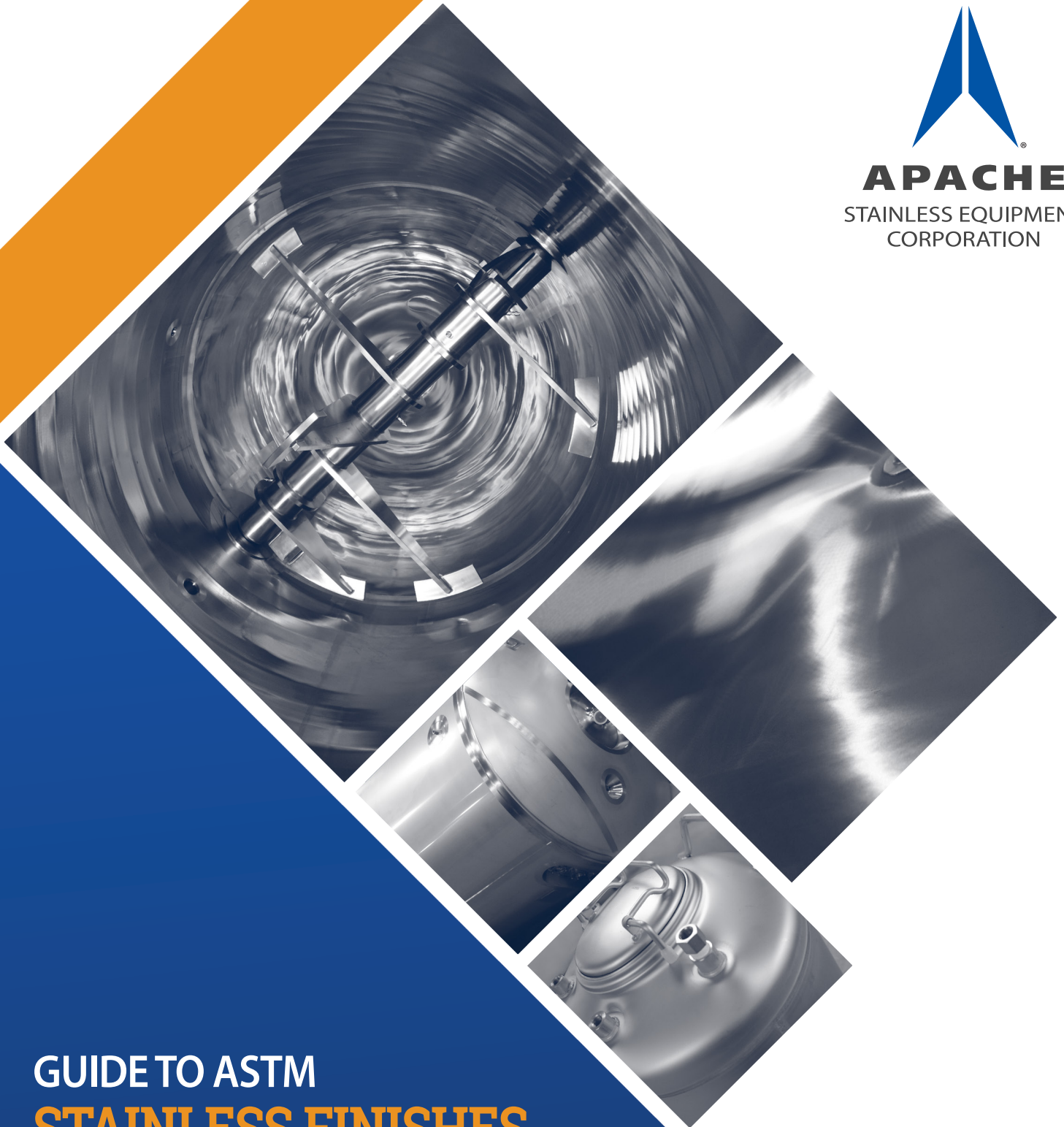




**APACHE**

STAINLESS EQUIPMENT  
CORPORATION



GUIDE TO ASTM  
**STAINLESS FINISHES**  
on Sanitary Equipment



The fundamental process of working with stainless steel having sanitary requirements includes selecting the right material for the application and careful handling to prevent contamination from the manufacturing environment, including using protective surfaces throughout all processes.

In sanitary applications, stainless steel equipment requires a sanitary finish. The term “sanitary finish” in general refers to a smooth, scratch-free, non-corrosive finish. There are several mechanical and chemical finishes that can fulfill compliance requirements for sanitary specifications. In choosing the type of finish, it is important to understand the definitions and criteria for how finishes are designated.

## DESIGNATIONS

**Surface Texture** The surface of the material, including irregularities and deviations, including roughness and grain, defines the surface texture.

**Grit** is defined as the size of the abrasive used in the polishing process. Typically coarse, lower grit numbers are associated with grinding; and higher grit numbers are associated with polishing. Grit size however does not fully define the surface.

**RA (Roughness Average)** A standard for an average of the peaks and valleys of the metal’s surface, measured in microinches or micrometers.

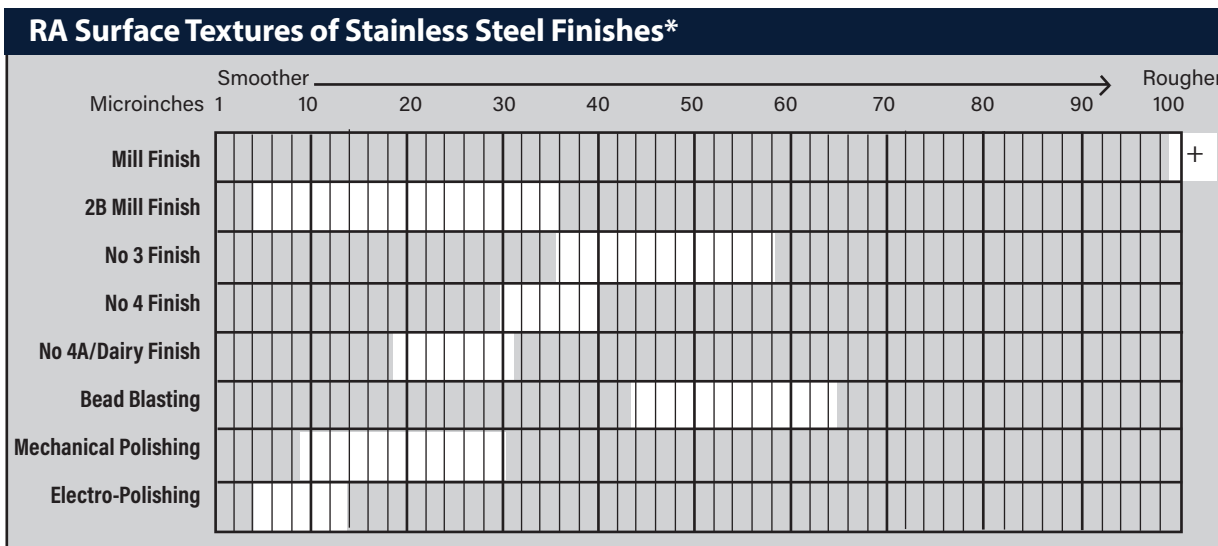
**RMS (Root Mean Square)** is a machining standard used to diagnose machine operations and surface finish.

The fineness of the finish and ultimate success of the sanitation effectiveness is measured in RA, (roughness average), measured by height in millionths of an inch or microinches. A profilometer determines RA values of small surface variations and calculates their average to determine roughness.

Mechanical, chemical and applied processes are used to achieve different finishes. Mechanical polishing involves the removal of material using a grinding process. Typically, grit sizes of 120 and finer classify as mechanical polishing.

Chemical treatments remove the outer layer of corrosion in the material to preserve the integrity of the metal.

The chart below shows the RA range of surface textures used in sanitary equipment.



\*This chart compares RA surface designations in a range of finishes. More precise RA values are dependent on the gauge of material. Refer to page seven (7) for more specific finish designations by gauge.



# STAINLESS STEEL FINISHES

**Mill Finish** A Mill Finish has an unpolished, dull-gray, matte appearance. This finish forms the basis for supply condition for all stainless steel flat products and also forms the basis for additional finishing operations. It is hot or cold rolled with an RA of more than 100 microinches, depending on the gauge of the material. (Gauge refers to cold rolled; plate is hot rolled material.)

**2B Mill Finish** This is a widely used stainless steel finish, common in industrial, chemical and food applications. It is corrosion-resistant and has a typical RA range of 40 (7 gauge) to 15 (16 gauge) microinches.

**No. 3 Finish** The No. 3 Finish uses a 120 grit abrasive. It has a semi-polished finish with an RA range of 36 - 58 microinches.

**No. 4 Finish** This finish uses a 150 grit abrasive, and shows a polished brushed surface. The RA range is 29 - 40 microinches.

**No. 4/ Dairy** For processing industries, the Number 4/ Dairy is required to meet the basic 3-A standards. It uses a 180 grit and has an RA range of 18 - 31 microinches.

**Bead Blasted Finish** The process of bead blasting utilizes bead material such as glass or ceramic beads to produce a non-directional, textured surface with a soft satin appearance and low-reflectivity. The finer the blasting media, the more corrosion resistant the surface performance. The RA values are typically higher than 45, but are dependent on the blasting process and the stainless material.

*A profilometer (RA meter) is used to measure the roughness average of peaks and valleys in stainless material.*



*Showing a matte appearance, this small vessel has been descaled with pickle passivation.*



*Robotic polishers use an abrasive material (measured by grit coarseness) to create the finish.*

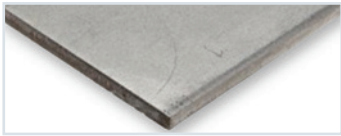
*Inside of small mixing vessel showing final electro-polished surface after mechanical and chemical finishing processes.*



*Stainless material with a mill finish has a rough, dull and non-uniform appearance.*



## Mill Finish



### Description

(Mill Finish - Plate)  
The baseline for comparison, this is unfinished steel in basic supply condition.

### Applications

Structural

### Sanitation Environment

None - not used in food contact areas

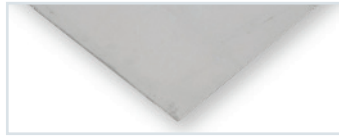
### RA

>100 microinches  
Depending on material

### Caution

Does not meet sanitary, food contact or processing finishing requirements

## 2B Finish



### Description

(2B Finish -Gauge)  
Common corrosion resistant, heat resistant, smooth, (not brushed) steel

### Applications

Material handling, processing, direct food contact

### Sanitation Environment

Suitable for caustic sanitary wash down procedures

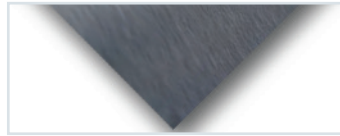
### RA

36 (7 gauge) to 15 (16 gauge) in microinches

### Caution

Note that 2B finishes can have the same RA as higher end finishes depending on gauge, compare economies when making material decisions unless otherwise required by compliance factions

## No. 4 Finish



### Description

Characterized by short, polished brushed lines

### Applications

Used for food processing and ancillary equipment in clean rooms

### Sanitation Environment

Suitable for caustic sanitary wash down procedures

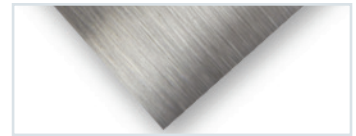
### RA

29 to 40 microinches

### Caution

Note that a No. 4 finish is not compliant for 3A standards; a No. 4/Dairy finish will satisfy RA requirements for the Dairy/Cheese manufacturing industry

## No. 4/Dairy Finish



### Description

Also characterized by short, polished brushed lines, the No.4/Dairy finish uses a finer grit polish

### Applications

Used in clean rooms, processing equipment, used in Pharmaceutical industries and complies to 3A Dairy standards

### Sanitation Environment

Suitable for caustic sanitary wash down procedures

### RA

18 - 31 microinches (3A standards require 32 or less)

### Caution

Welds are also required to be ground to a No. 4/Dairy Finish to meet 3A Dairy standards

## Bead Blast



### Description

The high pressure application of fine glass or ceramic beads (uniform, non-directional, low-reflective surface)

### Applications

Used when a uniform finish is desired in structural, material handling or food handling applications

### Sanitation Environment

Bead blasting on common 304 and 316 stainless material is suitable for caustic wash down procedures

### RA

>45  
depending on  
blasting process

### Caution

Bead blasting is not necessarily a smooth finish, the RA and smoothness depends on the stainless material used, the fineness of the blasting media and the blasting process.

## Passivation



### Description

A chemical (typically nitric or citrus acid) treatment that produces a formation of a protective passive film on stainless steel

### Applications

Most stainless steel material is passivated, polished or treated in some way to prevent corrosion; passivation may also be a federal specification

### Sanitation Environment

Passivated stainless material can withstand caustic wash down procedures

### RA

RA values have  
no significant improvement  
after passivation\*

### Caution

Chemical passivation is a protective treatment, not a descaling process.

### ASTM Specification No.

A-967

## Pickle Passivation



### Description

Also referred to as descaling, pickle passivation removes the scale and leaves a clean, matte finish, free from contamination

### Applications

Used in Pharmaceutical industries as a federal specification and in food processing applications to reduce food safety risk

### Sanitation Environment

Suitable for caustic, aggressive sanitary wash down environments

### RA

Depending on material, pickle passivation can result in up to 25% increased smoothness measured in RA\*

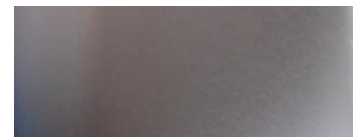
### Caution

Partner with expert finishing specialists who perform the recommended procedures for best results.

### ASTM Specification No.

A-380

## Electro-Polishing



### Description

Surface metal is dissolved, removing all embedded contaminants, creating a smooth, mirror finish

### Applications

Used in pharmaceutical industries as a federal specification and in food processing industries to prevent bacterial attachment and reduce food safety risk

### Sanitation Environment

Highest grade of passive surface available, can be subjected to long term caustic wash down

### RA

Depending on material, electropolishing can result in up to 50% increased smoothness measured in RA\*

### Caution

Partner with expert finishing specialists who perform the recommended procedures for best results.

### ASTM Specification No.

B-912

\*Apache In-house finishing before/after tests; results vary depending on stainless material.



# CHEMICAL FINISHES



## CHEMICAL FINISHES & ASTM SPEC

ASTM (American Society for Materials and Testing) was developed to set standards for chemical, mechanical, physical and electrical properties of material, as well as testing standards for materials. ASME (American Society of Mechanical Engineers) includes ASTM standards, AWS (American Welding Society) standards and other nationally and internationally recognized standards as part of a widely adapted design specification for many structures, including pressure vessels.

**Passivation** Passivation is the removal of excess iron or iron compounds from the surface of stainless steel by means of a chemical, typically an acid based solution. Unlike pickle passivation, no metal is removed from the surface during the process. The process has little effect on the RA values of the stainless material being passivated.

The ASTM A967 is a passivation standard that applies to the cleaning, passivation and testing of stainless parts.

**Pickle Passivation** is the immersion of the metal in a pickling bath or coating the material with pickling solution such as nitric-hydrofluoric acid. The process removes both metallic contamination and heat-treating scales. Pickle passivated stainless steel has a matte appearance. Apache's tests have confirmed improvements up to 25% in RA readings on material that has been pickle passivated.

The ASTM A380 is a passivation standard that covers cleaning, descaling, and passivating stainless material and parts. Spec A380 may include a variety of treatments, including precleaning, chemical descaling, degreasing and more.

**Electropolishing** Electropolishing is an electro-chemical process that removes surface material from stainless-steel. The process includes an immersion of the stainless steel component into a temperature-controlled bath of electrolytes that are charged with a DC power supply. Electrolytes used in electropolishing are concentrated sulfuric and phosphoric acid solutions. The finish has a mirror appearance. Apache's before and after tests have shown improvements in RA smoothness up to 50%; results vary depending on stainless material.

The ASTM B912 specification outlines the electropolishing process for 200, 300 and 400 series alloys. Spec B912 may include preparatory cleaning procedures, post coating procedures and rinsing protocols. Final testing is also stated in the specification to evaluate performance of finish.

### FINISH DESIGNATION by Type, Gauge and Grit

1-9 RA (1-10 RMS)	#8
4-13 RA ( 5-15 RMS) 2B	(16 Ga. Sheet)
9-18 RA (10 - 20 RMS)	2B (14 Ga. Sheet)
13 -22 RA (15-25 RMS)	2B (12 Ga. Sheet)
18-27 RA (20-30 RMS)	2B (11 Ga. Sheet)
18-31 RA (25-35 RMS)	2B (10 Ga. Sheet)
22-36 RA (25-40 RMS)	2B (7 Ga. Sheet)
10-16 RA (11-18 RMS)	#7 (320 Grit)
13-27 RA (15-30 RMS)	#6 (240 Grit)
18-31 RA (20-35 RMS)	#4 Dairy (180 Grit)
29-40 RA (32-45 RMS)	#4 (150 Grit)
36-58 RA (40-65 RMS)	#3 (120 Grit)
49-76 RA (55-85 RMS)	2D (80 Grit)

Note: The thinner the gauge material, the more rolling processes and cold reduction the material is subjected to, which creates a smoother surface.

### STAINLESS STEEL GAUGE

Gauge	Decimal Size
28	.015
26	.018
24	.024
22	.030
20	.036
18	.048
16	.060
14	.075
13	.090
12	.105
11	.120
10	.135
8	.165
7	.1874



## About Apache Stainless

The Apache Stainless Equipment Corporation employs skilled technicians in the fabrication of stainless equipment for a range of industries. Apache's tanks and vessels and Mepaco's food processing equipment showcase our expertise in high-end stainless finishes used in the beverage, biotechnology, pharmaceutical, and food processing industries.

Passivation, pickle passivation and electropolishing processes are offered in-house; there is no dependency on outsourcing. Apache provides finishing services on tanks, vessels and food processing equipment as well as contract finishing requests.

Apache consists of four product families: Large ASME tanks, Small/Portable vessels, Contract Manufacturing and Mepaco®. With modifiable options, Mepaco®'s product line includes: thermal processing equipment, mixers, blenders, augers, dumpers, sanitary conveyors and material handling systems.

As a 100% employee owned company, Apache's culture exemplifies continuous improvement, efficiency, innovation and commitment to our customer.

### References:

The Fabricator, A publication of the Fabricators & Manufacturers Association, Intl.

ISSF, International Stainless Steel Forum

ASTM, International Standards Worldwide

3-A, Basics of Sanitary Design

Apache and Mepaco® industry experts and reference documents

Marketing/Resources/Stainless Finishes

