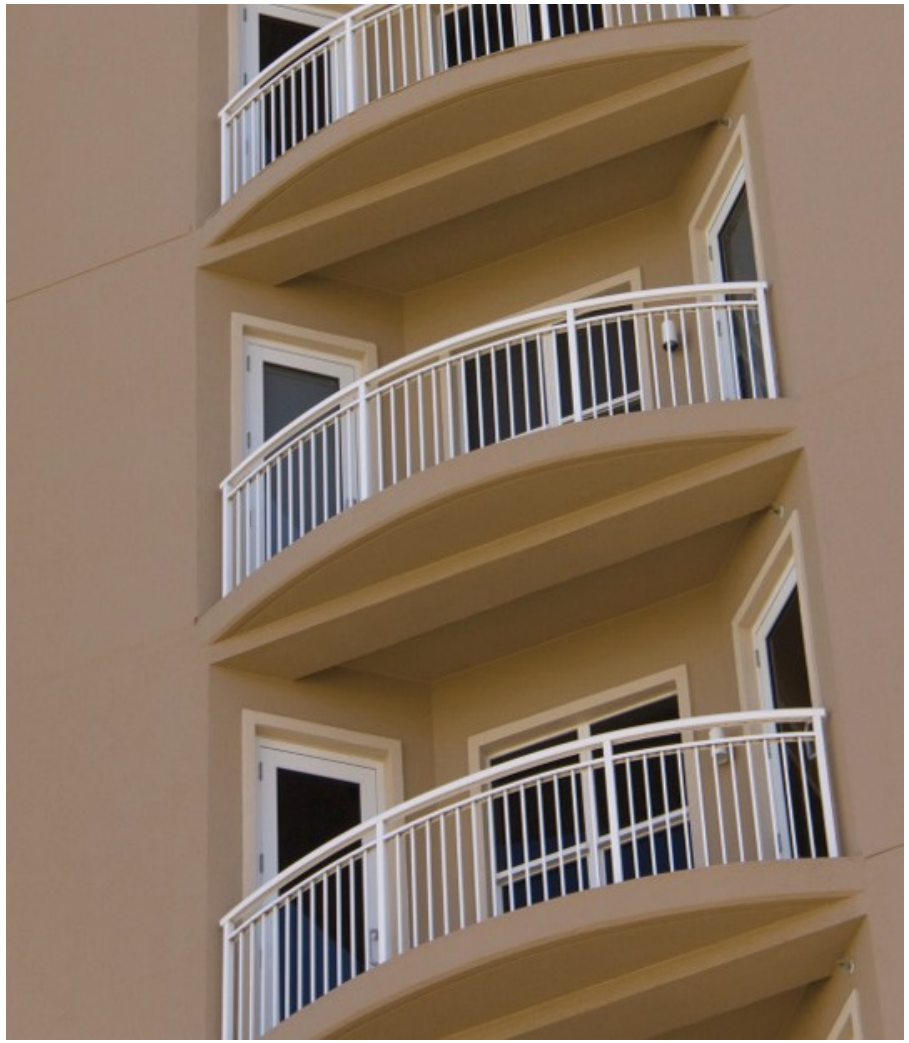
Advantages of Powder vs. Liquid

Environmental

- No VOCs
- Non-toxic waste - less harmful for the environment
  - REACH
  - ROHS - European requirement

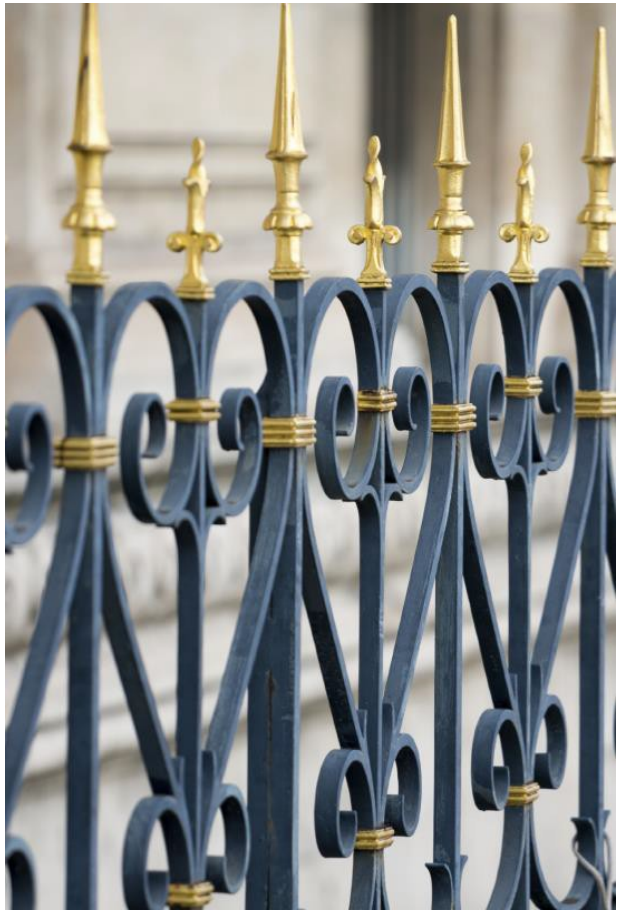
Material Efficiency/Transfer efficiency

- 95% transfer efficiency for powder vs. 65% for liquid
- Little to no waste
- Recyclable



Advantages of Powder vs. Liquid

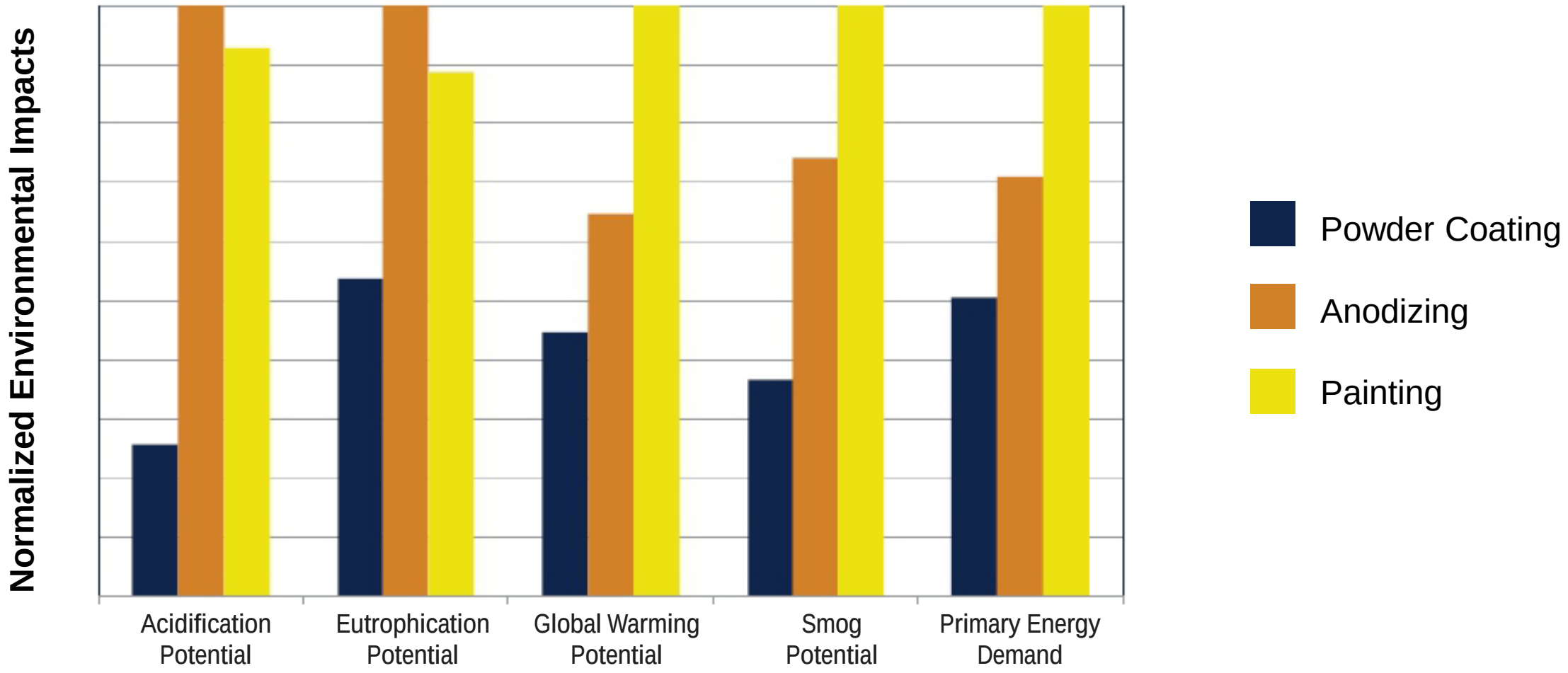
- Eligible for LEED credit points
- Exhaust for liquid typically will be passed through thermal oxidizer to combust the VOC
- This is how the exhaust from a liquid line can be environmentally friendly
- Thermal oxidizer does increase carbon footprint for liquid



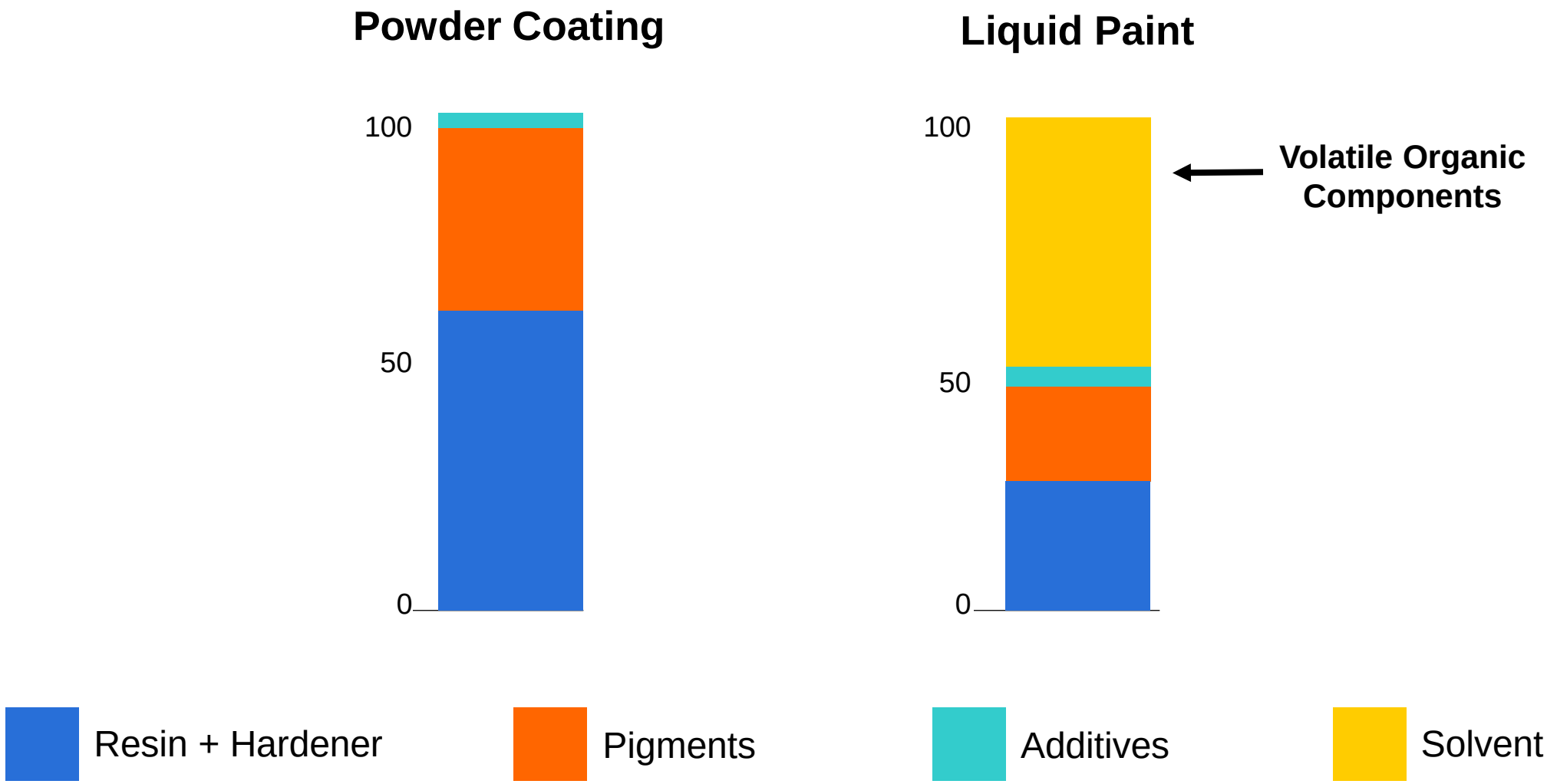
Advantages of Powder vs. Liquid

Overall LCA Results – Gate-to-Gate

Comparison of Finishing Techniques



Thermosetting Powder Coating vs. Liquid Paint



Advantages of Powder vs. Liquid

Dry Film Thickness

- Powder at 2mil vs 1mil with liquid
- Not spending twice as much because your transfer efficiency is much better
  - Better edge coverage
  - Better corrosion/degradation resistance
  - Better durability - cured film for powder is harder than for liquid (*cross linking and baked on*)

Advantages of Powder vs. Liquid

Pretreatment and primer options:

- **Architectural powders**
  - Can be used with a chrome ***or*** chrome-free pre-treatment
  - No need for primer
  - Will meet/exceed the performance requirements of AAMA 2603, AAMA 2604 and AAMA 2605 in a single coat
  - Use of chrome based products in pretreatment/primer is not required
  - Environmentally responsible choice

- **Liquid “Kynar” paints**
  - Chrome OR chrome free based pre-treatment
  - MUST have a chrome based liquid primer

Advantages of Powder vs. Liquid

Superior Mechanical Performance:

- Great film integrity due to thermosetting properties
- Superior scratch resistance at around 2H
- Unbeatable abrasion resistance - over 1000 rotations in TABER abrasion test
- Excellent abrasion resistance due to thermosetting properties
- First class protection against mechanical damage in high-use/high-traffic areas

Determining Applied Cost

The Science of Applied Cost

192.3 / specific gravity x % of material utilization = P
P / film thickness in mils = coverage per pound

Cost per pound / coverage per pound=applied cost per square foot

Example:

Specific Gravity:	**1.45**
Film Thickness:	**1.8 mils**
% Material Utilization:	**95%** (*assumes reclaim*)
Cost/pound:	**$3.00**

(192.3 /1.45) x 0.95 = 125.99/ 1.8 = 69.99 sqft/lbs. ***$3.00/ 69.99 = $0.043 /sqft***

Determining Applied Cost

The Science of Applied Cost

Specific Gravity:	1.32
Average Mils:	1.9
Price:	$3.50
Square feet:	145.68
95% utilization:	138.39
@ 1.90 mils:	72.84
@ $3.50 per pound:	
Cost per square foot:	**.04805**

Specific Gravity:	1.75
Average Mils:	1.9
Price:	$3.00
Square feet:	109.88
95% utilization:	104.39
@ 1.90 mils:	54.94
@ $3.00 per pound:	
Cost per square foot:	**.05460**

Advantages of Powder vs. Liquid

Cost

- Savings in application and installation
- Savings in material
- Savings in time - faster turnaround
- Savings in waste disposal
- Savings of longevity over the life of the coating

Section 02

Understanding the Critical Aspects of a Superior Powder Coating System

Pretreatment/Surface Preparation

Critical to pretreat to maximize coating adhesion and corrosion resistance

Clean

- Remove all soils and contaminants

Rinse

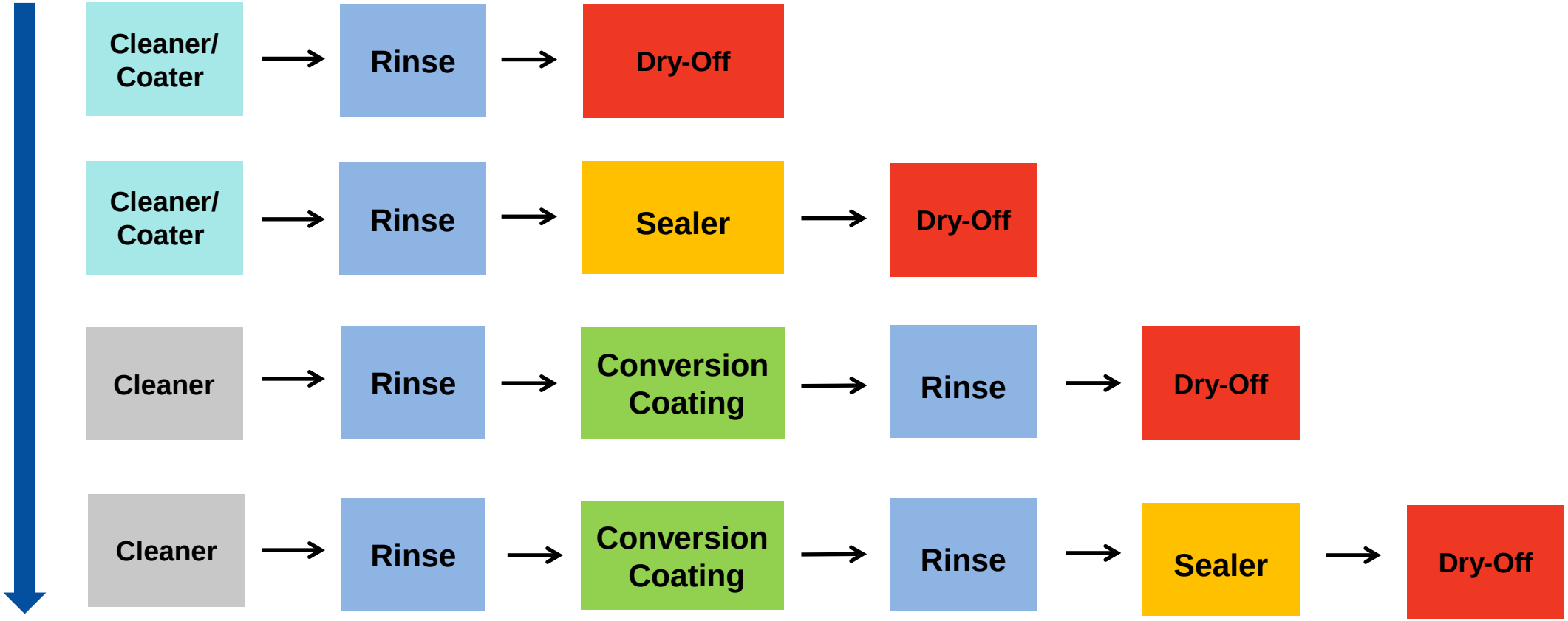
- No city water (*full of contaminants/minerals*)
- Must use reverse osmosis (RO) water or deionized (DI) water

Conversion Coating

- Converts metal surface to provide adhesion for powder coating
- Type of conversion coating will depend on the metal substrate
  - Consult your pretreatment provider

Pretreatment/Surface Preparation

Examples of Chemical Pretreatment Systems…



Performance increases as the number of pretreatment steps increases

Pretreatment/Surface Preparation

Chrome and Non-Chrome Basic Information

Substrates:

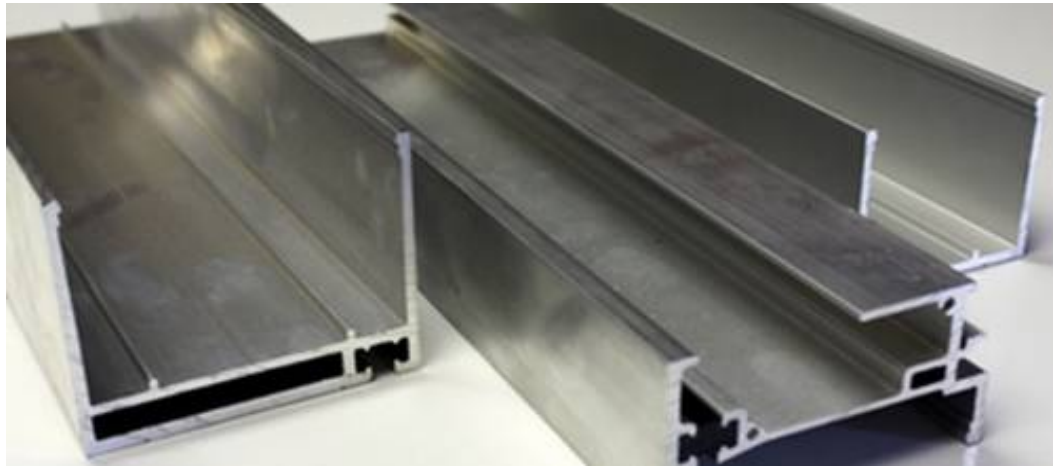
- Aluminum

Application Method:

- Spray
- Immersion

Typical Uses:

- Architectural Aluminum
- Window Frames
- Door Frames
- Building Frames



Pretreatment/Surface Preparation

Poor Rinsing Leads to:

- Cross-contamination of process chemicals
- Visually objectionable parts
- Streaks
- Spots
- Field failure of finished parts
- Blisters
- Delamination
- Corrosion

If rinsing is poor, it doesn't matter how good the rest of the process is!

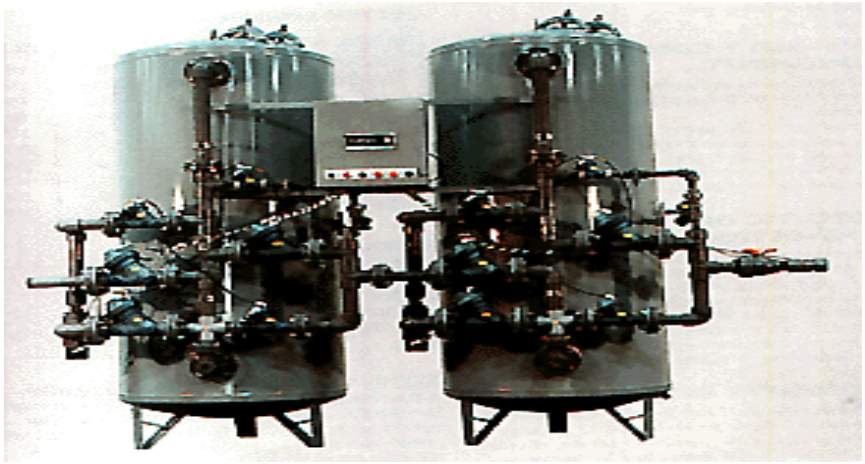
Pretreatment/Surface Preparation

Rinsing Water Quality

- RO (Reverse Osmosis) Water
- DI (De-Ionized) Water
- Well Water
- Soft Water
- Hard Water (City Water)
- Rain Water…

Best practices recommend RO or DI for best results.

RO rinse waste system



DI rinse waste system

Powder Storage and Handling

Powder storage recommendations

- Products should be stored below 80°F
- Some low cure powders require 65°F
- Humidity should be 40-60%
- Shelf life typically 12 months
- Shipping concerns in warm climates
- Conditioning
- Different shipping container sizes

Issues affecting powder storage:

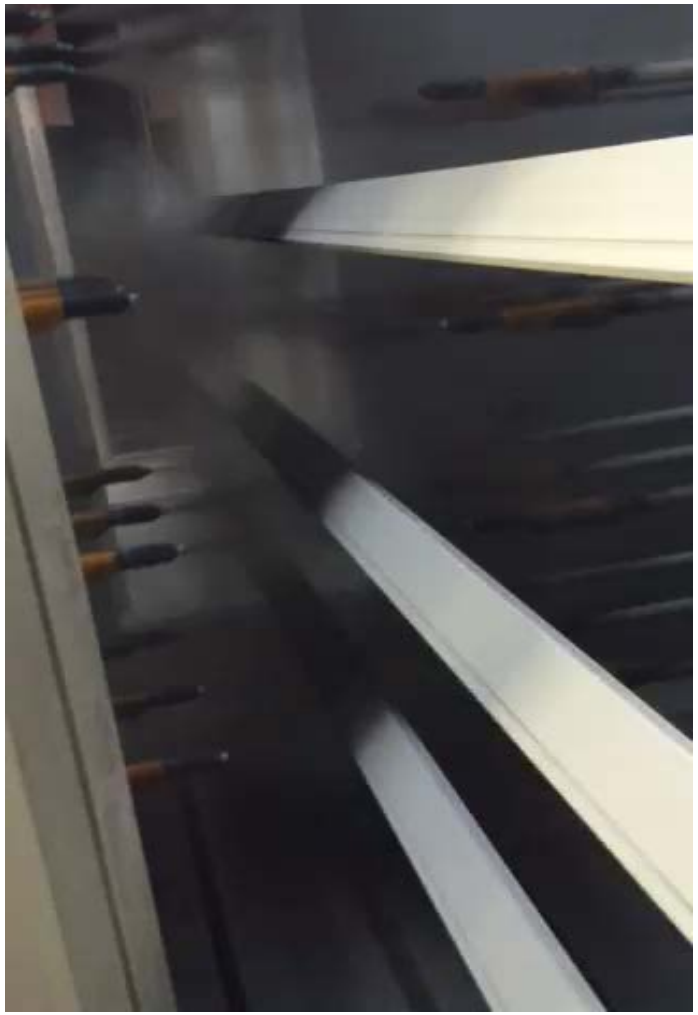
- Moisture-in-air absorption
- Cross-contamination of partially used materials
- Over-exposure to heat
- Inactivity or exceeding shelf life

Drum feeder for
powder application

Coating

Application

- Appropriate film build and edge coverage is critical
- Right size coating booth
- Appropriate number of application guns
- Part Configuration / Faraday areas
- Racking / Line density
- Grounding
- Dedicated environmental (EV) room for application and curing in a controlled environment (not subject to the elements of field application)



Curing

Types of Curing methods

- **Gas Convection oven** – most common cure method. Raises temperature of the metal to the appropriate cure temperature and maintains it for the recommended length of time.

  Conveyor oven – In line system where a conveyor runs the part profile through a large oven to get the part profile up to the recommended cure temperature for the appropriate time frame

  Batch oven – Off line oven for larger profiles where a conveyor oven is not practical.

Coating

Infrared Ovens

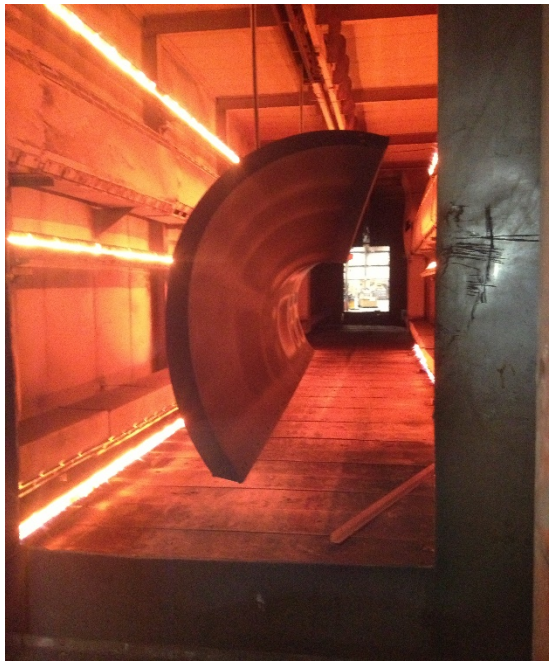
Infrared Ovens – primarily used a gel the powder film before it enters the convection oven. However, some profiles can be fully cured using infrared technology with powders specifically formulated to cure using that method. Infrared energy is a form of radiation and come in short (high energy), medium (medium energy), and long (low energy) wavelengths.

Gas Infrared – medium and long wave technology.

Medium energy (medium wavelength) IR is used for curing because the energy is absorbed directly by the coating. This type of oven works best with symmetrical parts.

Low energy (long wavelength) IR typically is used in conjunction with a gas convection oven since the energy is absorbed at the surface of the coating. However, there are several cases that use only long wave for full cure.

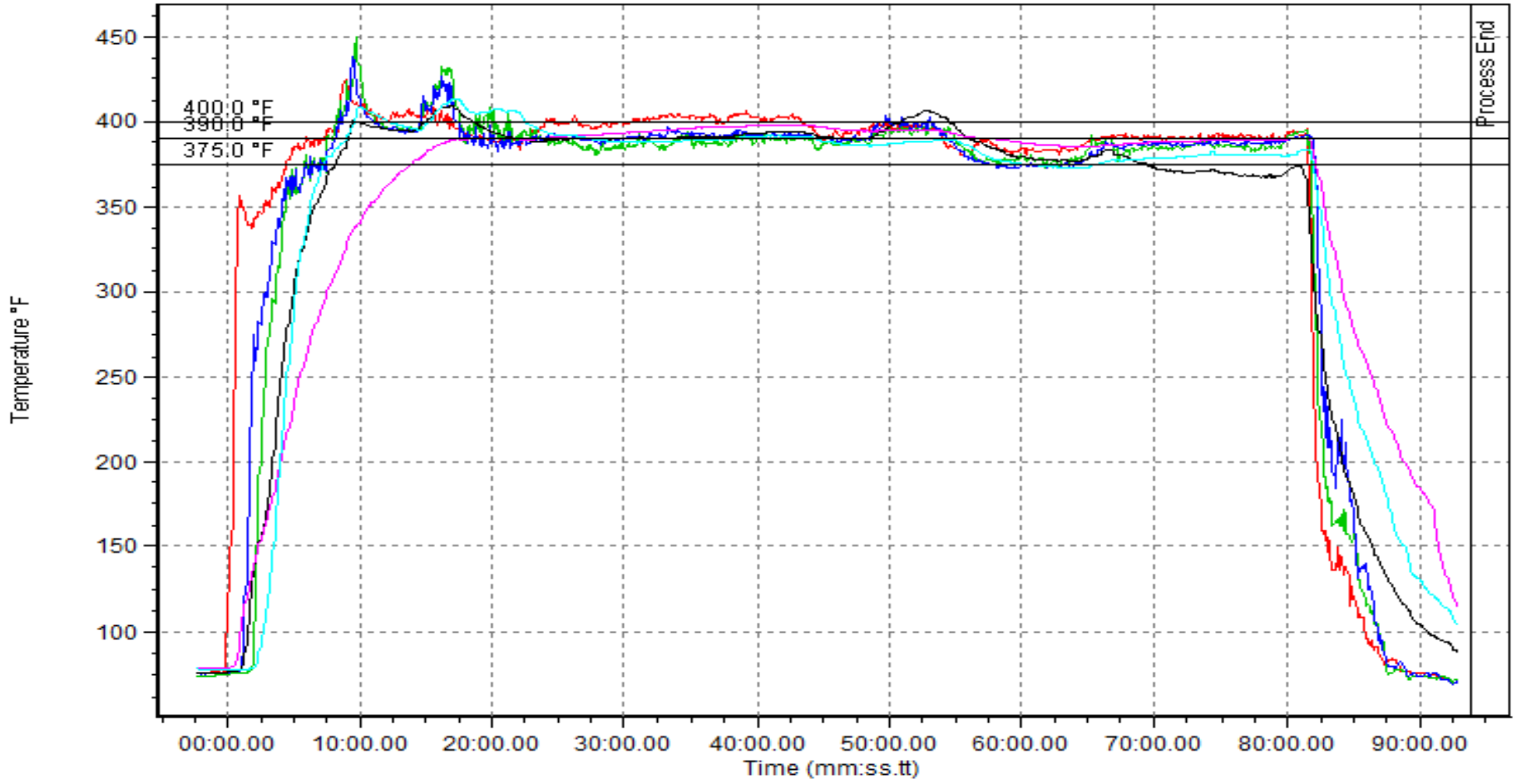
Electric Infrared – faster response and heat up rates. Most of the energy is absorbed by the coating and transmitted to the substrate.



Coating

Cure Recommendations

- 90% or above cured to form proper crosslink
- Critical to maximum physical properties and aesthetics (continuous uniformity)



Equipment and Training

Training

- Look for a powder manufacturer and equipment manufacturer who can provide on-site training for the applicator and work with the pretreatment provider

Internal Training

- Who can reject a part?
- Who can stop production?
- Do we have trained people on all shifts?
- Are we consistent with our assessments?
- How often do we train?
- Is our training adequate?
- Are visual min/max examples posted in the QC area?

Quality Assurance

Quality Control Standards – Must ask these questions

- What do we expect the coating to add to the part?
- What physical properties do we need?
- To what type of environment will the finished part be subjected?
- Has enough information been gathered to write a product specification?

Look for applicators who provide

- Record line operated speeds
- Oven temp regulation
- Job standards control
- Product identification
- Proper stacking/packing

Section 03

Proper Specification

Define your Environment

What is it going to be exposed to?

- Interior/exterior
- Weather and climate
- Corrosive environment
- Building use

Define your Performance Requirement

- Gloss requirement
- Color retention
- Weathering performance
- Corrosion resistance
- Chemical resistance
- Dry Film hardness
- Abrasion resistance
- Customer specific requirements

Warranty

How long do we need that coating to last?

AAMA

- American Architectural Manufacturers Association
- Defines performance criteria
- **Look for manufacturers who meet AAMA volunteer standards**

3 Quality levels - AAMA Specification

1. **2603** - Pigmented organic coatings on aluminum extrusions
   - *Standard performance polyester*

2. **2604** - High performance organic coatings on aluminum extrusions
   - *Superior performing polyester*

3. **2605** - Superior performing organic coatings on aluminum extrusions
   - *Superior weatherability fluoropolymer*

AAMA Performance Specifications

Test	AAMA2603	AAMA2604	AAMA2605
Adhesion	No film removal under the tape within or outside the cross hatched area or blistering anywhere on the test specimen	No film removal under the tape within or outside of the crosshatched area or blistering anywhere on the test specimen	No film removal under the tape within or outside of the crosshatched area or blistering anywhere on the test specimen
Impact Resistance	No removal of film from substrate	No removal of film from substrate	No removal of film from substrate
Abrasion	Test not required for standard polyesters	The abrasion coefficient value of the coating shall be minimum 20.	The abrasion coefficient value of the coating shall be minimum 40.
Humidity Resistance	1,500 hrs. test Blisters size 8	3,000 hrs. test Blisters size 8	4,000 hrs. test Blisters size 8
Salt spray Resistance	1,500 hrs. test Blisters size 8	3,000 hrs. 1-2mm creepage Blisters size8	4,000 hrs B117 or 2000 hrs G-85 1-2mm creepage Blisters size 8

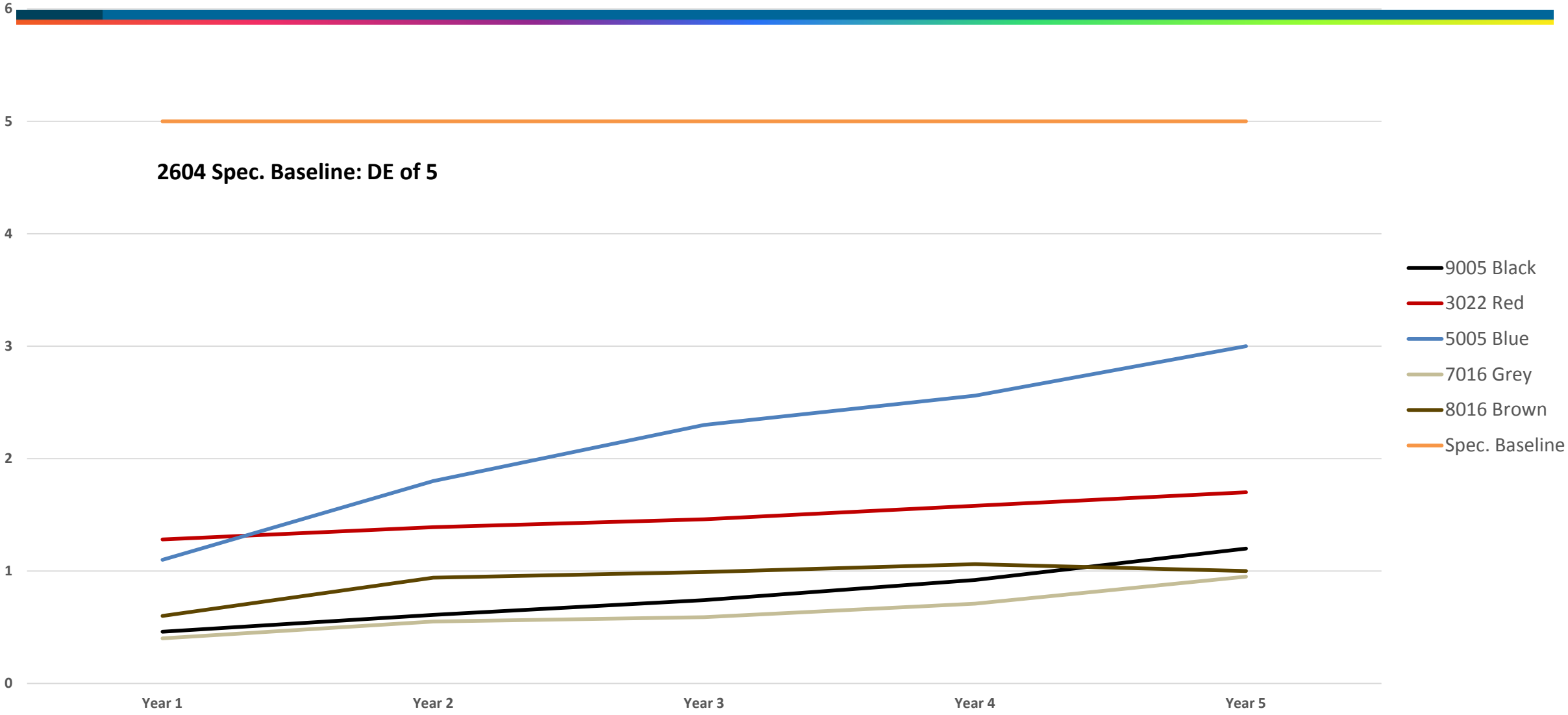
AAMA Performance Specifications

Test	AAMA2603	AAMA2604	AAMA2605
Muriatic acid Resistance	No blistering and visual change in appearance with the unaided eye.	No blistering and visual change in appearance with the unaided eye.	No blistering and visual change In appearance with the unaided eye.
Mortar Resistance	Mortar shall dislodge easily from painted surface and any residue removed with a dampcloth.	Mortar shall dislodge easily from painted surface and any residue removed with a damp cloth.	Mortar shall dislodge easily from the painted surface and any residue removed with a dampcloth.
Nitric acid Resistance	N/A	Not more than 5 DE units color change between exposed and unexposed areas.	Not more than 5 DE units color change between exposed and unexposed areas.
Detergent Resistance	No loss of adhesion, blistering or significant visual change.	No loss of adhesion, blistering or significant visual change.	No loss of adhesion, blistering or significant visual change.
Window Cleaner	N/A	No blistering or visual change.	No blistering or visual change.

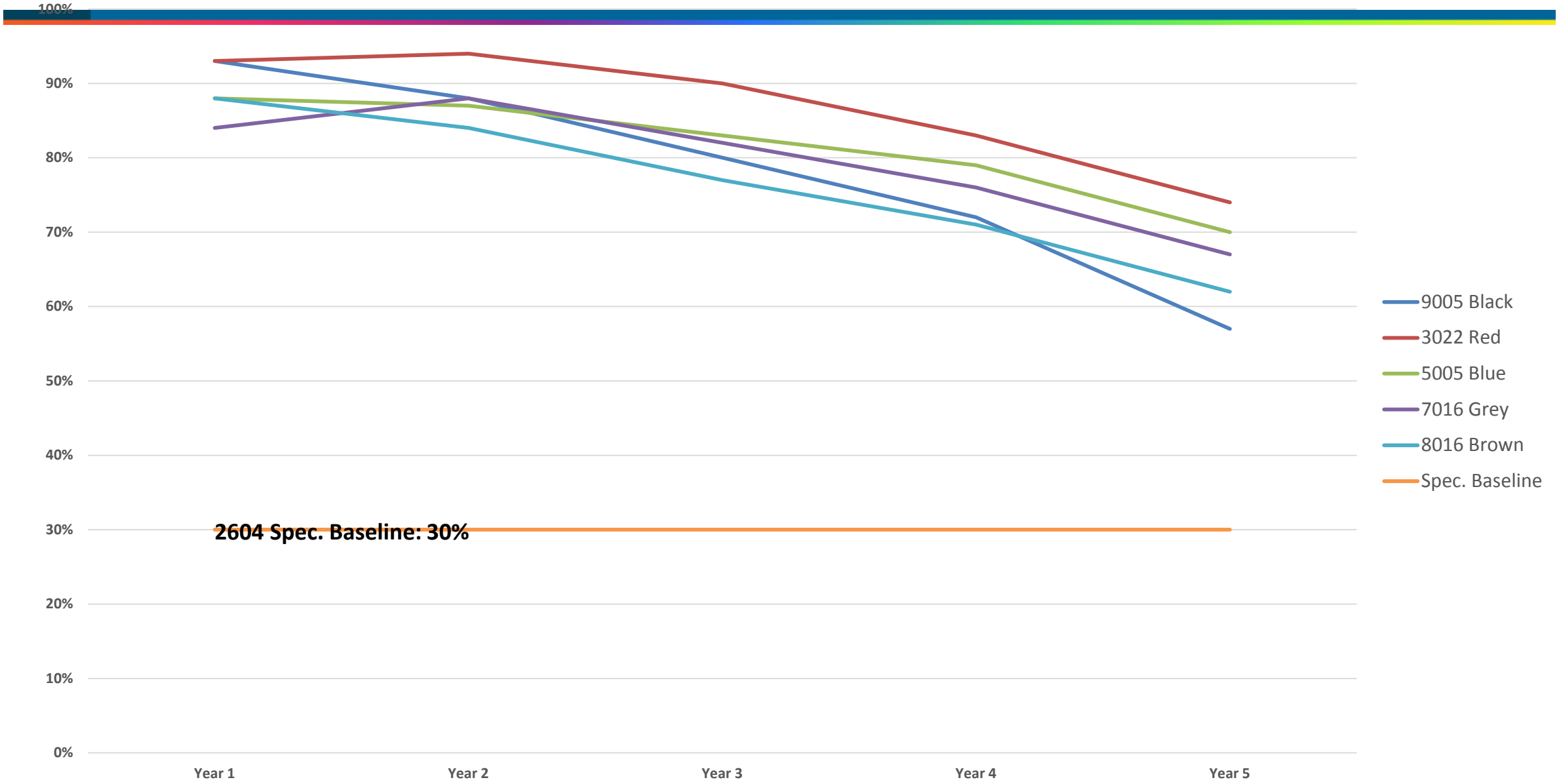
AAMA Performance Specifications

Test	AAMA2603	AAMA2604	AAMA2605
Florida Exposure	1 year	5 years	10 years
Color Retention	Slight change	Color change Delta E<5	Color change Delta E<5
Chalk Resistance	Slight chalking	No more than 8 rating	No more than 8 rating and 6 rating for whites
Gloss Retention	Slight fade	Minimum 30%	Minimum 50%
Erosion Resistance	No loss of erosion	Less than 10% film loss after exposure.	Less than 10% film loss after exposure.

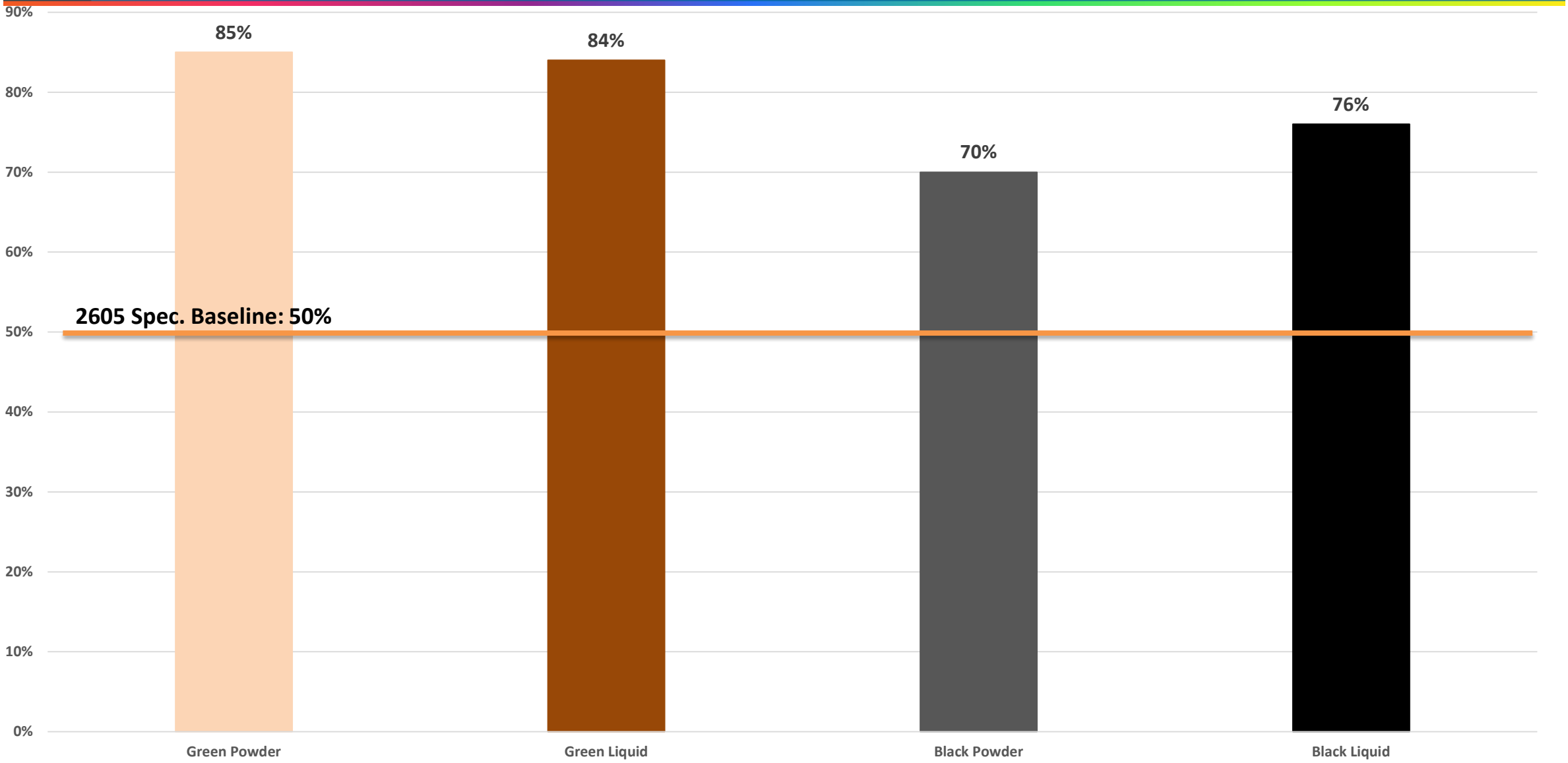
2604 Five Year Color Retention



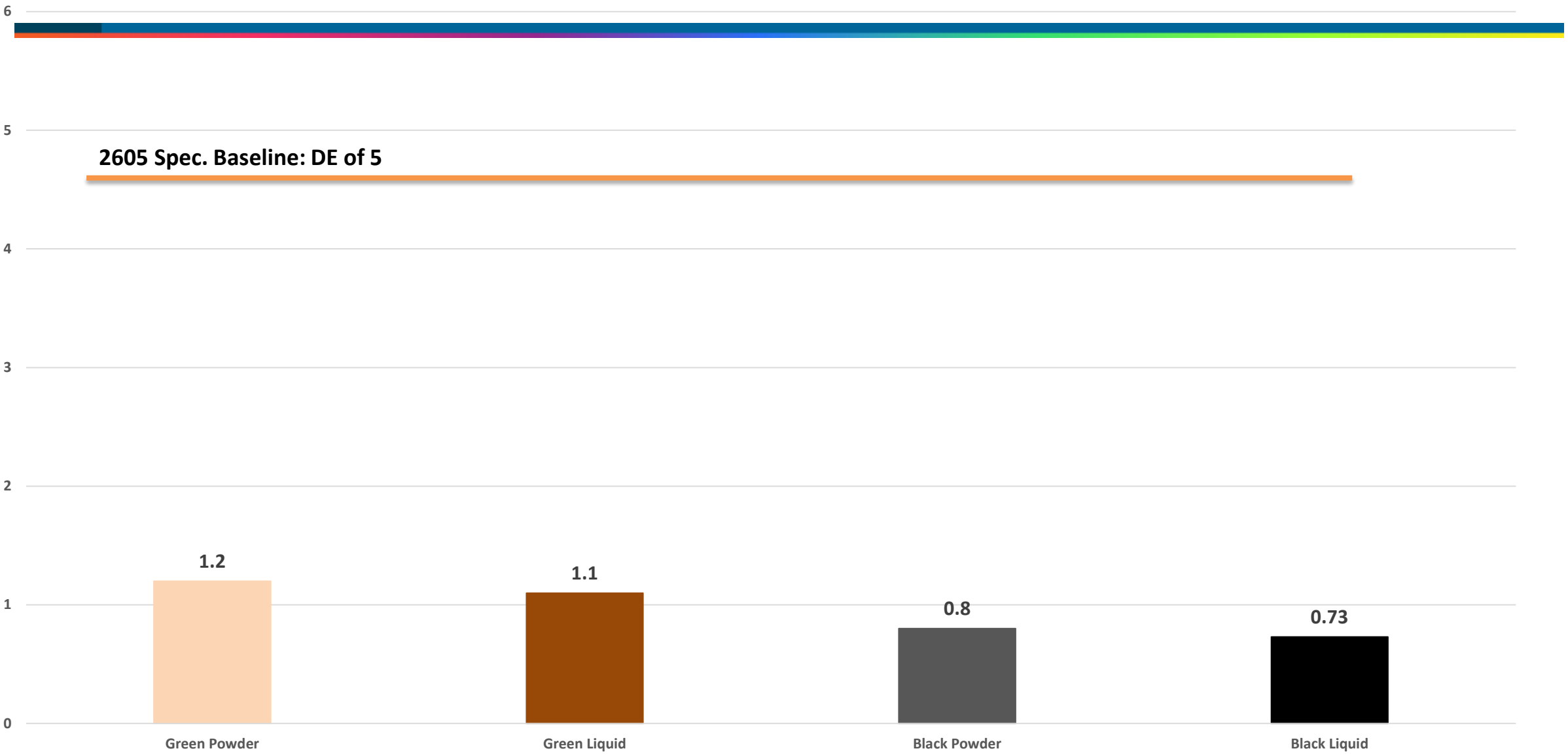
2604 Five Year Gloss Retention



2605 Ten Year Gloss Retention

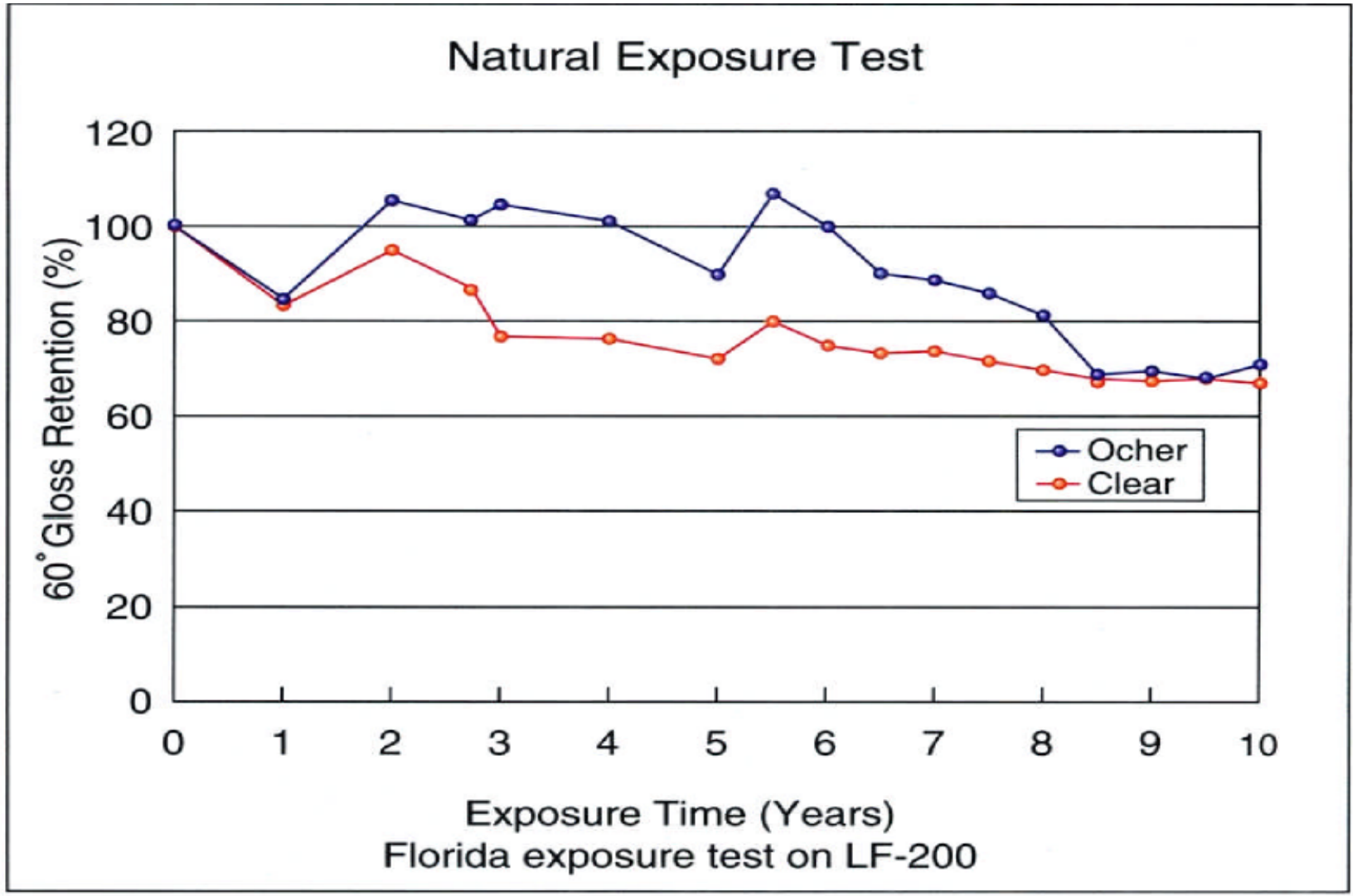


2605 Ten Year Color Retention



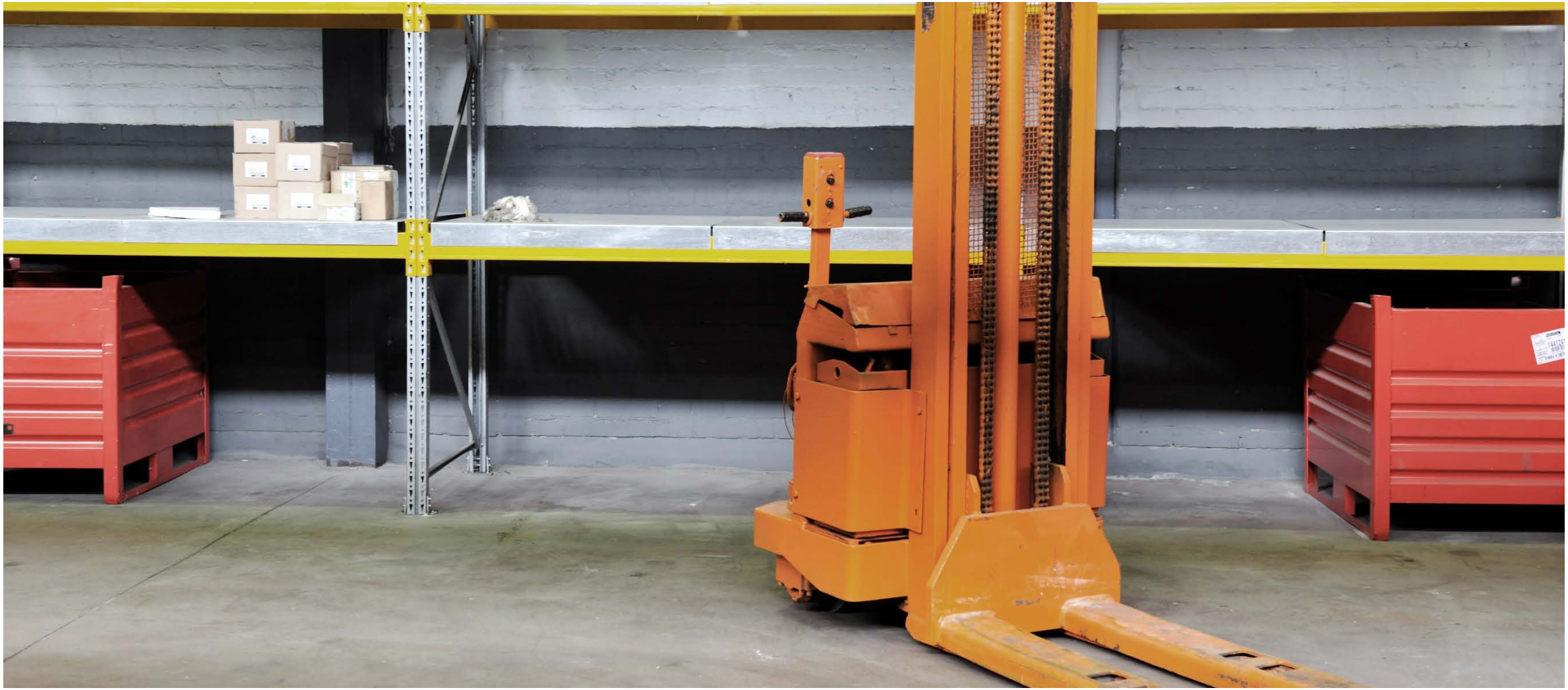
Weathering Performance

Florida Results: Fluoropolymer Powder Coating (AAMA 2605 Quality)



Test Method:ASTM
Type of test:Direct 30 DEG SOUTH, OPEN BACK
Location:Exposed in Miami, Florida

Courtesy of Asahi Glass Co., Ltd.



Section 04

What Else to Look for in a Manufacturer

What Else to Look for in a Powder Manufacturer

Experience/history and specialization to provide depth of knowledge and know-how

Speed to market

- Accessibility
- Flexibility
- Responsiveness
- Fast turnaround

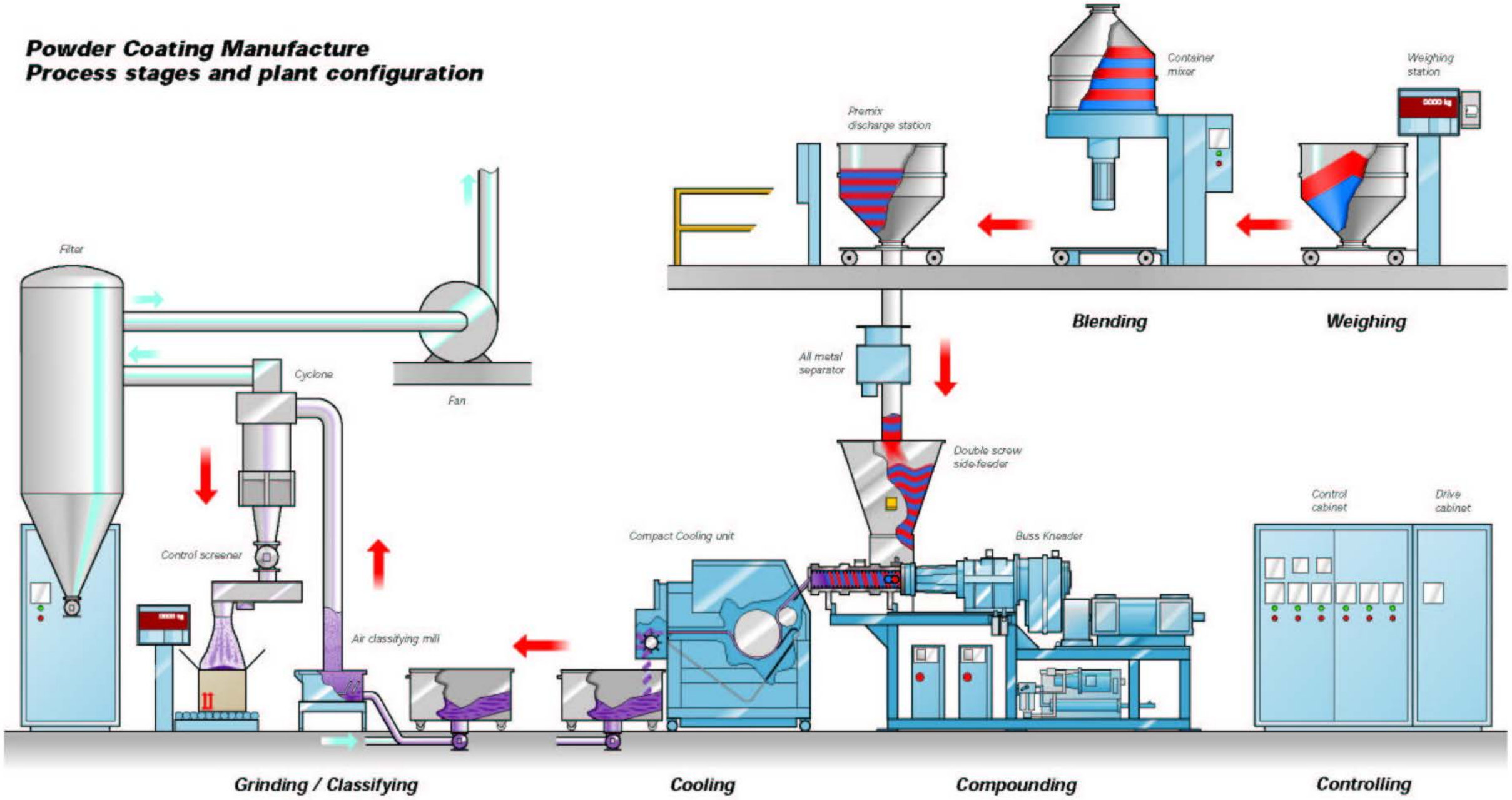
Small batch capabilities

- Dedicated small batch plant
- Enables fast response times as well

Large batch Capabilities

- Dedicated large batch plant

Powder Coating Manufacture
Process stages and plant configuration



What Else to Look for in a Powder Manufacturer

Operational excellence

- Batch-to-batch consistency
- Lead times
- Color matching
- Gloss control (within a certain range)
- In-house metallic bonding

Dedicated R&D

- Product development
- Performance testing
- Customized formulation if needed based on project requirements
- Industry-leading instrumentation
  - › Datacolor 800 spectrophotometer
  - › Differential scanning calorimeter
  - › Laser diffraction particle size analysis
  - › Comprehensive weather testing
  - › Natural outdoor weather testing in North and South Florida

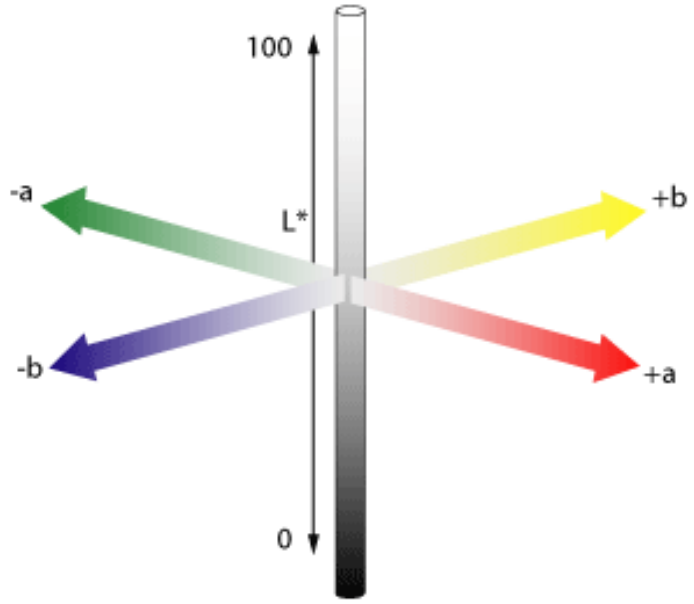
What Else to Look for in a Powder Manufacturer

Color Measurement: Get the Right Standard First

Determine if match is measured by spectrophotometer:

- Is it a visual match or will the match be measured on a spectrophotometer?
- R&D Lab needs chip very close to master color position in their spectrophotometer
- Suggest measuring chip and recording its position as well as master color position

What are L, a, b and delta E?



What Else to Look for in a Powder Manufacturer

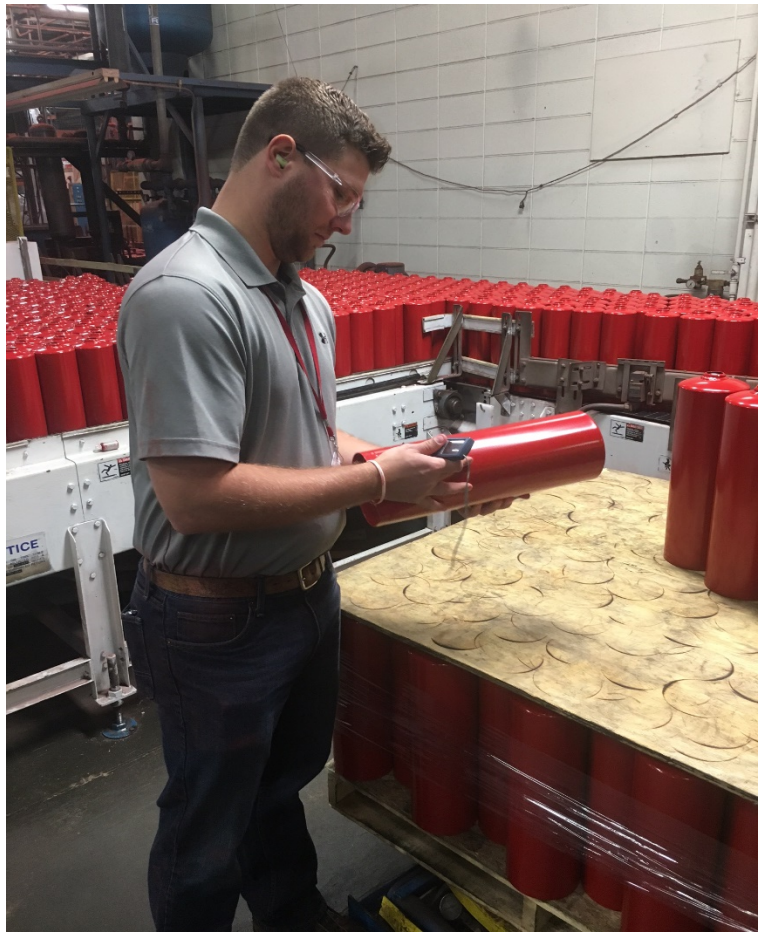
Service

- Field technical service
  On site technical service for start up support, conversion, new equipment or trouble shooting

- Line audits including pretreatment, application system and cure process.

- Comprehensive applicator training program
  Classroom or on line training at your facility

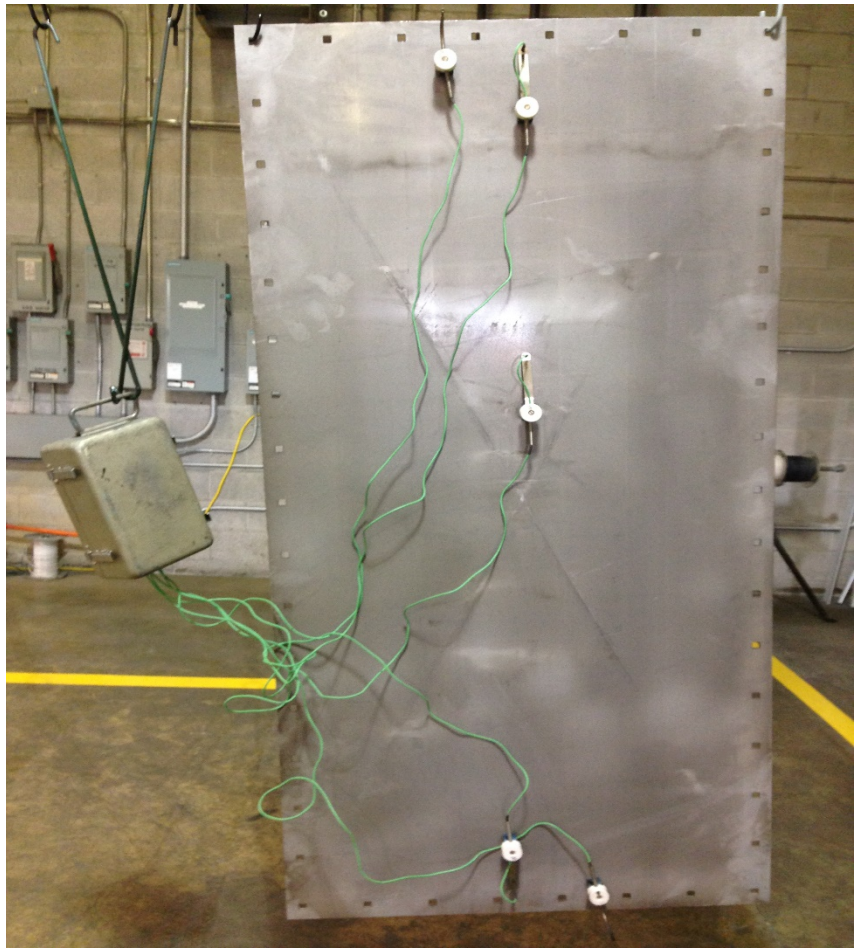
- Certified architectural applicator program



What Else to Look for in a Powder Manufacturer

Certified Applicator Program

- Warranty only provided to Certified Applicator
- Certification requires on site performance testing
- Testing typically takes 4- 6 months to complete
- **Detailed audit of customer processes**
  - Including Datapaq ran at the time test parts are coated
  - AAMA recognized pretreatment is required by most suppliers
  - Good information for the applicator
- No warranties for hand spray/wand pretreatment systems



What Else to Look for in a Powder Manufacturer

Can You Apply the Same Coatings to Steel or Iron?

- Can be applied to steel but most suppliers do not offer the same warranty
- Steel cannot provide the same corrosion resistance as aluminum
- Architectural powder can still provide the color/gloss retention desired for steel/iron
- Some suppliers offer a color/gloss only warranty

Section 05

Project Examples

Memphis Flats
Philadelphia, PA

La Gianna Apartments
White Plains, NY

Arcade Lofts
St. Louis, MO

JJ Newberry Lofts
Port Huron, MI

Monroe Street Market
Washington, DC

Embassy Suites
Sacramento, CA

Iron Building
Pittsburgh, PA

Bergen Saratoga Apts
Brooklyn, NY

Review

Now the design professional will be able to

1. ***Explain*** the advantages of powder coating systems in terms of performance, environmental impact, and savings

2. ***Identify*** the critical aspects of a superior powder coating system for optimal application and performance

3. ***Discuss*** how to properly specify the right powder coating system based on project needs and environment, and explain the role of AAMA standards and coating warranties

4. ***List*** the key attributes of a powder coating manufacturer and applicator you'll want to look for when specifying a powder coating system

Questions?