

DESIGNER

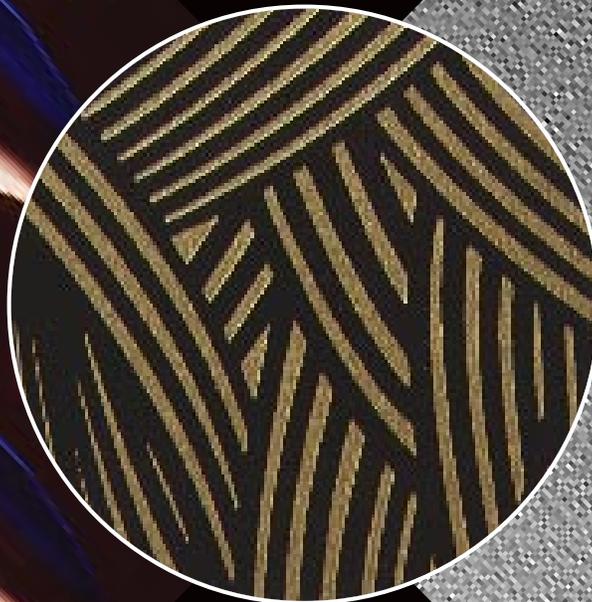
HANDBOOK

# *Special Finishes*

FOR STAINLESS STEEL

## F I N I S H E S I N G E N E R A L

The surface finish on a piece of stainless steel sheet as produced by a mill or supplied by a steel service center is generally the result of processing to bring the sheet product to a final dimension. The resulting finish is usually a "rolled" (or unpolished) finish, either dull or bright. Several creative "rolled" finishes have been developed for aesthetic applications. They add texture or simulate other finishes, for example, polishing or abrasive blasting. Subsequent operations, such as



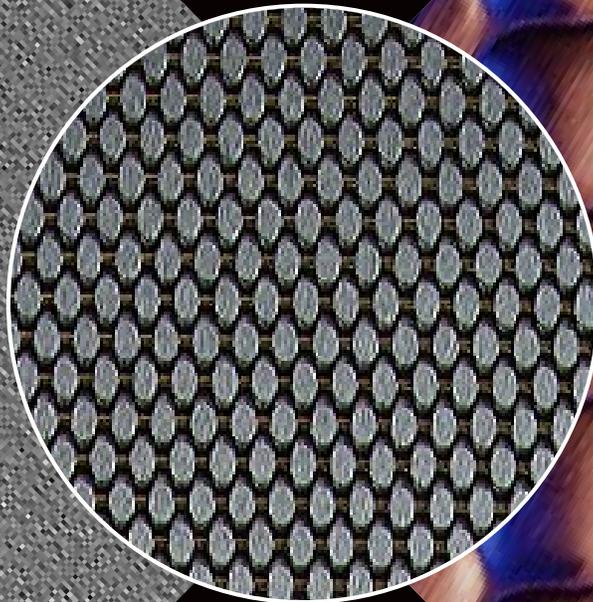
grinding, polishing, buffing, blasting, colorizing and etching can be utilized to create a wide variety of special finishes.

ILLUSTRATED FINISHES (left to right) FLOOR PLATE; POLISHED BACKGROUND WITH A GOLD PAINTED ETCHED PATTERN; ROLLED FINISH SIMULATING ABRASIVE BLASTING; WOVEN STAINLESS STEEL AND COPPER CLOTH; AND AN EMBOSSED PATTERN.

*The Specialty Steel Industry of North America gratefully acknowledges the assistance of Catherine M. Houska, Technical Marketing Resources, Inc., Pittsburgh, Pennsylvania, consultant to the Nickel Development Institute, Toronto, Canada.*

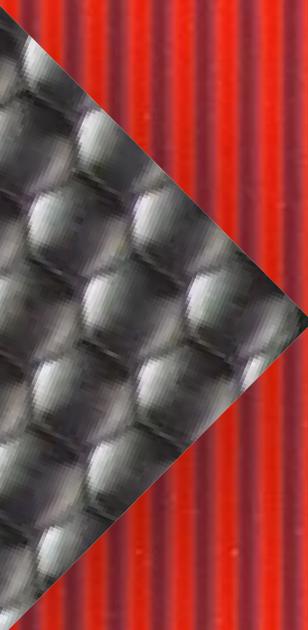
## I N T R O D U C T I O N

Surface finish is an important factor in any specification or purchase order for stainless steel regardless of the intended end use. For those applications where appearance is important, finish is a design element and must be specified. The choice of finish should never be left to the supplier, and the specification should never be a loosely worded description such as *"type 304 with a brushed finish"* or *"embossed finished."* The finish should be properly identified by either the standard industry



designation, by the trade name or designation for proprietary finishes. The Specialty Steel Industry of North America has a designer handbook *Finishes for Stainless Steel* which details the standard industry finishes (Nos. 1, 2D, 2B, 3, 4, 6, 7 and 8 plus Bright Annealed, and Mill-buffed). This handbook is designed to provide a sampling of the "Special Finishes" that can be obtained in today's marketplace.

The finishes in this brochure are not described in the ASTM standards. Information about the standard mill and polished finishes described in the ASTM standards can be found in SSINA's *Designer Handbook: Finishes for Stainless Steel*.



# Rolled

## F I N I S H E S

Rolled finishes are created when a stainless steel coil is passed through a set of rolls. The finish on the rolls is transferred to the surface of the coil. They are directional and, if panels are not installed in the same rolling direction, a checkerboard appearance can result. To prevent this problem, the rolling direction should be marked on the back of the panel. Dirt and debris accumulation is greater when directional finishes are installed with a horizontal grain orientation.

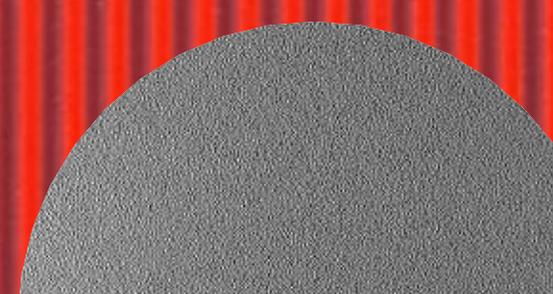
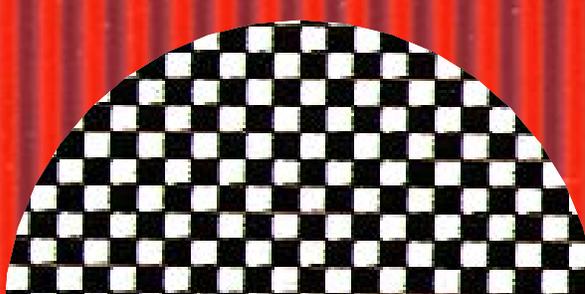
### C O I N I N G

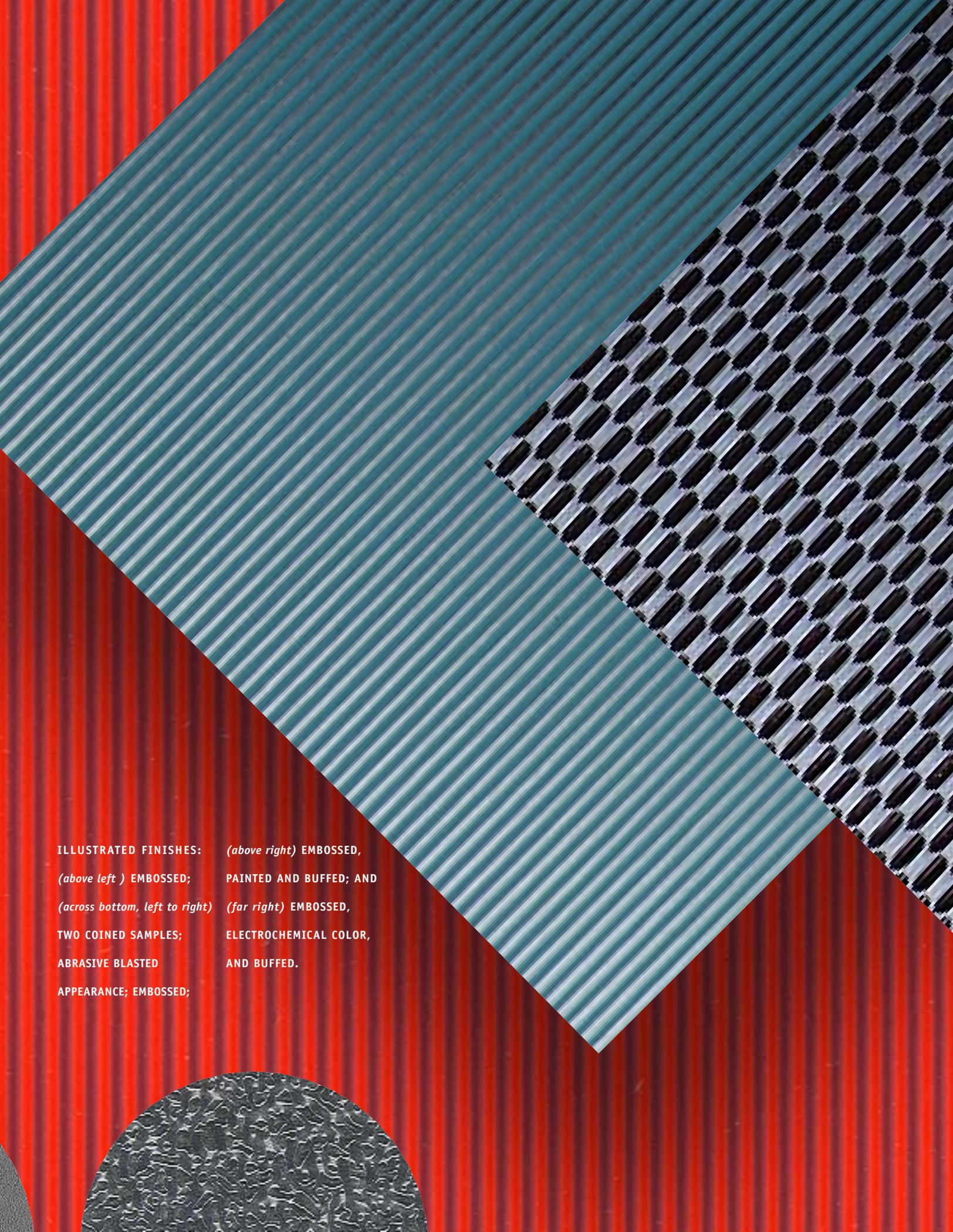
In coining, one roll is smooth and the other is textured. The process creates a light, raised, one-sided pattern and strengthens the stainless steel through work hardening. This increases its impact resistance, reduces the depth of scratches, and often makes it possible to use a thinner gauge. Numerous patterns exist but the most popular mimic fabrics like linen. Coined finishes are used frequently on building exteriors to reduce gauge requirements and provide improved visual flatness. They are also popular in high traffic areas because

they minimize scratches and provide improved impact resistance. Other applications include roofing, furniture, elevator panels, and kitchen refrigerator doors, cabinets, and backsplashes. Coining can be combined with electro-chemical color and paint. When the raised areas are buffed to remove color, the remaining color is protected from scratching and the resulting finish has performed well in high traffic areas.

### E M B O S S I N G

Embossing is similar to coining except that both rolls have raised interlocking patterns. When the stainless steel coil is passed through the rolls, a deeper, two-sided pattern is created. Because more metal is displaced, there is a higher level of work hardening and a greater increase in strength. The pattern depth determines the increase in strength, impact, and scratch resistance. With deep patterns, it is sometimes possible to make more substantial decreases in thickness requirements or sustain higher levels of impact. Like coined patterns, embossed finishes can be combined with color.





ILLUSTRATED FINISHES:    *(above right)* EMBOSSED,  
*(above left )* EMBOSSED;    PAINTED AND BUFFED; AND  
*(across bottom, left to right)* *(far right)* EMBOSSED,  
TWO COINED SAMPLES;    ELECTROCHEMICAL COLOR,  
ABRASIVE BLASTED        AND BUFFED.  
APPEARANCE; EMBOSSED;



## ROLLED FINISHES

*(continued)*

### ABRASIVE BLASTED APPEARANCE

Several companies have developed non-directional rolled finishes that mimic the appearance of abrasive blasting. These finishes generally provide better flatness and uniformity and are more cost effective than abrasive blasting sheet or strip. They are applied in the same manner as coined or embossed finishes and can be either one or two-sided. Because they do not have as much cold work or the raised patterns of the coined and embossed finishes, they do not hide scratches. Their impact resistance is similar to other flat finishes. They have been used for roofing, wall panels and other applications but are generally not used in high traffic areas. Some are susceptible to fingerprinting problems.

### POLISHED APPEARANCE

Several stainless steel producers have developed rolled finishes that mimic the look of a No. 3 or No. 4 polish or a hairline finish. Because these finishes are applied to the coil in the mill, they are less expensive than polished finishes. They can be one or two-sided. Their impact resistance is similar to that of other flat finishes. They will hide minor scratching that is in the same direction as the polish pattern. Blending and repair of minor damage is possible for some of these finishes.

#### ILLUSTRATED FINISHES:

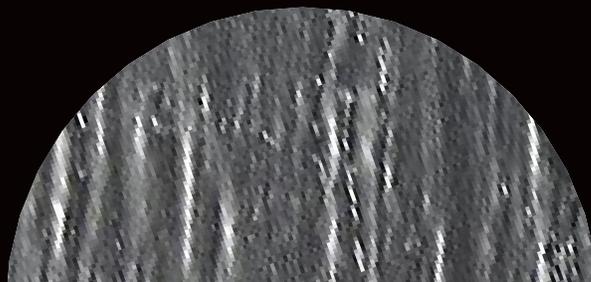
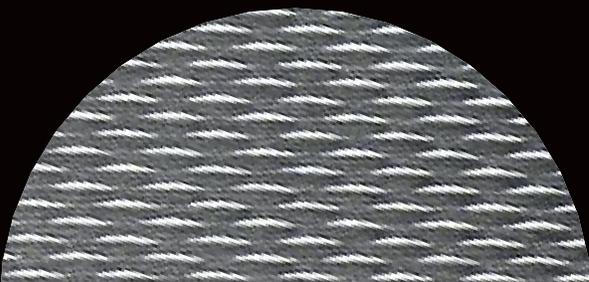
*(above left)* EMBOSSED,

ELECTROCHEMICALLY

COLORLED, BUFFED;

AND *(below)* EMBOSSED

EXAMPLES.



# Colored

## F I N I S H E S

Stainless steel can be colored by electrochemical coloring, sputtering, plating, and resin-based paints. The scratch resistance, appearance, and color stability of these processes varies considerably and should be taken into consideration during selection. Although some of these processes improve corrosion resistance, this should not be considered a substitute for selecting an appropriate grade of stainless steel for the environment.

### ELECTROCHEMICAL COLORING

Electrochemical coloring (also called light interference or INCO coloring) is achieved by immersing pieces in a hot acid solution and applying an electrical current. This thickens the transparent chromium oxide film, which makes stainless steel corrosion resistant and changes the way light is reflected by the surface. A full spectrum of colors is available including gold, bronze, purple, blue, red, black, and green. The color will

not fade and can be applied uniformly or varied for a rainbow effect. There will be slight variations in coloration.

Since the color is transparent, the finish beneath it is visible. Different color and finish combinations create unique effects. Color can be removed selectively by etching, polishing or engraving. Fingerprints are visible but can be removed from smoother finishes. They may become permanent when rough finishes are used.

The color can be damaged by scratching and is not repairable. When the color is applied over a coined or embossed finish and the raised areas are buffed, the remaining color is recessed and protected and has performed well in high traffic areas.

### SPUTTERED COLOR

Sputtering is sometimes referred to as plasma vapor deposition (PVD). The process applies a very thin, colored ceramic coating to the surface. A variety of colors can be obtained including: gold, black, blue, wine red, rose gold, silver gold, and brass. The color is stable, very uniform and significantly more abrasion resistant than electrochemical coloring. Although it has been used for aggressive applications like door hardware, it is important to note that the color can be damaged and is not repairable. The pattern of the underlying finish is visible after color is applied and color can be removed selectively by etching or engraving.

#### ILLUSTRATED COLORS:

ELECTROCHEMICAL BLUE  
AND PURPLE AND  
SPUTTERED GOLD.



## C O L O R E D F I N I S H E S

*(continued)*

### P A I N T

Painting stainless steel is similar to painting other metals except that it is done for aesthetic reasons rather than corrosion protection. The repainting schedule will be dependent on the paint's performance. The surface finish must be clean, dry, and rough enough for adherence. An appropriate primer and paint system should be selected with the assistance of a paint system supplier. The No. 2B or No. 2D mill finishes and rougher polished finishes, such as a No. 4, have been painted successfully.

### T E R N E , T I N A N D T I N / Z I N C C O A T I N G S

Terne metal (80% lead, 20% tin), tin, and a zinc/tin coatings are primarily used for roofing but have also been used for exterior wall panels. They weather to a medium to dark gray tone and can be damaged by scratching or abrasion. The final color is dependent on the service environment. They can be applied to Type 304 or Type 316 and provide some additional corrosion protection. These coatings should not be considered a substitute for using an appropriate stainless steel in more aggressive environments. They can be painted using manufacturer recommended primers and paints.

### P L A T I N G W I T H O T H E R M E T A L S

Stainless steel can be plated with gold, copper alloys, and other metals. Copper plated stainless has had limited use in roofing applications when the strength of stainless and color of copper were desired. Gold plating is soft and easily abraded and is sometimes hard coated, but it should be noted that the hard coating might discolor and deteriorate over time.

### ILLUSTRATED FINISHES:

*(above)* EMBOSSED, RED  
PAINT, BUFFED; *(above,*  
*lower sample)* EMBOSSED,  
BLUE ELECTROCHEMICAL  
COLOR, BUFFED; AND  
*(left)* POLISHED, ETCHED,  
SPUTTERED GOLD COLOR.



# graphic

## F I N I S H E S

### ETCHED

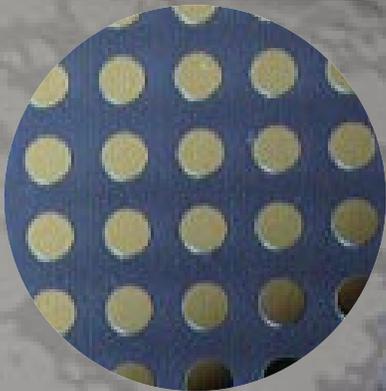
Etched patterns are created by selectively applying a protective acid resistant film to a highly polished surface and acid etching the unprotected areas. The film can be applied by hand painting, silk screening or other methods. Incorrect etching can undercut the protective film and result in rough edges. The etching removes a thin layer of stainless steel, changes the color to a dull silver gray, and roughens the surface. The etched pattern can be left as is or made more reflective. The finish is often electro-polished after completion. Very elaborate patterns can be achieved. Both custom and stock patterns are available.

### SELECTIVE POLISHING

When a polished finish is selectively coated with protective film and the unprotected areas are polished, buffed, or abrasive blasted to create a pattern, the process is called selective polishing. Like etching, the protective film can be handcut rubber, plastisols applied by silk screening or a photoresist technique. The film is removed after processing. Fine detail can be achieved and the difference in reflectivity of the finishes creates the pattern. Some have a three dimensional appearance.

### ENGRAVED

Like other metals, letters or lines can be cut into stainless steel by engraving. This is most commonly used for signage. Engraved patterns can be electrochemically colored or sputtered and engraving can be done after both of these coloring processes.



### THE CIRCLES ARE POLISHED

ILLUSTRATED FINISHES;

(background) POLISHED

AND ETCHED; (above, top

sample) THE BACKGROUND

OF THIS SAMPLE IS

ETCHED WITH A BLACK

ELECTROCHEMICAL COLOR,

WITH A GOLD ELECTRO-

CHEMICAL COLOR; AND

(above, bottom sample)

POLISHED GOLD ELECTRO-

CHEMICALLY COLORED

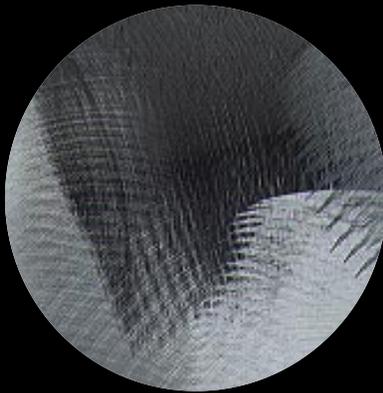
BACKGROUND WITH AN

ETCHED PATTERN.

# mechanical

## F I N I S H E S

A wide variety of very different and remarkable finishes can be achieved by a number of mechanical treatments to the surface of stainless steel. Other interesting textures and patterns can be created with perforation; knitting, weaving or welding cloth; and cutting and expanding the metal.



### ILLUSTRATED FINISHES:

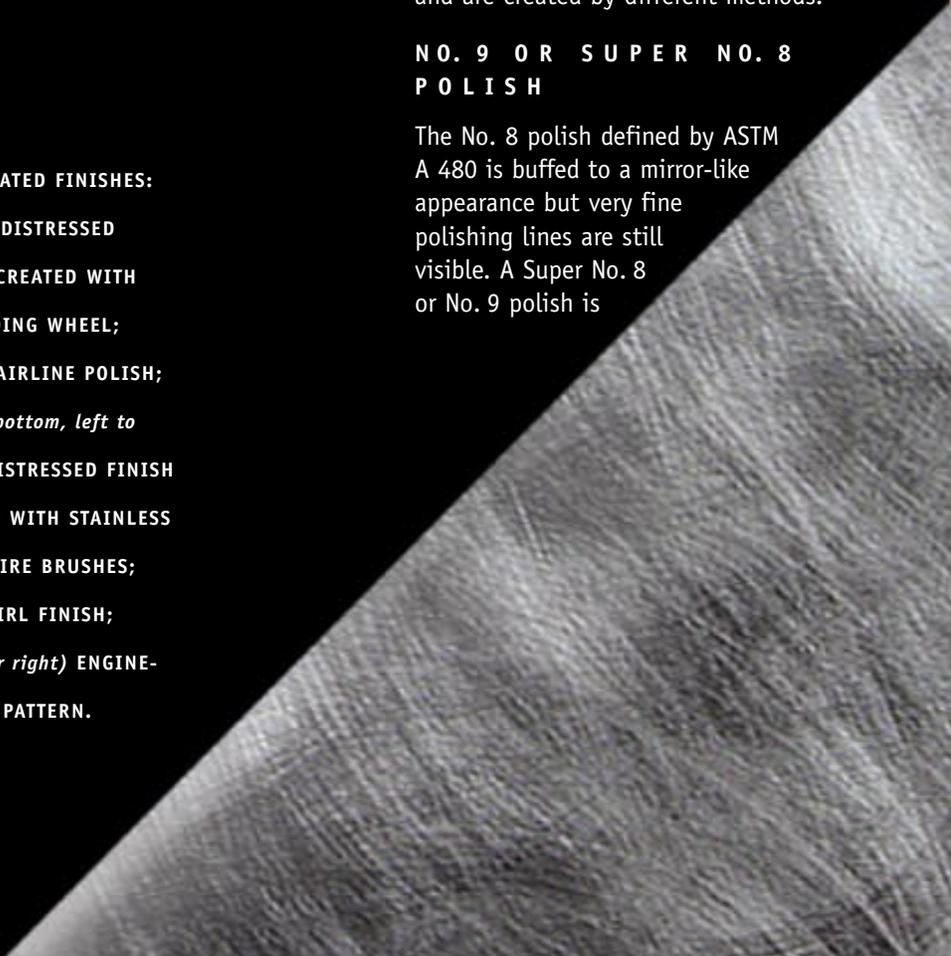
*(above)* DISTRESSED  
FINISH CREATED WITH  
A GRINDING WHEEL;  
*(left)* HAIRLINE POLISH;  
*(across bottom, left to  
right)* DISTRESSED FINISH  
CREATED WITH STAINLESS  
STEEL WIRE BRUSHES;  
AND SWIRL FINISH;  
AND *(far right)* ENGINE-  
TURNED PATTERN.

### HAIRLINE POLISH

Seemingly endless polishing lines applied with Scotch Brite® pads give the hairline, long-grain, or fine-line finish its unique appearance and make it more reflective than a No. 4 polish. Small scratches can be repaired in the field with Scotch Brite pads of equivalent grit or roughness. The Hairline finish is sometimes inaccurately sold as either a No. 5 or No. 6 polish. The No. 6 polish defined by ASTM A 480 and the Hairline finish have no visual similarity and are created by different methods.

### NO. 9 OR SUPER NO. 8 POLISH

The No. 8 polish defined by ASTM A 480 is buffed to a mirror-like appearance but very fine polishing lines are still visible. A Super No. 8 or No. 9 polish is



# nical

buffed to a true mirror polish. Because it is not defined by ASTM and supplier terminology varies, it is important to determine that the supplier is providing a highly polished mirror finish. Applications range from decorative panels to bathroom mirrors.

## ANGEL HAIR

A very fine, non-directional scratch pattern created with a stainless steel wire wheel is referred to as Angel Hair. The scratches can be long or short and the finish can be applied by hand or with CNC-operated equipment programmed

to move the brush in a multi-directional pattern. Angel Hair was designed to hide light random scratching in high-traffic areas. Because there can be considerable variations in scratch length and other aspects of appearance, control samples are important.

## DISTRESSED FINISHES

Distressed finishes have coarser scratches than Angel Hair finishes and are applied using a small grinding wheel or coarse stainless steel wire brushes. They can be applied by hand or with CNC-operated equipment programmed to move the wheels or brushes to give the appearance of random scratching. This pattern hides heavier random scratching in high traffic areas. Because there can be considerable differences in scratch length and other aspects of appearance, control samples are important.

## SWIRL PATTERNS

Like the Angel Hair and Distressed finishes, grinding wheels or stainless steel wire brushes are used to create Swirl Patterns. The swirls can range in size and be either smooth or choppy. The grinding wheel grit or wire brush coarseness can be varied to create different effects. The finish can be applied by hand or CNC-operated equipment can be used to move grinding wheels or wire brushes in preset patterns. Swirl patterns can be applied to flat or curved pieces and small or large areas. Because a wide range of patterns can be created, it is important to have control samples to maintain consistency. Swirl patterns hide accidental scratching and are very decorative.

## ENGINE-TURNED PATTERNS

Engine-Turned patterns are created with CNC-controlled equipment, which grind circles into a flat surface that has been highly polished or bright annealed to a mirror-like appearance. The circles can range in size, overlap, and form decorative patterns. When the ground circles cover the entire surface, they are effective in hiding light random scratching.



**ILLUSTRATED FINISHES:**  
*(above)* THE REFLECTION  
OF SEVERAL OBJECTS ON  
A SUPER NO. 8 FINISH;  
AND *(below)* AN ANGEL  
HAIR FINISH.

## **M E C H A N I C A L   F I N I S H E S**

*(continued)*

### **A B R A S I V E   B L A S T E D**

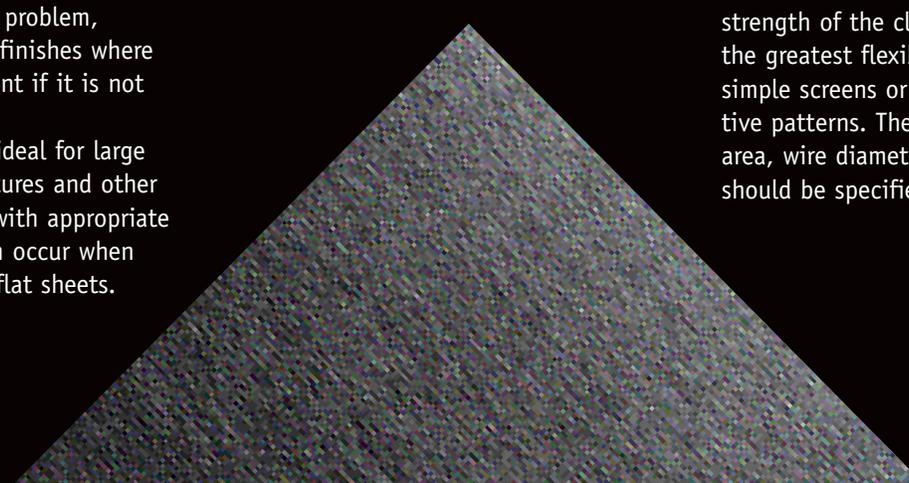
Stainless steel can be abrasive blasted with a variety of media to create a non-directional, repairable finish. As shown in Table 3, the choice of media will determine the appearance. It is important to clean the surface before and after blasting and to use clean media to avoid surface contamination. Fingerprinting can be a problem, particularly on rougher finishes where it may become permanent if it is not removed promptly.

Abrasive blasting is ideal for large structural pieces, sculptures and other heavier sections. Even with appropriate fixturing, distortion can occur when abrasive blasting thin, flat sheets.

Experienced suppliers blast both sides and either laminate pieces to a rigid backer or use fixturing to reduce distortion. If thin sheet or strip is required, it may be more cost effective to consider one of the rolled finishes that simulates abrasive blasting.

### **W O V E N ,   W E L D E D   A N D K N I T T E D   S T A I N L E S S S T E E L   C L O T H**

Cloth is produced by weaving, knitting, or welding stainless steel wire. It is used for security screens, baskets, fencing, shelving, partitions, and decorative applications. The wire thickness determines the weight, flexibility, and strength of the cloth. Weaving provides the greatest flexibility and can produce simple screens or more complex decorative patterns. The percentage of open area, wire diameter, and opening size should be specified.



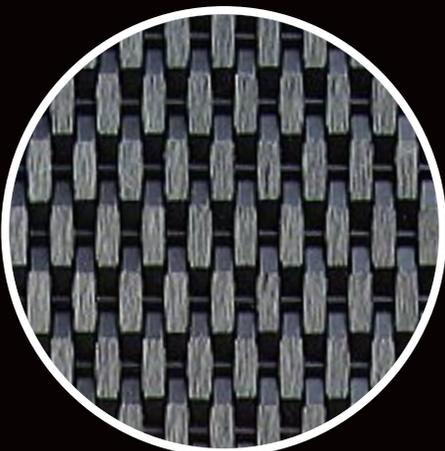
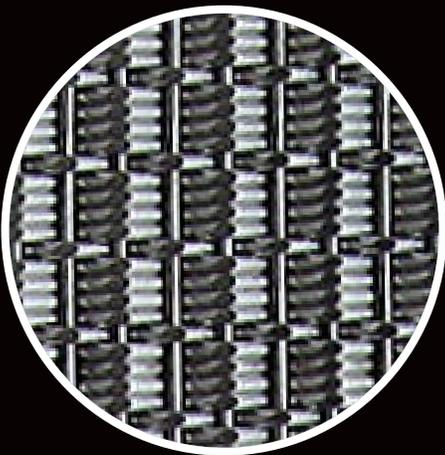
## GUIDELINES FOR FINISH SELECTION

### EXPANDED METAL

To produce this product, slits are cut in the stainless steel at set intervals. When the edges are pulled outward, a diamond pattern is created. The diamond size and metal thickness should be specified. Cold rolling can provide a flat surface but, because this is optional, it must be specified. Expanded metal is used for floor gratings and mesh products.

### PERFORATION

Drilling, laser or water jet cutting, and punching can perforate stainless steel. Laser and water jet cutting can create elaborate, custom patterns. Punching is commonly used for acoustical panels, gratings, decorative panels, screens, and grilles. Both standard and custom perforation patterns are available.



1 The appearance of stainless steel surface finishes is not defined by standards, so a finish sample should be used as a visual standard. The appearance of some finishes can vary from lot to lot or piece to piece. On large projects, multiple samples should be considered to show allowable variation.

2 Finishes with the same or similar names from different suppliers may not have the same appearance. Whenever possible, specify one finish supplier. If this is not possible, a visual standard can help achieve uniformity.

3 If multiple fabricators are purchasing material, the finish supplier should be told that it is for the same project to ensure uniformity.

4 Reserve finishes that are more likely to show scratches or fingerprints for out of reach or low traffic areas.

5 It is important to select an appropriate stainless steel for the service environment. (See Table 2) Additional information on stainless steel selection is available from the Nickel Development Institute (416-591-7999) or the Specialty Steel Industry of North America (800-982-0355).

#### ILLUSTRATED FINISHES:

(above) DECORATIVE  
WOVEN PATTERN; AND  
(left) WOVEN STAINLESS  
STEEL, PAINTED BLACK,  
AND BUFFED.

6 Rougher finishes collect more dirt and debris and more frequent cleaning may be needed to retain an attractive appearance. Corrosive debris accumulation on rough surfaces can increase the potential for pitting corrosion.

7 In more corrosive environments or where cleaning will be infrequent, smoother finishes and designs that maximize rain cleaning should be considered.

8 Plan for regular cleaning and provide cleaning guidelines from the finish supplier.

9 If a finish has an obvious directional grain, design or profile and it is oriented horizontally, it will collect more dirt.

10 Ask the supplier whether a finish is suitable for a particular application prior to specification.

11 Rolled and polished finishes are directional and can differ slightly in appearance from one end of the coil to the other. All panels should be installed in the same direction and panels from the same section of the coil should be grouped during installation to avoid a checkerboard effect.

12 If done correctly with an appropriate metal thickness, stud welding should not affect finish appearance.

13 Welding or soldering destroys the finish. Repairable finishes can often be blended to hide welded areas but this should be discussed with the finish supplier prior to specification.

**TABLE 1 APPLICATION PERFORMANCE COMPARISONS AND SELECTION CRITERIA (MORE ▲'S INDICATE IMPROVED PERFORMANCE)**

	APPLICATIONS				SELECTION CRITERIA		
	WALL PANELS AND TRIM	ROOFING	SIGNAGE, ART, DECORATIVE PANELS	HIGH TRAFFIC AREAS	REPAIRABLE	FEWER VISIBLE SCRATCHES AND FINGERPRINTS	IMPROVED IMPACT RESISTANCE
<b>STANDARD MILL FINISHES</b>							
No. 2D	▲	▲					
No. 2B							
Bright Annealed	▲		▲		▲(3)		
<b>ROLLED FINISHES</b>							
Abrasive Blasted Appearance	▲	▲	▲				
Polished Appearance	▲		▲		▲(4)	▲(1)	
Coining	▲▲	▲	▲ ▲▲		▲▲	▲▲	
Embossing	▲▲▲	▲	▲ ▲▲▲		▲▲▲	▲▲▲	
<b>MECHANICAL FINISHES</b>							
ASTM Defined Polished Finishes	▲		▲		▲(3)	▲(1)	
Super No. 8 or No. 9 Polish	▲		▲		▲(3)		
Hairline	▲		▲	▲	▲	▲ (1)	
Angel Hair	▲		▲	▲	▲	▲	
Distressed	▲▲		▲	▲▲ ▲	▲▲		
Swirl	▲▲		▲	▲▲ ▲	▲▲		
Engine-Turned	▲▲		▲	▲	▲	(2)	
Abrasive Blasted	▲	▲	▲	▲			
Cloth			▲	▲▲▲	▲▲▲	▲▲	(5)
Expanded Metal				▲▲▲	▲▲▲	▲▲▲	
Perforation			▲	▲	▲		
<b>COLORED FINISHES</b>							
Electrochemical	▲	▲	▲				
Embossed, Electrochemically Colored and Buffed (highlighted)	▲▲▲	▲	▲ ▲▲▲		▲▲▲	▲▲▲	
Sputtered	▲▲	▲	▲ ▲		▲		
Terne-Coating	▲	▲					
Other Metal Plating	▲	▲	▲				
Paint	▲	▲	▲	▲	▲		
<b>GRAPHIC FINISHES</b>							
Etched	▲		▲				
Selectively Polished	▲		▲				
Engraved	▲		▲				

- (1) Reduces the visibility of light scratching if it is in the same direction as obvious grain or polishing lines. Perpendicular scratches are more visible.
- (2) The finish must be applied over the entire surface to reduce fine scratch visibility.
- (3) Minor scratches are sometimes repairable on small surface areas.
- (4) May be repairable.
- (5) Dependent on cloth weight

SPECIALTY STEEL INDUSTRY OF NORTH AMERICA'S *Designer Handbook: Finishes for Stainless Steel* contains information about mill and polished finishes.

**TABLE 2 SUGGESTED STAINLESS STEELS FOR COMMON EXTERIOR ENVIRONMENTS**

LOCATION	RURAL/SUBURB			URBAN			INDUSTRIAL			MARINE		
	L	M	H	L	M	H	L	M	H	L	M	H
Grade (Type)												
Higher Alloy Stainless Grades	■	■	■	■	■	■	■	■	*	■	■	*
316 or 316L	■	■	■	■	*	*	*	*	*	●	*	*
304 or 304L	*	*	*	*	*	●	●	●	▼	*	●	▼
430	*	●	●	▼	▼	▼	▼	▼	▼	▼	▼	▼

- L Least corrosive conditions (i.e. low humidity, low temperatures)
- M Fairly typical of the category
- H More aggressive corrosion likely (i.e. persistent high humidity, high ambient temperatures, aggressive air pollutants)
- Generally provides good performance but may not be cost-effective due to higher cost
- \* Probably the best performance and cost choice
- May be suitable if precautions are taken (i.e. a relatively smooth surface is specified and it is washed regularly)
- ▼ Likely to suffer excessive corrosion

**TABLE 3 FINISH APPEARANCE WITH VARIOUS ABRASIVE MEDIA**

ABRASIVE MEDIA	FINISH
Fine Sand or Silicon Carbide	Dark coarse finish
Glass Beads	Light smooth grainy finish
Stainless Steel Shot	Small curved indentations
Ground Quartz	Shiny coarse angular indentations

**TABLE 4 PROCESSING STEPS TO ACHIEVE VARIOUS SPECIAL FINISHES**

