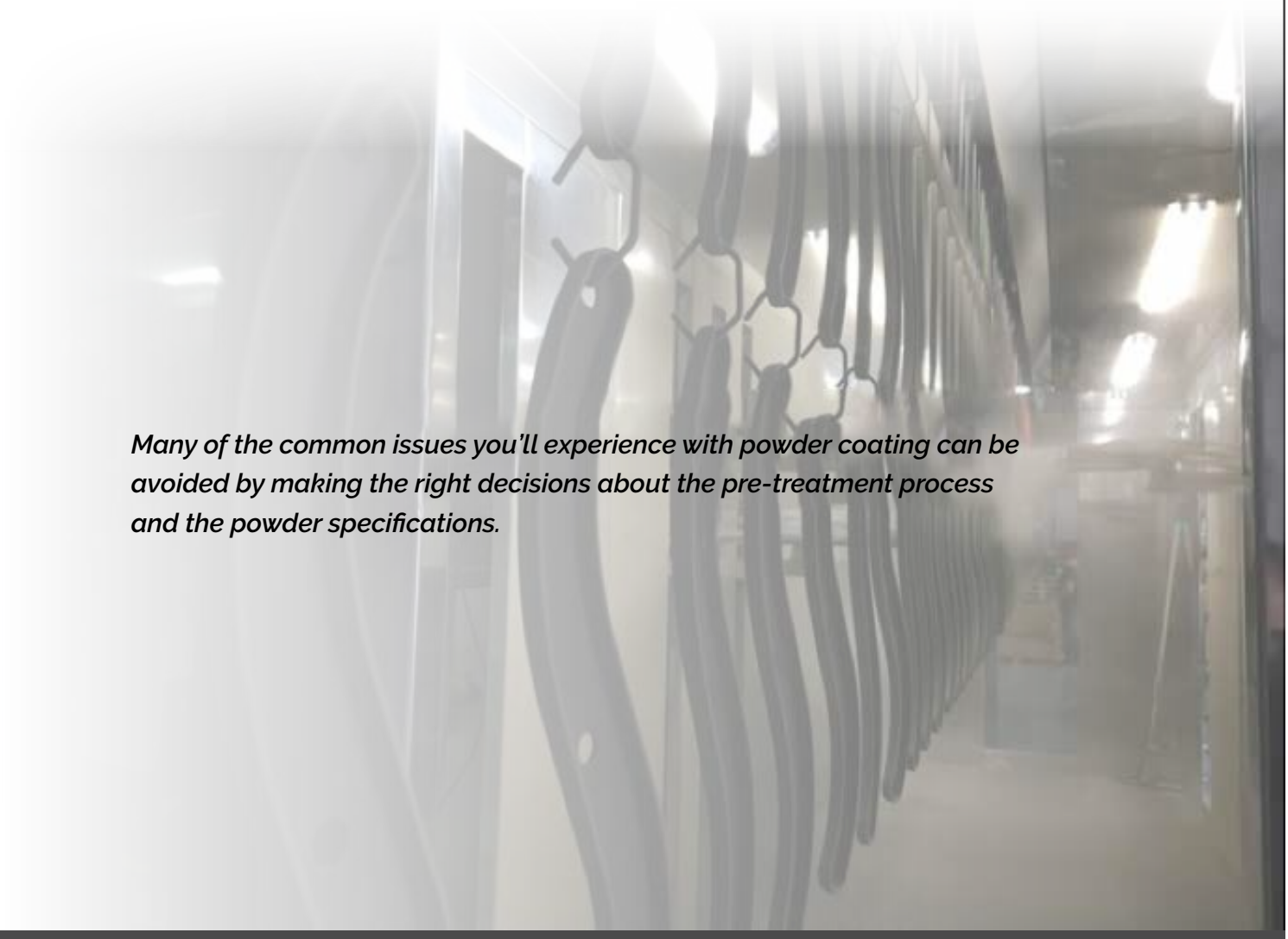
How to avoid powder coating quality issues

Powder coating is a common finish for sheet metal fabricated parts. It improves corrosion resistance and gives you multiple options for aesthetic finishes and branding. However, when the process isn't performed correctly, problems can arise that impact the appearance and the longevity of the part.

Pre-treatment for powder coating

A clean and properly prepared surface is vital for powder coating to be successful. Preparing a part is usually a multi-step process that begins with cleaning steps to remove oil, dirt, and other debris. Cleaning can include washing, wiping, and/or blasting. Other pre-treatment processes like phosphating or etching will improve the adhesion of the powder coating giving you a better, more durable finish.



Many of the common issues you'll experience with powder coating can be avoided by making the right decisions about the pre-treatment process and the powder specifications.

There are several different steps to prepare the surface depending on the metal, the part, and your requirements. You should work with your custom fabricator to determine the best mix of these pre-treatment steps.

Cleaning processes

SHOT BLASTING

Shot blasting can be used to both clean the surface as well as prepare it for powder coating. The surface is blasted with sand, walnut shells, metal soda ash, or another substance to clean the surface of scale, corrosion, or surface imperfections. The blast profile also helps the powder adhere to the surface, but an optional primer can be added for better surface preparation.

Black high gloss

Commonly used on: angle iron

What you should know:

- Powder coating will adhere better to surface after sand blasting
- Choose the shot medium based on the metal being finished. Some heavier shots can cause damage to softer metals.
- Can remove existing metal coating if refinishing
- Smooths surface defects
- Does not remove oils or contaminants on surface
- Good option for parts that are too big for traditional chemical treatments
- Can produce enough heat to warp aluminum

WASHING

The surface of the part is washed or dipped using a detergent specific to the fabrication process being used. The hot water or steam used helps break down any oils on the surface.

What you should know:

- Can remove oils, waxes, polishes, and other surface contaminants
- Process can clean difficult to reach spots or gaps in the part

Pre-treatment processes

A thorough pre-treatment process can include anywhere from 8 to 12 steps. A common procedure would include: surface cleaning, rinsing, conditioning, phosphating, rinsing, an optional neutralizing rinse, drying, applying lubricants or sealers. The number of steps in the process is determined by your needs and can be shorter.

Black matt finish

RINSING

Rinsing commonly follows the cleaning stage and removes any of the cleaning agents on the surface. Best practices suggest using water that has the fluorides, chlorides, and other additives removed through reverse osmosis or deionization.

What you should know:

- Surface must be dried immediately to prevent rust

CONDITIONING

A conditioning agent is applied to adjust the surface pH level, conditioning the part for further treatments.

PHOSPHATING

Phosphating is a very common pre-treatment process adding an iron, zinc, or manganese phosphate layer to improve corrosion resistance and prepare for further finishing. The part will require rinsing after phosphating.

What you should know:

- Surface coating creates a tight bond with metal
- Improves adhesion of powder coating
- Improves corrosion resistance by up to 2-3 times what powder coating would do on its own
- Zinc phosphate is common for parts in saltwater or marine environments
- Creates a uniform protective layer
- Can be used on iron, steel-based metals, zinc, aluminum, manganese

DRYING

Not only should the part be dry before powder coating is applied, but quickly removing water or moisture is important to prevent rust or corrosion. An oven is used for this step.

Choosing the right powder specifications

There are many factors that go into selecting the right powder coating and a reputable fabricator should discuss these options with you before selecting a product for your parts. Often, trade offs are made, selecting a powder formula that is best suited to what's most important for you. You may sacrifice chemical resistance for example for a finish with superior hardness.

Powder coatings are generally classified as Class A, B, or C with A being the costliest and used for parts requiring high standards and requiring an aesthetically pleasing finish. Class C is the lowest cost option, allows for a certain degree of defects, doesn't require high corrosion protection, and is not visible to the end user. Class B is in the middle.

RESIN TYPE

Powders are available in several different resin types: polyester, epoxy, epoxy-polyester.

What you should know:

- Polyester gives excellent durability and UV resistance making them a good choice for outdoor parts
    - Superdurable polyesters give superior durability, hold their color for up to 10 years or more, have better gloss finishes, better corrosion resistance
- Epoxy creates a hard surface with good corrosion and impact resistance. Best used for indoor parts as UV exposure creates a chalky appearance.
- Epoxy-polyester blends the properties of both and is a popular, well-rounded finish option
- Fluoropolymers are common for architectural products like windows and doors because they have good weather and corrosion resistance with excellent color and gloss retention
- Urethanes provide a smooth surface, good chemical and corrosion resistance

WEATHERABILITY / UV RESISTANCE

Parts that are outdoors are exposed to UV light which can affect the longevity of the finish. Yellowing can occur if the wrong powder coating is chosen.

What you should know:

- UV light effects the powder coating binder which impacts the gloss and color of the finish
- Chalk, epoxies, and epoxy hybrids are not recommended for parts that will be outdoors
    - Epoxy has 1 to 3 months durability when outdoors (based on Southern Florida conditions)
    - Epoxy – Polyester hybrids have a 2 to 6 months durability when outdoors (based on Southern Florida conditions)
- Polyester and acrylic powder coating are a good choice for parts exposed to outdoor UV light
    - Standard polyester has 1 to 2 years durability when outdoors (based on Southern Florida conditions)
    - Superdurable polyester has 3 to 5 years durability when outdoors (based on Southern Florida conditions)

CORROSION RESISTANCE

Parts can be exposed to corrosive conditions whether inside or outside. The powder coating and pre-treatment will both work to improve corrosion resistance and your decisions should be based on the corrosive environment the part will be exposed to.

What you should know:

- A single coat of powder coating will generally offer better corrosion resistance than a traditional liquid paint
- Parts exposed to extremely corrosive conditions should receive two coats of powder coating. A combination of an epoxy primer and UV resistant topcoat is a good option.
- Epoxies offer the highest corrosion resistance but degrade under UV exposure so are often used for indoor parts
- Polyurethanes give good corrosion resistance, good UV durability, and are suitable for saltwater or marine environments
- Polyester offers good corrosion resistance and is often used for gardening equipment

HARDNESS, ABRASION, AND IMPACT RESISTANCE

Characteristics like hardness, abrasion resistance, and other mechanical properties are often related. Your parts may require both good abrasion resistance and a surface with low friction if it is repeatedly in contact with other parts or surfaces for example. Flexibility is also a factor if parts are powder coated before additional forming or other parts are fastened.

What you should know:

- Epoxy and epoxy-polyester hybrids have excellent flexibility and impact resistance
- Polyester has excellent flexibility and impact resistance
- Acrylic and superdurable polyester can be brittle with little mechanical flexibility
- Abrasion issues are often a result of under curing (time and temperature)
- Impact resistance can very by the type of powder coating you choose, but issues are generally a result of incorrect curing (time and temperature)
- Thicker applications often result in impact resistance issues

CHEMICAL AND STAIN RESISTANCE

Different powder coatings will resist chemical exposure better than others. Consider whether or not your part will be exposed to oils, solvents, fuels, food, or other compounds when choosing the best coating medium.

What you should know:

- Epoxies and polyurethanes offer the best chemical and stain resistance
- Fluoropolymers are an option for good chemical resistance but can be expensive
- Polyester offers good resistance to chemicals, some food products, and some cleaning agents
- Acrylic is very resistant to chemicals especially gasoline, motor oils, and hydraulic fluids

PRIMERS

The type of metal, type of powder coating, and the use of primers are all interconnected. Not all circumstances will benefit from a primer so work with your fabricator to determine the best choice for your part.

What you should know:

- Primers improve adhesion of the powder coating, add corrosion and chip resistance
- An epoxy or zinc-epoxy primer is recommended when the part is exposed to a corrosive environment (weather, saltwater, high humidity etc.)

Sandtex black

APPLICATION METHOD

Powder coating is usually applied in a spray booth with an electrostatic spray gun that controls the pattern and spray density of the application. The powder is charged to encourage the particles to wrap around the entire surface and not just those surfaces directly exposed to the spray.

What you should know:

- Spray gun methods can be manual or automated, is a slower application than dip method, and can offer thick or thin coatings

CURE TIME AND TEMPERATURE

The curing process plays a key role in the durability of the powder coating finish. The cure schedule is determined by the time and temperature needed for a particular finish and is based on the temperature the part should reach for a full cure.

What you should know:

- The curing schedule is determined by the metal used for the part and the specifications of the powder coating being used.
  This should be customized to your part by your fabricator.
- An under cured finish can be brittle, have poor chemical resistance, poor weatherability, and possibly look different than expected
- Parts that are over cured can be brittle and have yellow discoloration