

ENGINEERING GUIDE

Powder Coating Metal Products

A practical guide to finishing metal parts with durable, high-performance powder coatings.

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- 02 Common Metal Products
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DeWys Metal Solutions

dewys.com

What You'll Learn

This guide walks you through every stage of the powder coating process — from design decisions that affect finish quality to final packaging that protects your investment.

01 Why powder coating outperforms liquid paint

Durability, efficiency, and environmental advantages.

02 Which metal products benefit most
Furniture, medical equipment, enclosures, architectural, and more.

03 How to design parts for better finishes
Edge radii, drainage holes, weld prep, and hanging points.

04 Material selection for coating success
Steel, aluminum, and other considerations.

05 Surface preparation essentials
Cleaning, blasting, and chemical pretreatment.

06 Pretreatment chemistry

Iron phosphate.

07 Powder application techniques
Electrostatic spray.

08 Oven cure parameters
Time, temperature, and metal relationships.

09 Inspection & quality assurance
Thickness, adhesion, cure, and visual standards.

10 Packaging that protects the finish
Custom solutions for transit without damage.

The Powder Coating Process

Every powder-coated metal product follows a defined sequence of manufacturing stages. Each step builds on the one before it — skipping or rushing any stage compromises the final result. Understanding the full process helps engineers, buyers, and quality teams make better decisions earlier.

- 1 Product Design**
Geometry, material, and tolerances are chosen with coating access and finish quality in mind.
- 2 Manufacturing**
Laser cutting, forming, and welding create the part. Clean cuts and smooth welds reduce prep work downstream.
- 3 Surface Preparation**
Grinding, deburring, and cleaning remove contaminants and create a uniform surface ready for chemistry.
- 4 Pretreatment**
Chemical cleaning and conversion coating build adhesion and corrosion resistance at the molecular level.
- 5 Powder Application**
Electrostatically charged powder is deposited evenly onto the grounded metal surface.
- 6 Oven Cure**
Controlled heat cross-links the powder into a tough, permanent protective film.
- 7 Inspection**
Visual, dimensional, and performance checks confirm the part meets specification before release.
- 8 Packaging & Shipping**
Coated parts are separated, wrapped, labeled, and protected to arrive damage-free.

Key Insight

At DeWys, powder coating is integrated into the full fabrication workflow — not outsourced as an afterthought. This means every upstream decision can be optimized for finish quality.

Design for Finishability

The quality of a powder-coated finish is determined long before the first particle of powder reaches the surface. Decisions made during product design — material selection, edge geometry, weld quality, drainage, and part orientation — directly affect finish quality, corrosion resistance, production efficiency, and overall cost.

Why It Matters

A well-designed part flows smoothly through fabrication, pretreatment, powder application, curing, inspection, and assembly. Poorly designed parts often require additional labor, masking, rework, or recoating — adding cost and lead time.

At DeWys, we encourage customers to adopt a Design for Finishability mindset early in the engineering process. Considering powder coating requirements during design eliminates avoidable issues while improving product performance and manufacturing efficiency.

What Thoughtful Design Achieves

- Improved cosmetic appearance
- Increased corrosion resistance
- Reduced manufacturing costs
- Minimized rework and scrap
- Faster production throughput
- Better assembly fit
- Extended product life
- Fewer warranty claims

Key Insight

Powder coating within DeWys allows parts to be specifically hung and pretreated for optimal finish quality — reducing handling and improving consistency.

Material Selection & Surface Preparation

Not every metal is equally suited to powder coating. The substrate material, its surface condition, and the preparation it receives before coating all determine how well the finish adheres, how long it lasts, and how much it costs to apply.

Common Substrates for Powder Coating

- Cold-rolled steel — excellent adhesion, easy to pretreat, most common substrate
- Hot-rolled steel — requires descaling; good candidate once mill scale is removed
- Aluminum — lightweight, corrosion-resistant; needs chromate-free conversion coating
- Galvanized steel — already corrosion-protected; outgassing risk requires careful cure
- Stainless Steel & Aluminum –

What Makes a Good Coating Candidate

A part is ready for high-quality powder coating when it has consistent material thickness, clean weld seams without porosity, smooth edges free of burrs, and surfaces free of oil, rust, or mill scale. Parts that arrive clean and uniform move through pretreatment faster, coat more evenly, and produce fewer rejects.

Practical Preparation Guidance

- Cleanliness — remove oils, greases, and drawing compounds before shipping
- Part consistency — uniform wall thickness prevents uneven heat during cure
- Weld quality — continuous, ground welds eliminate pinholes that trap air
- Edge condition — rounded or broken edges hold powder better than sharp ones
- Surface profile — light mechanical abrasion improves adhesion on smooth metals

How Preparation Affects Finish Quality & Cost

Parts that arrive poorly prepared require additional grinding, chemical treatment, or rework — adding labor, extending lead times, and increasing per-part cost. Investing in upstream preparation consistently delivers better finishes at lower total cost.

Key Insight

At DeWys, parts move directly from fabrication to coating under one roof — so surface condition is controlled from cut to cure, reducing contamination risk and rework.

Pretreatment

Pretreatment is the hidden step that determines adhesion and long-term performance. Before any powder touches the surface, the metal must be chemically and physically prepared to accept a coating that will bond tightly and resist corrosion for years.

The Pretreatment Process

1. Cleaning — remove surface contaminants, dirt, and loose debris
2. De-greasing — dissolve oils, lubricants, and drawing compounds with an alkaline wash
3. Rinsing — flush residual chemicals to prevent interference with subsequent stages
4. Conversion coating — apply iron phosphate to create a bonding layer
5. Drying — remove all moisture before powder application to prevent outgassing

Why Each Stage Matters

Skipping or rushing any stage introduces risk. Residual oil causes fisheyes in the finish. Inadequate rinsing leaves chemical deposits that weaken adhesion. Without a proper conversion coating, the powder has no chemical anchor — it may look fine initially but fail under stress, humidity, or UV exposure.

Modern multi-stage wash systems automate this sequence, controlling temperature, concentration, and dwell time to deliver repeatable results at production speed.

Key Insight

Clean, properly pretreated metal gives the coating its best chance to bond and resist corrosion. Pretreatment is where finish durability is won or lost.

Powder Application

Powder coating is applied using electrostatic spray guns that charge dry powder particles as they exit the nozzle. The charged particles are attracted to the grounded metal part, wrapping around surfaces and clinging uniformly until cured.

How Electrostatic Spray Works

The spray gun imparts a negative charge to powder particles. Because the metal part is electrically grounded, the charged particles follow field lines toward the surface and adhere on contact. This electrostatic attraction holds the powder in place during handling and transport to the cure oven.

Factors Affecting Coverage

- Part geometry — deep recesses and internal corners resist powder penetration
- Edge build-up — sharp edges attract excess powder due to concentrated field lines
- Grounding — poor ground contact causes uneven deposition and thin spots
- Film build — target thickness (typically 2–4 mils) must be consistent across the part
- Transfer efficiency — optimized settings reduce overspray and material waste

Operator Technique & Automation

Skilled operators adjust gun distance, powder flow rate, and voltage to match each part's shape. Automated reciprocating systems handle high-volume runs with consistent motion paths, while manual touch-up addresses complex geometries.

Key Insight

Application technique affects both appearance and durability. Even small variations in film thickness can influence gloss, color consistency, and long-term corrosion resistance.

Oven Cure

Heat is what transforms loose, electrostatically held powder into a continuous, cross-linked film. The cure oven brings parts to a specific temperature for a defined duration, triggering a chemical reaction that fuses the powder into a tough, uniform protective coating.

How the Cure Cycle Works

Once parts enter the oven, the powder first melts and flows into a smooth liquid film. As metal temperature reaches the specified cure window — typically between 350 and 400 degrees Fahrenheit — the resin and hardener react, forming permanent molecular bonds. The part must hold at cure temperature for the full required dwell time, usually 10 to 20 minutes at metal temperature.

Why Temperature Control Matters

Under-cured coatings may appear normal but lack full hardness, chemical resistance, and adhesion. They are more likely to chip, chalk, or fail in service. Over-cured coatings can yellow, lose gloss, become brittle, or suffer reduced flexibility. Precise oven profiling — verified with data loggers — ensures every part reaches and holds the correct temperature regardless of mass, geometry, or rack position.

What Proper Curing Delivers

- Full film hardness and scratch resistance
- Maximum adhesion to the pretreated substrate
- Consistent gloss, color, and surface appearance
- Long-term flexibility without cracking
- Reliable corrosion and chemical resistance

Key Insight

The cure cycle is what turns powder into a durable protective finish. Without verified time at temperature, even perfectly applied powder cannot deliver its full performance.

Inspection & Quality

Every coated part must meet defined standards before it ships. A structured inspection process catches defects early, confirms process control, and gives customers confidence that fit, finish, and performance requirements have been verified.

Quality Verification Checklist

- ✓ Visual inspection — check for runs, sags, pinholes, inclusions, and color match
- ✓ Coating thickness — measure dry film thickness with calibrated gauges (mil or micron)
- ✓ Adhesion testing — cross-hatch or pull-off tests confirm bond to substrate
- ✓ Impact — bend and impact tests verify film ductility
- ✓ Corrosion testing — salt spray or cyclic exposure validates protective performance
- ✓ Dimensional and masking checks — confirm tolerances on mating surfaces and threads

Why Consistent Inspection Matters

Inspection is not just about catching rejects — it is a feedback loop. Thickness trends reveal gun settings drifting out of spec. Adhesion failures point back to pretreatment chemistry. Cure issues flag oven temperature variation. Each data point strengthens process control and reduces waste over time.

Documented inspection records also support traceability — linking each batch to specific process parameters so that any field issue can be traced back to root cause quickly and accurately.

Key Insight

Consistent inspection protects fit, finish, performance, and traceability — turning quality from a gatekeeping function into a continuous improvement engine.

Packaging & Protection

A flawless coating means nothing if the part arrives damaged. Proper packaging preserves the finish through handling, storage, and transit — ensuring the customer receives exactly the quality that left the line.

Handling & Separation

Coated parts should never contact each other directly. Use foam dividers, kraft paper interleaving, or custom dunnage to prevent surface-to-surface abrasion. Edges and corners are especially vulnerable — protect them with edge guards or cushioned wraps.

Practical Packaging Guidelines

- Separate layers with foam sheets, corrugated dividers, or VCI paper
- Wrap individual parts or nest them in molded trays for high-value items
- Protect edges and corners with cushioning or cardboard guards
- Keep surfaces clean — avoid packing materials that shed fibers or dust
- Label containers clearly with part number, quantity, and handling notes
- Secure loads to prevent shifting during transit

Reducing Transit Damage

Vibration, stacking pressure, and temperature swings during shipping can all compromise coated surfaces. Secure parts within containers so they cannot shift. Use stretch wrap or banding to stabilize pallets. For long-distance or export shipments, consider moisture barriers and desiccants to prevent condensation damage.

Key Insight

Careful packaging preserves the finish until installation. The last few feet of the supply chain deserve the same attention as every process step before them.