



Tackling Challenges of Tinted Stainless Finishes on Appliances

By Todd Weiss, Technical Manager and Jigar Mistry, PhD Scientist

Appliance designers and marketers are constantly evolving to satisfy the ever changing wants and needs of their consumer base. The latest evolution of appliance finishes seeks to add even more luxury to traditional stainless steel applications by applying a clear black tint to the surface of stainless steel.

While this look seems like a straightforward change to the finish of the appliance, the application and execution of this coating presents multiple challenges to the appliance supply chain. The black stainless look is an evolution from traditional stainless appliances, which were introduced to the U.S. residential market in the early 1990s. Stainless steel quickly gained popularity for its durability, ease in matching every type of cabinet and timeless look. Stainless has reigned as the dominant appliance finish for more than a decade, and the new tinted coatings seek to continue the dominance of stainless steel in the market.

Black stainless steel first appeared on high-end appliances in Europe and was introduced into the U.S. market in 2015. Not quite as industrial-looking as traditional stainless steel, black stainless delivers a softer, warmer yet modern aesthetic.



In contrast to traditional stainless steel, tinted stainless is less reflective, and smudge and fingerprint resistant.

To achieve this look, stainless steel must be coated with semi-transparent coatings that will provide consistent color coverage while also allowing the grain to remain visible. This process is creating special challenges for some appliance manufacturers in achieving a consistent color look across different types of metal required in the manufacturing process.

In this article, we explore the challenges and solutions for producing beautiful black stainless steel appliances. A niche market

today, this color trend could accelerate quickly as coating companies work with appliance manufacturers to improve the science behind black stainless steel.

The Technology Behind Black Stainless Steel

The black stainless effect is created by applying a clear coat that has been tinted over traditional stainless steel. The tinted clear coating is applied at thin millage to the stainless steel so the grain can still be seen. To ensure that the grain is still visible in the design, the coating is designed at 40 percent opacity. The clear coat can also be formulated to protect the finish, providing fingerprint and smudge resistance. As a result of the coating opacity, any change in coating thickness or application speed can result in a slightly different color (darker or lighter). To combat this difference in appearance, many of today's black stainless appliances are typically designed with detailed trim work and additional lighting features to help mask color differences between metal components on the appliance. But as more manufacturers are interested in designing sleek higher-end appliances in black stainless steel, coating manufacturers are eager to help solve this color challenge.

Today, the majority of the black stainless coating is applied using coil/liquid technology, but the look can be achieved using liquid, powder or e-coat technology. However, no matter what coating technology is used, a large part of the overall finish color will be determined by the substrate and not the film.

Consistent Color of Stainless Steel Matters

Both the color of the steel and the coating thickness impacts the color of the finished product. Coating thickness can vary on a production line. Using the ideal coating thickness of 0.7 to 0.9 DFT, coating manufacturers have tested variability of color to see how much impact the color of the stainless steel has on the finished appliance.

This testing has found that:

- 60% of finish color is tied to the color of the steel: Even with tight control standards, the final look of any tinted clear coating is greatly affected by the color and brush pattern of the substrate.

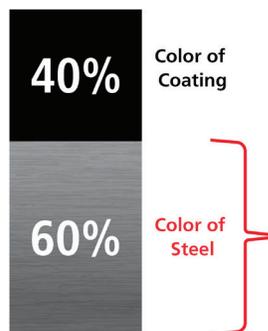
- 40% of the finish color is tied to the color of the coating: variation in the final finish color will also depend on the application of the coating. The tinted clear effect can shift if the coating is too thick or thin.

Stainless steel has inherent variation from batch to batch. Appliances made from different batches of stainless steel or appliances in a suite that are assembled at different locations or different days and times may have slight, but visible changes to the steel color.

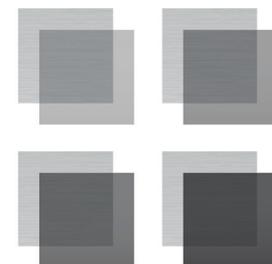
With more than 150 grades of stainless steel available, the underlying color of the stainless steel can have a large impact on the overall finish color. Differences in the steel color can become more apparent when the tint is applied. It is not uncommon to see several types of steel substrates used on one appliance or within a family of appliances or for parts on one machine to be cut from different stainless steel lots.

Consideration needs to be given to both steel selection and coating technology when manufacturing black stainless steel appliances.

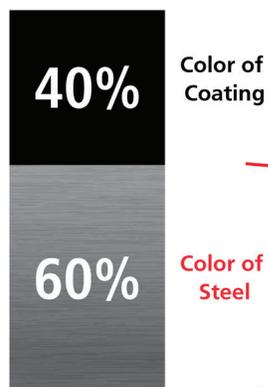
Coating Influence at 0.7-0.9 DFT



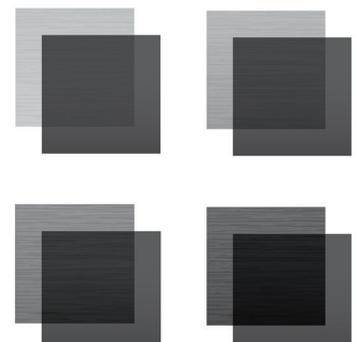
Even with tight control standards, the final look of any tinted clear will be greatly affected by the color and brush pattern of the substrate.



Coating Influence at 0.7-0.9 DFT



Variation in the final finish color will also depend on the application of the coating. The tinted clear effect can shift if the coating is too thick or thin.



Stainless grades typically are selected based on a few factors including:

- Formability: How much the steel can be bent to form different parts and still retain its strength.
- Corrosion resistance: Appliance parts with more exposure to solvents and water require stronger corrosion resistance.
- Temperature resistance: Where the steel resides on the appliance will require specific temperature resistance.
- Cost: The higher the grade of steel, the higher the cost. Manufacturers need to balance the aesthetics with durability and overall costs.
- Color: To match color, manufacturers need to select similar grades of stainless steel.

Coating Technologies

There are several coating technologies available for stainless steel that can deliver high-performance properties such as durability and longevity required by appliance manufacturers. Typically, more than one coating process is used depending on the type of part being coated.

But the technologies do experience differences in long-term coating performance and vary in ability to deliver the black stainless steel look consistently across the appliance. Selecting the correct coating option depends on a variety of factors, including: current manufacturing footprint, chemical resistance needs, application stability, post-form coating needs, and environmental restrictions.

Pre-Coat or Coil Coatings Applied Before Appliance is Assembled

There are some advantages for pre-coating stainless steel in the flat sheet form before parts are shaped from the steel. This process is most often used for refrigerator doors or washers and dryers with large flat surfaces. It is easier to consistently control the film build on a flat sheet of metal, which is important for color consistency. It is easier to achieve high-performance properties such as scratch resistance. And, coil coatings can be used to telegraph the “brushed look” up through the film coating.

However, coil is difficult to use on parts that have complicated forming after paint is applied. As the steel is stretched in the forming process, the coating can appear thin along seams and bends, especially if the bend exceeds 50°.

Powder Coatings Applied After Welding Operations

This technology has been the most challenging to date for achieving the black stainless steel look, but coating manufacturers have made significant progress in this type of coating to achieve high-performance properties and the transparent black color with minimal blotchiness. Powder coatings are applied after products are welded. In addition, powder coatings provide outstanding chemical resistance and durability properties, reducing damage experiences during transit, display and everyday use.

Some challenges with this coating include the transparency of the film, requiring manufacturers to have extremely tight control of the steel substrate color. Managing the film build control can be challenging. Powder finish color can vary a bit on the edges of the metal and in corners, so coating application expertise is paramount. Getting a really smooth finish can be challenging with some “orange peel” effect typically common in powder coatings, but some manufacturers have developed techniques for a smoother finish.

Liquid Coatings Applied After Welding Operations

High-performance properties are attained when using this technology to coat black stainless steel along with providing an ultra-smooth film finish. Liquid coatings are applied after products are welded. Like powder, liquid coatings require extremely tight control of the steel substrate color for a consistent finish because of the transparency of the film.

However, liquid solutions also require tight film build control, which can be a challenge for plants. If the coating is applied too thick, the coating will hide the brushed texture under the film.

E-Coatings (Electrodeposition) Applied After Welding Operations

E-coat can provide the benefits of liquid coatings with one of the most consistent application processes.

The brushed look could be telegraphed through the film and the automated application process ensures completely consistent application of the film, resulting in consistent color.

While the appearance is consistent, it comes at a cost. There is a high initial investment cost in this technology, which is ideally suited for a high-volume product line. Because of these constraints, there are currently no clear tinted e-coat tanks in operation today, but as volume continues to grow, this will become a more viable option. This coating technology, like powder and liquid, requires manufacturers to have extremely tight control of the steel substrate color to achieve the desired transparent look.

Future Development: Sublimation Process

This process is not being used today for black stainless steel appliances, but has potential for the appliance industry. During the sublimation process, ink is used to “die” the steel by penetrating the surface with ink. The die is used independent of the clear coating to achieve the black stainless look. However, this approach could appear as a “lower-in-quality” finish that is more typically a decal approach. More exploration needs to be done to determine durability and feasibility for this industry including process capabilities in a full production setting.

Summary

Several coating technologies are available to achieve the trendy, desired black stainless steel look in appliances. Today, all are dependent on color of the stainless steel being used on the appliance, but progress is being made in achieving the consistent color desired through the work being done by coatings manufacturers with the appliance industry. The goal is to master the unique challenges of coating and matching a variety of stainless steel appliance parts. Black stainless steel has the potential to grow significantly in the higher-end appliance industry as the manufacturing and coating processes evolve to meet market demand. Contact a coatings professional to trial and review what coatings solution will work best for your application.

For more information, call 1.800.782.4682, email industrialfinishes@valspar.com or visit www.valsparindustrial.com



PO Box 1461
Minneapolis, MN 55440