Blackened Steel and Stainless Steel Sheet Metal Finishes and Applications

by Wiemann Metalcraft

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Understanding Finishes and Applications

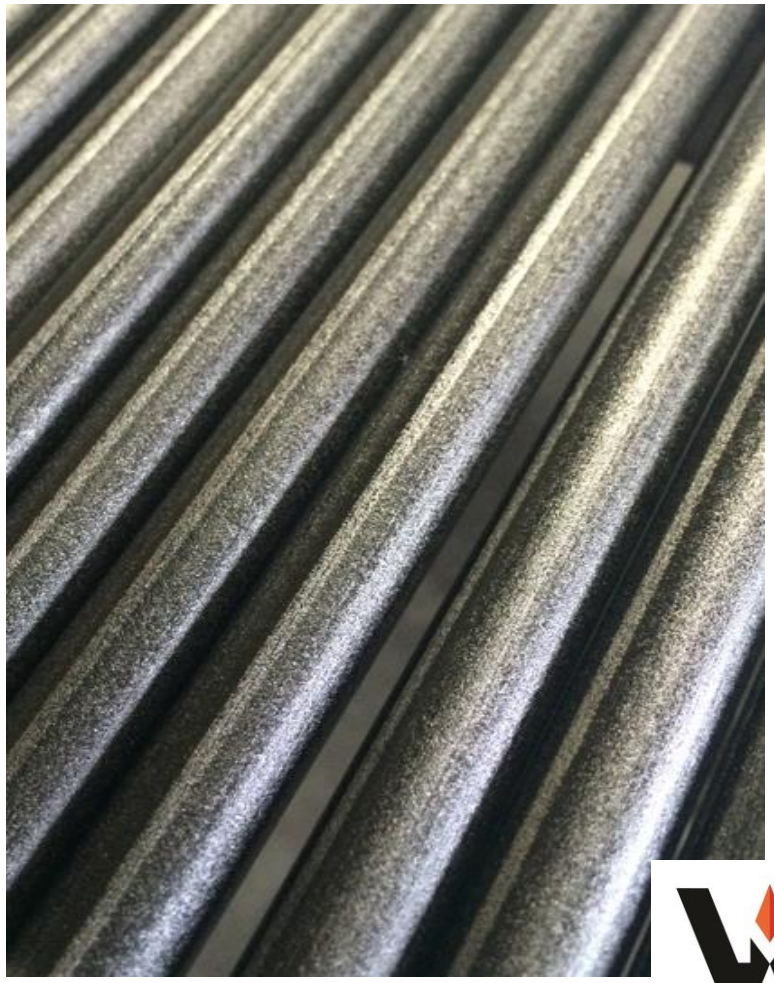
Finished steel is ubiquitous today across commercial, industrial, and residential applications due to its rugged, modern looks, ease of maintenance, and relative cost. Understanding how materials and finishes are created will help focus discussions and ensure customer expectations are met.

Patina and Oxidized Metal Finishes Overview

Blackened steel and stainless finishes are created through a chemical patina or oxidation processes and are often called “living finishes” due to their evolving appearance over time. Protective coatings may be needed to stabilize color and slow changes.

Patinas are more labor-intensive and costly than paint finishes, but they offer unique, character-rich results. Achieving consistent outcomes is complex—different metal alloys (steel, brass, aluminum), their finishes (hot-rolled vs. cold-finished), and surface preparations all affect results.

No universal formulas exist. Variables like humidity, water hardness, temperature, and applicator skill influence outcomes. Working with experienced fabricators is essential, especially since patinas are often toxic and should be handled professionally.



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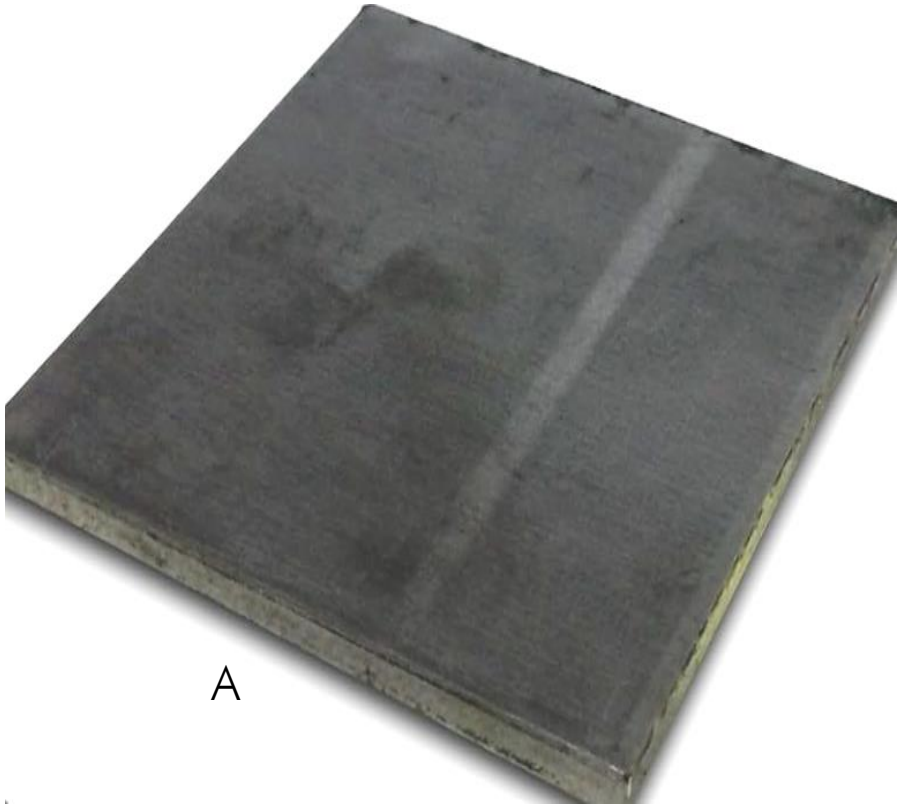
Carbon Steel

Hot Rolled Carbon Steel Plate with Mill Scale (Figure A): This low-cost, common metal features a distinctive mill scale that adds a rugged texture to its surface. Key characteristics include:

- Patination limitations - Patina is used to hide scratches and surface defects, but the mill scale generally does not darken much
- Patina application - Patina is possible after mill scale removal and on cut edges
- Mill scale removal - Extremely tough and can only be removed by aggressive grinding, sanding, or grit blasting
- Surface character - The rough surface texture is inherent in all hot-rolled metals and should be expected
- Availability – 16-gauge (.065") steel sheet and heavier can be sourced with mill scale; thinner steel sheets are only sold as cold rolled and are free of mill scale



A

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Carbon Steel

Hot Rolled Steel Plate Free of Mill Scale - Pickled and Oiled Process (Figure B): The same metal but the mill scale is removed through a pickled and oiled (P+O) process, making the hot-rolled steel plate ready for patina. Key features include:

- Surface refinement - Can be further refined or blended using sanders, grit blasting, or polishing
- Patina receptivity - Unlike its mill-scale counterpart, this surface readily accepts patina
- Surface character - The rough character and surface defects remain a notable feature of this metal

B

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Cold Rolled Steel

Cold Rolled Steel Sheet (Figure C): Offers a finer quality surface finish, devoid of mill scale and is much smoother than hot rolled. Key characteristics include:

- Surface quality - Superior finish compared to hot-rolled steel, with no mill scale
- Availability - Readily available in various shapes and becomes the sole option for sheet steel gauges thinner than 16GA
- Processing readiness - Surface is ready for further processing and patina application
- Versatility - Presents an excellent canvas for various applications

C

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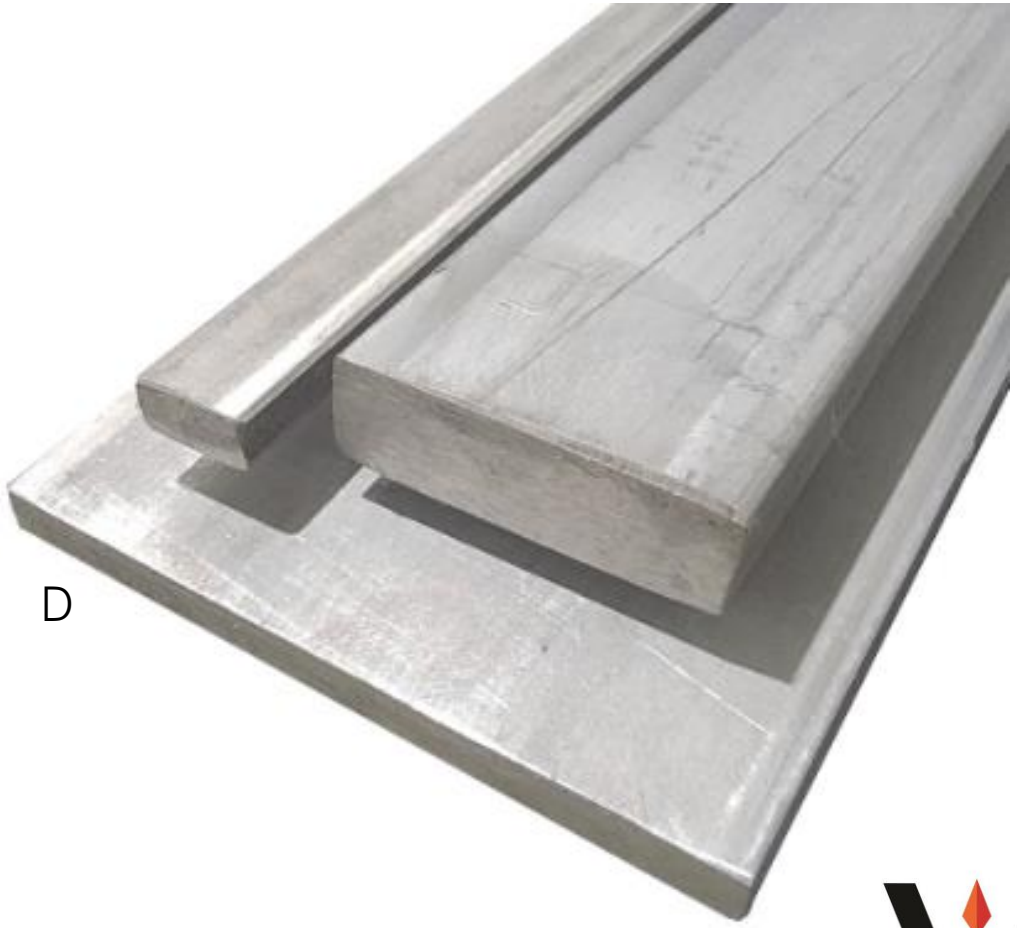
Stainless Steels

Stainless Steel, Hot Rolled Shapes (Figure D): Stainless steel features a rust-free and scale-free finish when hot-rolled or cold rolled, making it suitable for patina and recommended for use in locations that will get damp or wet. Important considerations include:

- Surface finish rule - Similar to carbon steels, hot-rolled surfaces are rougher and less costly, while cold-rolled counterparts are smoother and more costly
- Patina limitations - Options are limited to achieving only a black patina, and the process is notably caustic
- Surface preparation - For optimal results, sand off the outer oxide layer that forms naturally over time on stainless surfaces before applying patina
- Benefits of preparation - Proper surface preparation results in more consistent color and quicker action during the patina process



D

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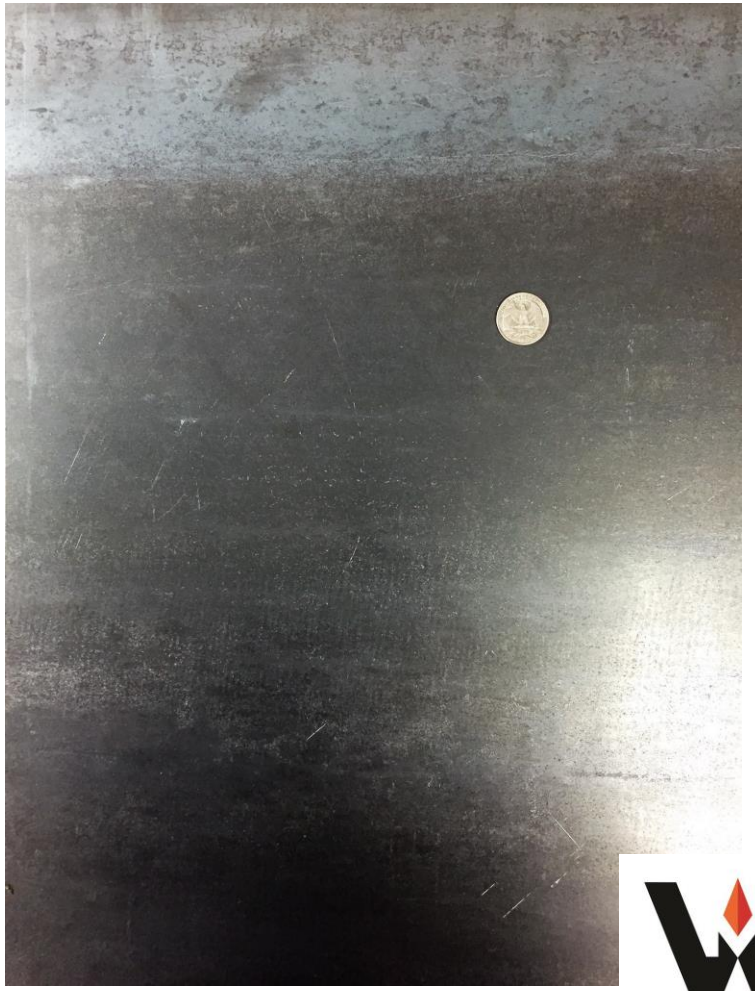
A 36 Carbon Steel and Mill Scale

A36, Mild Steel, and Carbon Steel: These terms are used interchangeably to describe the same type of metal utilized in various industrial processes.

This photo shows A36 Mild Steel with distinct mill scale, free of coatings or waxes. The surface quality, texture and color of the mill scale are inherently variable. Key characteristics include:

- Variable appearance - Mill scale texture and color differ from sheet to sheet
- Surface limitations - Mill scale is hard and cannot accept patina
- Patina applications - Can be used to conceal scratches and create more uniform finishes under clear coats
- Mill scale removal - Blasting or grinding reveals the underlying silver-gray steel with a smoother surface that readily accepts patina (including rust) and finishing processes



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Hot Rolled Steel and Mill Scale

Mill Scale on Hot-Rolled Steel Sheets: The distinctive and irregular coloring on these hot-rolled steel sheets comes from mill scale—a thin film of resilient impurities formed during steel manufacturing. This coloration is beyond the control of both the mill and fabricator.

Key characteristics and considerations:

- Aesthetic potential - Can create seamless color blending between parts for a quilt-like finish appearance in intricate fabrications
- Patina limitations - Mill scale is resilient and rust-resistant but cannot be patinated except where steel is exposed by scratches or abrasion
- Removal requirement - Must be removed by grit blasting or grinding for specific applications requiring patina
- Alternative option - Pickled and Oiled steel sheets undergo chemical processing to remove mill scale before delivery, providing a surface ready for patina application

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Hot Rolled Carbon Steel A36 or Mild Steel Sheet

Examples of sheet metal constructs using uncoated A36.

- Notice the watering marks and the color shift from one part to another.
- Fingerprints can also be seen.
- Clear coating this surface will darken it and blend the irregular features.
- A tinted black clear coat can be used to further darken the final color.
- Using the previous slide, we show the approximate location that the colors can be found on a sheet.

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Hot Rolled Steel Sheet with Mill Scale and Clear Lacquer

In this example, full size sheets are simply clear coated for ease of maintenance and to darken the overall appearance. This is a cost-effective way to get an irregular blackened steel appearance. The sheen of the lacquer can be modified.

- Pros: It is easier to maintain and clean, and somewhat inexpensive.
- Cons: ammonia water (mops) quickly breaks down the lacquer and the exposed steel surface may develop rust. Even with a clear coating this surface finish is not recommended for exterior use or in areas that may get damp.

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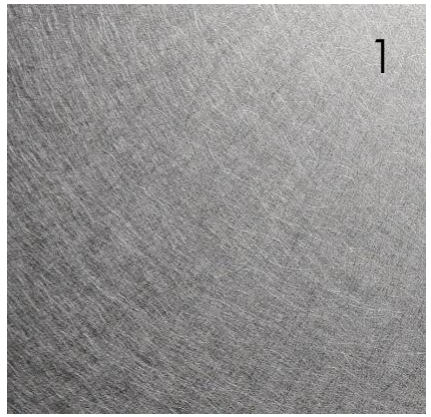
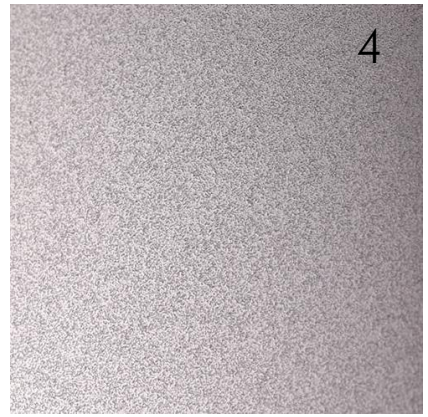
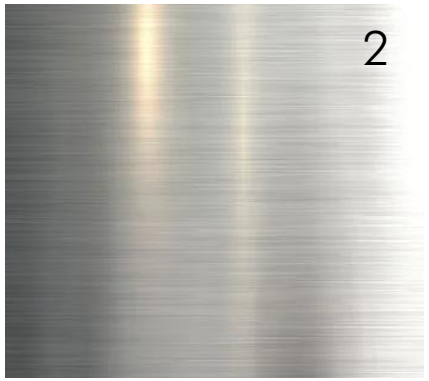
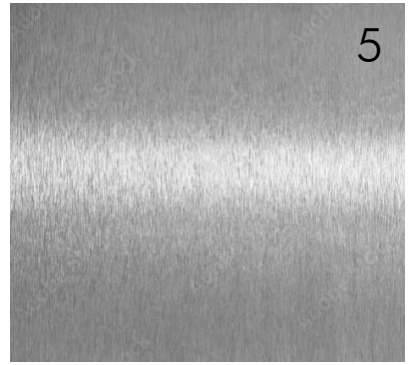
Mechanical finishes

- Before oxidation or patina processes occur, the metal surface of the metal is usually prepped using a mechanical method.
- Mechanical Finishes include Grit Blasting, Sanding and Graining and Polishing. Some finishes are applied by hand while others require specialized tools and machinery.
- Any of these steps will promote a more even and controlled patina conversion, deeper colors, and adhesion.
- Some of these finishes such as non-directional sanding are easier to touch up in case of damage on site, while some are more costly, such as mirror polishing.
- Each mechanical finish may show through a patina coating if the coating is not dark black. This should be considered in the sample submittal process and reviewed with finish swatches or coupons.

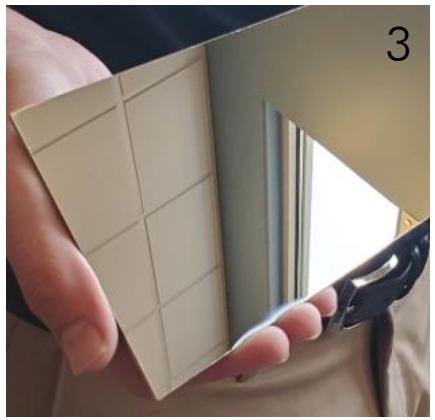








1. Non-Directional Sanding
2. Fine Linear Grain
3. Mirror Polish
4. Sand or Grit Media Blasted
5. Medium/Course Linear Grain



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Chemical Conversion/ Patina/Oxide

- After mechanical finishes are completed and surfaces are clean, the application of the patina should follow quickly.
- This step creates the colorful oxide layer.
- The chemicals used may be toxic, so it is best suited for skilled applicators in a controlled environment where variables such as heat, humidity, wind, sunlight, water quality can be minimized. Proper handling of hazardous chemicals and supporting can be captured and disposed of properly.

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Coatings

- After the patina, coatings may be desired.
- Lacquers and waxes are most common. They are easily applied and refreshed when needed.
- If desired, tinted lacquers or waxes are used to achieve darker finishes.
- Coatings will always darken the finish. It's best to get samples to verify the final finish color and sheen before starting the work.
- Powder coats are not recommended since the required pre-wash phosphate cleaning process may alter the patina chemistry.
- Powders, urethanes, and enamels are also more durable than lacquers, but when the coating needs to be refreshed, it will be much more difficult and costly to strip these.

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Shop Applied Patina on Stainless 304 Alloy (hot roll) flat bars

These bars are all the same except the finish has been buffed back on the middle and bottom panels to reveal a stainless steel color. Stainless is a superior choice to A36 steel for exterior applications.

Note the pitting inherent in the surface of the metal. This is indicative of most hot rolled steel and stainless products and is more visible the lighter the color.

There is no clear coat, these are very flat black finishes and will change over time with exposure to air, water and humidity. If used where they will get wet, a clear coat is recommended to slow or prevent further oxidation.

Shop or cold applied patinas are not as durable as hot black oxide patinas on stainless. Shop applied finishes also are more labor intensive, so they are usually reserved for smaller architectural applications. A clear coat can be applied to these finishes, which will darken them and protect them from further oxidation.

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Shop-applied Patina on Stainless Panels

These cold rolled stainless panels have a surface that is very smooth and pit free. This is common with thinner gauge stainless sheets and carbon sheets and can be specified as well.

The entire panel was mechanically finished with a non-directional orbital tool, followed by the hand application of a full black room temperature (shop-applied) patina.

The lower half was buffed back with Scotch Brite, while the upper half was not. A clear lacquer was applied to the top half.

Shop-applied patinas result in a more even color than hot dipped patinas, though they are labor-intensive. There is some control the depth of color by buffing back some of the oxide, as in this example.

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Hot Dip Blackened Stainless Alloy 304

Stainless Alloy 304 with a mechanical finish followed by a hot black oxide dip creates a rich, durable and variegated finish that is suitable for outdoors. These panels still look like this 5+ years after installation in Sacramento, CA.

- The sheet size is limited to the tank size used for dipping. Panel sizes less than 120"x48" is preferred.
- Stainless fasteners can be coated to match.
- These sheets have a light oil finish which allows for transport and handling during install. Otherwise, there is no wax or clear coat and the surface requires no special maintenance.
- The pattern on each panel is unpredictable and considered to be desirable, not defective.

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Hot Dip Blackened Stainless Alloy 304

- Panels and cladding are applied in many ways. The architect should consider this during construction documents.
- Panels will condense water on the back side during spring and fall temperature swings in many locations.
- Hidden fasteners vs. visible will change the scope of work for the panel fabricator and the installer significantly thereby changing the cost for each significantly depending on the decision.
- Panels may “Oil Can” or deform during hot months if the metal selected is too thin and this thermal movement may damage the fasteners over time if they are not frequent enough or large enough.

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Hot Dip Blackened Stainless Alloy 304

These panels have no clear coat and will weather very well with minimal maintenance.

A 36 steel is not recommended for this application, even with clear coats.

Close coordination with the stainless fabricator, including as-built envelope dimensions, will create tight, crisp lines with fastener alignment and utility access creating an additional subtle, controlled layer.

These panels are delivered to the site with laser cut precision, eliminating the need for field cutting, which creates bright, noticeable edges where trimmed or cut.

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Hot Dip Blackened Stainless Alloy 304

When used indoors, stainless 304 panels provide an exceptional long wearing surface, even without a clear coat.

Carbon steel can be substituted for stainless in interior applications however there are some important considerations:

- Hot dipped or shop applied patina on carbon steel will not have the same color value as stainless steel.
- The carbon steel should have a clear coat or wax to prevent the oxide from rubbing off on a passersby. This will also change the color and the cost.

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Hot Dip Blackened Stainless Alloy 304

When used indoors, stainless 304 panels provide an exceptional long wearing surface, even without a clear coat.

The choice of either visible or hidden fasteners will impact on the scope of work for the fabricator, as well as the installer, and should be considered during construction documents.

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Tea Staining or Rusting Stainless Steels

- Oxide treatment of stainless steels helps protect the surfaces from further corrosion or oxidation.
- In the case of un-oxidized stainless surfaces, even when properly passivated, and exposed to the weather, the phenomenon known as tea staining will occur.
- The discoloration is not a sign of material failure but simply a reflection of the fact that stainless steel is over 60% Iron and can be affected by atmospheric pollution.
- In shop fabrications, the “rusty” stains may also be a result of poor shop hygiene:
  - The steel was casually introduced to the stainless by welding or grinding
  - Poor handling or storage.

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Which material and finish is the right one?

The versatility of blackened and stainless steel have made it a standard for executing clean, modern designs.

The decision on which material and how to finish it depends on many factors:

- Aesthetics
- Application
- Environment
- Cost
- Maintenance

Cooperation between architects, contractors, and your metalcraft experts at Wiemann Metalcraft - from the earliest stages to final walkthrough - ensures a successful and beautiful project.

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Let's get started

Call us to discuss your next blackened steel or stainless-steel project:

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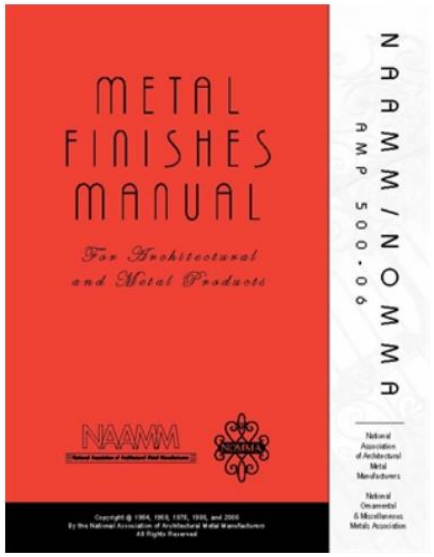
Vendors and Resources

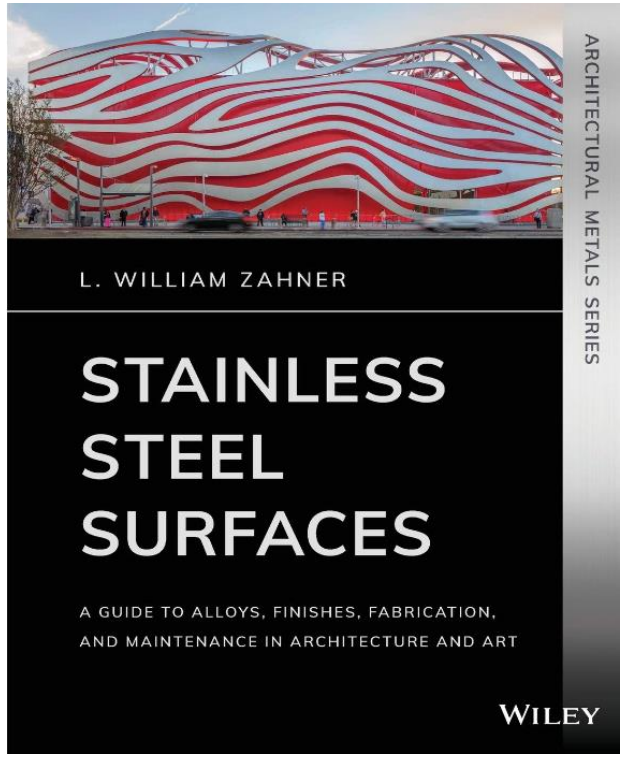


Metal Finishes Manual

2006 AMP 500-06 AMP

Downloads: $0 each

Provides classification designation and recommended specifications for finishes applicable to architectural metals; introduction section plus sections on finishes for aluminum, the copper alloys, stainless steel, carbon steel and iron, and applied coatings. (AMP 500-06)



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