CAN PREPAINTED METAL BENEFIT YOUR PRODUCTION PROCESS?

PREPAINT VS. POST-PAINT DURING THE PRODUCTION PROCESS

CONSIDERATIONS FOR CONVERTING TO SHERWIN-WILLIAMS COIL COATINGS PREPAINTED METAL

White Paper

SHERWIN-WILLIAMS
Coil Coatings

OVERVIEW

Today, an increasing number of end-use manufacturers are converting to prepainted metals to achieve multiple production benefits – from speeding up market demand response, to reducing production cycle time. Prepainted metal significantly expands the options to meet consumer needs with an extraordinary palette of colors, sheens, and cosmetic effects for appliances, buildings, furniture, and other metal products.

With more than 50 years of experience, this global industry demonstrates the efficiencies of using outsourced prepainted metal. For instance, the appliance segment adopted this method for refrigerator doors and case bodies more than 30 years ago. Use of prepainted metal has since expanded within numerous industries with great success.

This technical paper is intended to help engineers and technical teams assess their current operations and determine if they could use prepainted metal to reduce production costs and time, while improving the coating quality on parts and products. The following information provides a general overview of the prepaint versus post-paint manufacturing process, the variety of prepaint benefits, and manufacturing and design considerations.

INDUSTRIES THAT CAN BENEFIT FROM PREPAINTED METAL

Two major market trends are driving the conversion to prepainted metal: consumer demands and global manufacturing efficiency. Consumers are trending toward using color as a way to define their personal home style. In addition to wanting both color and finish options, they also look for durability and performance in their appliance coatings. Manufacturers, on the other hand, continue to embrace prepainted metal in response to the variety of advantages it provides – including lower product costs, quicker response to market needs, and improved surface coating quality in a competitive global environment.

With prepainted metal, designers have cosmetic freedom since almost any color, pattern, or texture is applicable to a range of metal surfaces. This method's ability to also maintain a quality-consistent surface, not often achieved by post-paint, delivers an additional aesthetic benefit for the finished manufactured product. Prepainted metal is used to differentiate design around the world in ways not previously considered by many end users.

INDUSTRY APPLICATIONS OF PREPAINTED METAL:

- Construction: roofing, walls, soffits and fascias, garage and entry doors, storage units
- Appliance: laundry, refrigeration, dishwashers, small appliances
- HVAC: heating and air conditioning units
- Transportation: tractor trailers, trailer van panels
- Furniture: filing cabinets, desks, storage units, shelving, point-of-purchase displays
- Other Goods: containers, lighting fixtures, electrical cabinets, lockers, clocks

COIL COATERS AND COATING PROCESS

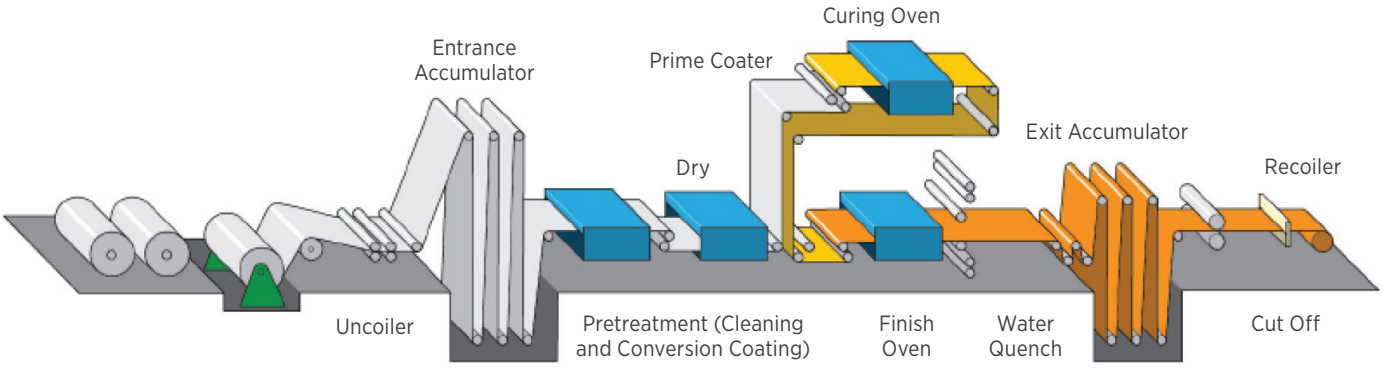
Prepainted metal is produced at coil coating facilities, by adding paint or film coatings to properly cleaned and pretreated strip metals (coils). Steel or aluminum substrates are delivered in large coil rolls from a mill. During the coil coating process, metal coils are unwound, cleaned, pretreated, painted, cured, and rewound all in one continuous process.

The quality of the prepainted finished coatings is excellent—smooth and consistent, with corrosion resistance. The metal substrates are aggressively alkaline and mechanically cleaned, then undergo controlled pretreatment applications. A corrosion-inhibiting primer, when applicable, is typically applied before the colored top coat. Then the finished painted coils are shipped to the manufacturer in either cut-to-length or coil form for end-use fabrication.

Coil coaters typically invest tens of millions of dollars in equipment. Depending on the facility's process capability and the metal substrate's thickness and width, line speeds have capabilities in excess of 600 feet per minute. Coaters provide inspection and physical testing to ensure all cosmetics and physical properties meet the manufacturer's end-use requirements.

This coating process is a highly-efficient way to coat metal before fabricating finished components. Every inch of surface is cleaned and treated when the metal is flat, which is generally not possible when painting is done after parts are formed.

Prepainted metals provide a high-quality, uniform, and reproducible surface finish with no loss to surface quality or beauty.



BENEFITS OF PREPAINTED METAL

The prepainted coating method is attractive to end-use manufacturers for many reasons. Among product launch speed and support in the market, other benefits include:

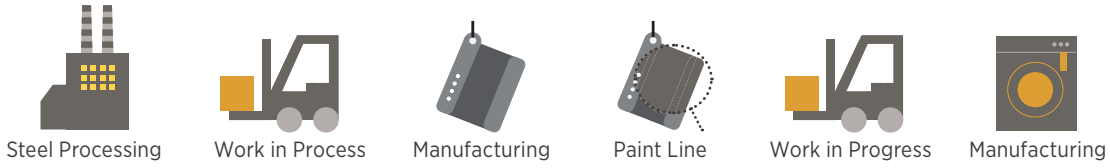
- **Beauty and Design Innovation**
  Coil-coated metal is visually appealing, from the consistent quality of the finish, to the nearly endless color, texture, and pattern options. Architects and product designers have maximum flexibility for design and production when developing a new appliance or a one-of-a-kind, iconic commercial project.

- **Speed to Market**
  Quick execution of new designs is essential in highly competitive industries, such as the consumer and industrial appliance segments. Both manufacturers and consumers benefit when design teams and manufacturers can shave weeks to months off the design and production process to deliver new designs to market more quickly. Prepainted metal significantly reduces time to market because manufacturers can respond to product color changes more quickly on their production lines.

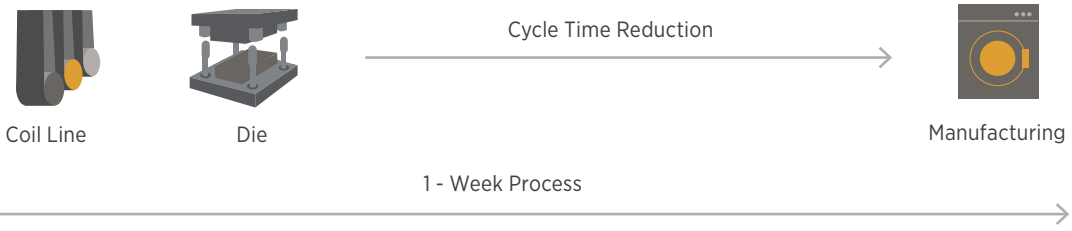
- **Manufacturing Efficiency and Cost Savings**
  Manufacturers that move from a post-paint process to prepainted metal can dramatically reduce production cost and time, and embrace lean manufacturing with shorter cycle times and reduced inventory. This method reduces or eliminates post-paint line costs, gains energy savings, minimizes waste and emissions, and assists with environmental regulatory compliance. From a supply chain standpoint, lead times are typically reduced and logistics are streamlined. Paint is often one of the most expensive components in part production. When comparing the cost of an estimated post-paint line at $1 to $2 million, versus the average cost of plant space at up to $100 per square foot, the savings benefits from prepainted products add up quickly.

SHERWIN-WILLIAMS COIL COATINGS PREPAINT VALUE MODEL

Traditional Post-Paint Process



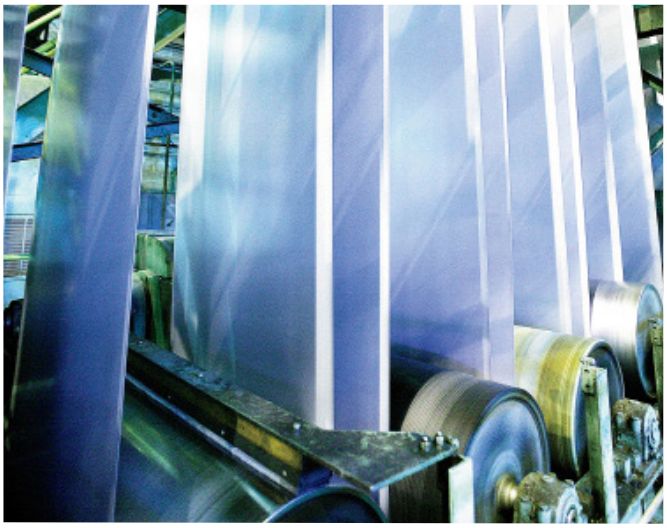
Sherwin-Williams Coil Coatings Prepaint Process



- **HSA/Environmentally Friendly**

  Prepainted coil can significantly reduce a manufacturer's emission footprint. Cleaning and pretreatment of parts, before painting at the end-use point of manufacture, creates a lot of waste. Powder coatings can also require two to three times more paint than coil coatings use during the prepaint process. When coil coaters take the cleaning, pretreatment, and painting process out of a manufacturing plant and into environmentally-compliant coil coating facilities, they help remove a majority of regulatory requirements for end-use manufacturers. This process can eliminate the manufacturer's in-house paint shop, which reduces waste, lowers energy consumption, and minimizes regulatory compliance challenges.

  Coil coating facilities help manufacturers and



  the environment by:

  - Reducing or eliminating waste handling costs
  - Easing burden of record keeping, reports, and permits
  - Curbing electrical costs and water use
  - Lowering maintenance costs
  - Eliminating the facility's post-paint process footprint

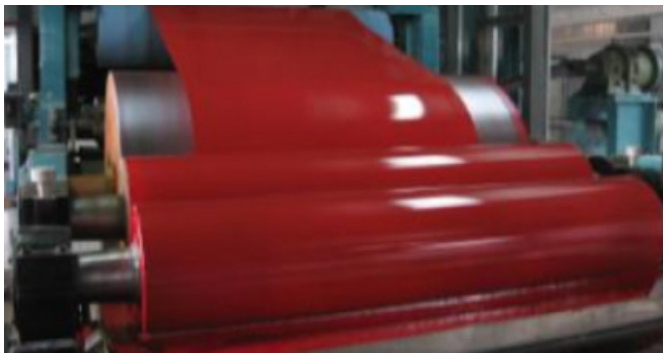
  Technical innovations for prepainted metal include: dried-in-place pretreatment applications, which reduce water use and minimize waste stream management concerns; paint curing in seconds using convection, induction, infrared, or near-infrared curing; and elimination of volatile organic compounds (VOCs) by collecting VOCs from solvents and using thermal oxidizers to turn those compounds into fuel to cure the coating. Prepainted metal can have Restriction of Hazardous Substances (RoHS) compliance, and conversions to chrome-free applications in certain industries are gaining popularity.

  Coil coating is one of the most efficient methods for applying finishes to metals. The coil paint process is highly regulated and employs EPA-approved water and pollution equipment that makes it possible to apply coatings to metal at high speeds with minimal environmental impact.

- **Coating Quality and Durability**

  With quality coatings, prepainted metal substrates withstand most environmental conditions, are corrosion and Ultraviolet (UV) resistant, and hold up better than post-painted surfaces. The excellent corrosion resistance yielded from prepainted galvanized steel, for example, is a combination of the steel's galvanic layer, aggressive alkaline cleaning, pretreatment, and the corrosion-inhibitive primer used before the top coat is applied. Additional quality and durability benefits of prepainted metal includes:

  - **Edge Corrosion:** Prepaint systems, designed for manufactured products with cut-edges, can yield significantly less corrosion than post-paint metal with no exposed edges. Furthermore, prepainted metal can be shipped in a large coil form while maintaining an intact quality surface. With advances in polyurethane and polyester primers, better cut-edge protection is available for HVAC products that require cut outs and notches. These prepaint primers deliver superior adhesion performance and have flexible forming capabilities.
  - **Dry Film Thickness:** Dry film thickness for a prepainted product's cosmetic or show surface is commonly around 1 mil, compared to potentially 3 to 5 mils of powder coating in post-paint.
  - **Finish Quality:** Prepaint is a more controllable and consistent coating process, with smooth application that ensures the highest quality finish across the entire coil width.
  - **Outdoor Ruggedness:** Reputable coatings manufacturers conduct substantive and ongoing real-world exposure testing for coatings used on buildings, HVAC equipment, and other exterior applications.



Accelerated corrosion salt spray and humidity testing is also available to help verify coatings will perform well after long-term exposure to harsh environments.

- **Orange Peel Finish:** Prepaint can reduce or eliminate the "orange peel" finish common to post-paint applications, because it offers excellent flow properties at relatively reduced film thicknesses.
- **Durability:** With a myriad of high-quality color and finish options exhibiting rugged durability, consumers benefit from products manufactured using prepainted metal.
- **Excellent Color Retention for Exterior Products:** Appropriate pigmentation is critical in formulating a quality coating finish that will resist fading. Not all pigments are suitable for every application. For example, exterior high-performance architectural coatings require high-end raw materials with outstanding properties – particularly for heat and UV light resistance. Certain colors are more affected by the environment than others. Long-term color retention is typically based on the percent of organic versus inorganic pigments used to create the final color. Bright colors, such as yellows, oranges, and reds fade faster and are typically formulated with organic pigments to meet the desired finished color space. Conversely, ceramic and select inorganic pigments offer the most durability with the highest resistance to fading. Inorganic pigments are the most heat stable, chemically inert, and UV and weather resistant pigments.
- **ASTM D2248 Testing:** Prepainted parts – specifically those for home laundry or fabric care in the appliance industry – perform well in detergent-resistance testing, which assesses resistance to failure in an accelerated test environment. Panels are typically immersed into a heated alkaline bath for 10 days or 240 hours. This test is most commonly used for home laundry and dishwasher parts.

- **Fingerprint Resistance**
  Stainless steel remains a popular choice for residential and commercial appliances, yet showroom managers and consumers dislike the fingerprinting and smudging that comes with stainless steel appliances. There is a growing demand from consumers and manufacturers for fingerprint-resistant clear coatings to reduce smudging. With prepaint, excellent fingerprint-resistant clear coatings and tinted clear coatings are available. Typically, sheen or gloss is reduced while the brush pattern stays visible in the stainless steel.
- **Formability Versus Durability**
  With advances in coating technology, prepaint coatings are harder and more durable but maintain formability. Prepainted metal is easily joined using adhesives or mechanical assemblies. Weldable primer applications are also available.

MANUFACTURER CONSIDERATIONS WITH PREPAINTED METAL

- **Timing:** Evaluate any plans to downsize, combine plants, or make other major changes in an operation, which may indicate it is a good time to switch to prepainted metal.
- **Cost Cutting:** Examine the elimination of in-house, post-paint production, which could reduce costs while improving the quality of coatings.
- **Major Capital Improvements:** Determine if any other capital improvements are underway, which may signify the timing is right to change to prepainted metal.
- **EPA and Environmental Regulations:** Consider how the use of prepainted metal eliminates the need and added cost of keeping up with stringent regulations, from clean-up and compliance programs to fines, penalties, and legal actions.
- **Inventory:** Coordinate a conversion to prepaint with stock already in hand, including paints, chemicals, solvents, cleaners, applicators, work-in-progress (WIP), and bare, pretreated, primed or painted parts.
- **Insurance:** Account for potential elimination of financial coverage for your part finishing area(s).
- **Cleaning/Waste Treatment Removal:** Review costs, including cleaning supplies and tasks, sludge removal, and maintenance.
- **Space:** Recognize factory space that can be freed up, from the post-paint operation on the floor to stocking of materials needed for the painting process.
- **Purchasing:** Analyze the role of purchasing, which includes sourcing, order follow-up, status reporting, negotiating specifications and prices, standard cost development, purchase orders, and damaged goods, which reduces stocking programs.
- **Operating Costs:** Identify operating costs that could also be eliminated, including energy, filters, delays, rejects, equipment maintenance, lubricants, shutdowns, rework, and spare parts required to keep equipment running.
- **Finishing and Clean Material Handling:** Calculate additional costs, which includes receiving, requisitioning, cycle planning, preventive maintenance, inspecting, spoilage, disposition, and maintenance.

DESIGN PROCESS FOR PREPAINTED METAL

Even if manufacturers don't plan to begin production using prepainted metal, they can evolve to prepaint production by planning for it during the design phase. Recommended steps for a team approach to the prepaint design process include:

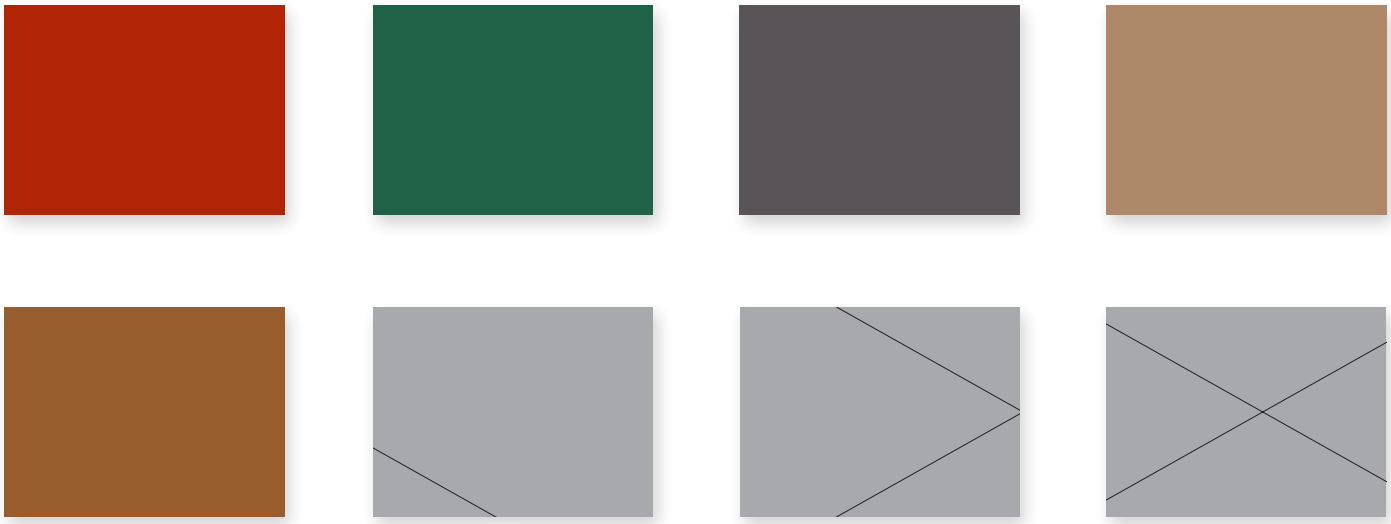
- **Broaden The Design Team:** Invite engineers, paint chemists, marketing, sourcing and supply management, coaters, and manufacturing representation to join discussions during the design process. Emphasize innovation and problem solving to create a seamless transition from initial design all the way through to finished part manufacturing.
- **Establish Coating Objectives:** Set coatings' objectives on the front end of the project to help guide the design process.
- **Explore Ways to Differentiate:** Achieve a unique product appearance through innovations in color and texture. A manufacturer's coating partner can help evaluate the pros and cons of various options. Rather than delivering a source chip to color match once the design process is complete, ask them to share trends in both existing markets and other industries concerning colors and finishes. Coatings manufacturing partners can help balance design, performance, functionality, and cost when recommending coating options.
- **Establish Vision During Initial Design Phase:** Review proposed part drawings early in the process, with attention toward finish options such as color, texture, and gloss. Typically the initial design phase is comprised of several planning meetings, and the end vision becomes clearer as meetings progress.
- **Prepare Lab Display Panels:** Explore cosmetic options by having the coatings partner prepare lab display panels with various coatings for design review.
- **Plan for Form and Function:** Ensure coatings meet both form and function requirements to avoid issues in the launch phase. This involves weighing the pros and cons of various coating types to meet aesthetics, flexibility, durability, and other performance objectives.
- **Apply Lean Methodologies to the Production Process:** Assess the entire coating production process to achieve efficiency, from sourcing raw materials to lean manufacturing. End-use production lines may require only minor tweaking to accommodate prepaint.

The benefits of using prepaint are realized through a strong and early design partnership with the coating manufacturer, applicator, and substrate supplier. Through a team-design approach, all involved members of the immediate supply chain have a voice and can actively contribute to the success offered by a prepaint process model.

DESIGN GUIDELINES FOR PREPAINTED METAL

When designing for metal coatings, consider the following:

- **Substrate Type:** Use general performance characteristics of selected substrates, including typography, yield, tensile, and elongation to help guide coating selection.
- **Pretreatment Designation:** Determine whether the application requires RoHS compliance.
- **Durability Versus Formability:** Understand the specifics around minimum durability requirements, such as scratch resistance and hardness. These characteristics likely require a specific prepaint formulation, which can influence prepaint flexibility performance. Design parts for prepaint with an as-generous-as-possible bend radii to allow for maximum factory formability.
- **Finish Requirements:** Realize appliance industry standard prepaint finish applications are generally comprised of a primer and finish coat application.
- **Fold Design:** Avoid exposed edges on final part design, allowing for an engineered fold to hide cut edges.
- **Multiple Design Finishes:** Consider a large range of finish colors and effects available in prepaint coatings, as well as multiple gloss levels.
- **Mechanical Post-Embossing:** Recognize and design for additional thickness on finished part applications that require a mechanical post-embossment. Mechanical embossing also lends structural rigidity to an end-use part.



CONCLUSION

DETERMINING IF COIL COATING IS RIGHT FOR YOUR OPERATION

Manufacturers in many industries continue to discover the benefits of prepainted metal, which differentiates products and improves speed to market. Prepaint opportunities are thriving in multiple industries.

A manufacturer's coatings partner can help complete a cost-benefit analysis of prepainted metal. The National Coil Coating Association (NCCA) offers a Cost Comparison Analysis tool that allows companies to quantify the long-term manufacturing savings in converting to coil coated material. This detailed form is divided into Inventory Costs, Fixed Paint Equipment Costs, and Operating Costs to identify an all-cost evaluation and assesses potential savings.

SOURCE

TECHNICAL AUTHOR

Jim Newton is a Technical Sales Representative at Sherwin-Williams Coil Coatings. Contact Jim for additional information at jim.newton@sherwin.com or visit coil.sherwin.com

Bill Hartford is a Sales Director and Marketing Segment Manager, Manufactured Products at Sherwin-Williams Coil Coatings. Contact Bill for additional information at william.hartford@sherwin.com or visit coil.sherwin.com

SOURCES

Sherwin-Williams Coil Coatings Technical team and coil.sherwin.com

National Coil Coating Association, www.coilcoating.org

To Convert or Not to Convert Case Study,
https://www.coilcoating.org/index.php/education/other-tools/case-study-5

Cost Analysis Form, www.coilcoating.org/index.php/education/other-tools

European Coil Coating Association, www.prepaintedmetal.eu