

# Mepaco®

RELIABLE BY DESIGN



FOOD  
SAFETY

## COMPARING STAINLESS FINISHES

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on Food Contact Surfaces and  
Processing Equipment

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## Stainless Steel Textures & Finishes used in Food Processing Equipment

In food processing applications, stainless steel equipment requires construction that meets sanitary design standards. The following best manufacturing practices relate to food contact surfaces and stainless material summarized from many food processing equipment design standards:

- Food contact surfaces must be made with materials that are resistant to corrosion.
- Stainless steel 304 or 316 grade or equivalent should be used.
- Food contact surfaces must not be plated, painted, or coated in the product zone.
- Materials must be compatible with cleaning methods and chemicals.

Stainless material selection and mechanical, applied, and chemical finishing processes, affect how the equipment performs in sanitation procedures. In fabricating food processing equipment, manufacturers use the following criteria for stainless material in the equipment fabrication process.

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

**Grit** is 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 micro-inches or micrometers.

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



### MILL FINISH

**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.



### MECHANICAL FINISHES

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

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



### APPLIED FINISH

**Bead Blasted Finish** The bead blasting process 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 depend on the blasting process and the stainless material.



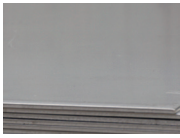
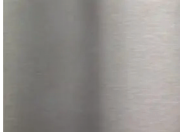
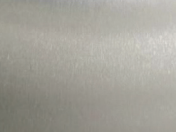



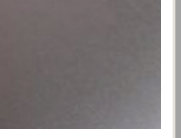
### CHEMICAL FINISHES

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

**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. Depending on the material, Apache's tests have seen up to 25% improvement in RA values.

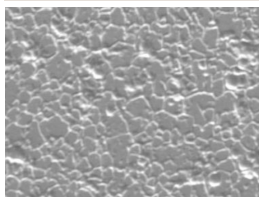
**Electropolishing** is an electro-chemical process that removes surface material from stainless steel. The process includes immersion of the stainless-steel component into a temperature-controlled bath of electrolytes that are charged with a DC power supply. Electrolytes used in electropolishing are 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.

# Comparing Stainless Food Contact Finishes

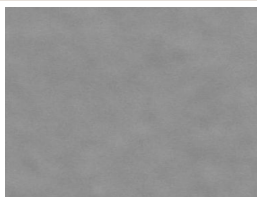
2B	No. 4	No. 4/Dairy	Bead Blast	Passivation	Pickle Passivation	Electropolishing
						
<p><b>Description</b></p> <p>(2B Finish -Gauge) Common corrosion resistant, heat resistant, smooth, (not brushed) steel</p>	<p><b>Description</b></p> <p>Characterized by short, polished brushed lines</p>	<p><b>Description</b></p> <p>Also characterized by short, polished brushed lines, the No.4/Dairy finish uses a finer grit polish</p>	<p><b>Description</b></p> <p>The high pressure delivery of fine glass or ceramic beads (uniform, non-directional, low-reflective surface)</p>	<p><b>Description</b></p> <p>A chemical (typically nitric or citric acid) treatment that produces a formation of a protective passive film on stainless steel</p>	<p><b>Description</b></p> <p>Also referred to as descaling, pickle passivation removes the scale and leaves a clean, matte finish, free from contamination</p>	<p><b>Description</b></p> <p>Surface metal is dissolved, removing all embedded contaminants, creating a smooth, mirror finish</p>
<p><b>Applications</b></p> <p>Material handling, processing, direct food contact</p>	<p><b>Applications</b></p> <p>Used for food processing and ancillary equipment in clean rooms</p>	<p><b>Applications</b></p> <p>Used in clean rooms, processing equipment, Pharmaceutical equipment and complies to 3A Dairy standards</p>	<p><b>Applications</b></p> <p>Used when a uniform finish is desired in structural, material handling or food handling applications</p>	<p><b>Applications</b></p> <p>Most stainless steel material is passivated, polished or treated in some way to prevent corrosion</p>	<p><b>Applications</b></p> <p>Used in pharmaceutical industries and in food processing industries to reduce food safety risk</p>	<p><b>Applications</b></p> <p>Used in pharmaceutical industries and in food processing industries to prevent bacterial attachment and reduce food safety risk</p>
<p><b>Sanitation</b></p> <p>Suitable for caustic sanitary wash down procedures</p>	<p><b>Sanitation</b></p> <p>Suitable for caustic sanitary wash down procedures</p>	<p><b>Sanitation</b></p> <p>Suitable for caustic sanitary wash down procedures</p>	<p><b>Sanitation</b></p> <p>Bead blasting on common 304 and 316 stainless material is suitable for caustic wash down procedures</p>	<p><b>Sanitation</b></p> <p>Passivated stainless material can withstand caustic wash down procedures</p>	<p><b>Sanitation</b></p> <p>Suitable for caustic, aggressive sanitary wash down environments</p>	<p><b>Sanitation</b></p> <p>Highest grade of passive surface available, can be subjected to long term caustic wash down</p>
<p><b>RA</b></p> <p>36 (7 gauge) to 15 (16 gauge)</p>	<p><b>RA</b></p> <p>29 to 40 microinches</p>	<p><b>RA</b></p> <p>18 - 31 microinches (3A standards require 32 or less)</p>	<p><b>RA</b></p> <p>&gt;45 depending on blasting process</p>	<p><b>RA</b></p> <p>RA values have no significant improvement after passivation</p>	<p><b>RA</b></p> <p>Depending on material, pickle passivation can result in up to 25% increased smoothness measured in RA</p>	<p><b>RA</b></p> <p>Depending on material, electropolishing can result in up to 50% increased smoothness measured in RA</p>
<p><b>Caution</b></p> <p>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</p>	<p><b>Caution</b></p> <p>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</p>	<p><b>Caution</b></p> <p>Welds are also required to be ground to a No. 4/ Dairy finish to meet 3A Dairy standards</p>	<p><b>Caution</b></p> <p>Bead blasting is not necessarily a smooth finish, the RA and smoothness depends on the stainless material used, and the blasting media / process.</p>	<p><b>Caution</b></p> <p>Chemical passivation is a protective treatment, not a descaling process.</p>	<p><b>Caution</b></p> <p>Partner with expert finishing specialists who perform the recommended procedures for best results.</p>	<p><b>Caution</b></p> <p>Partner with expert finishing specialists who perform the recommended procedures for best results.</p>

Here is a study, conducted at Apache and Mepaco®, that compares food contact finishes under 200X magnification. It shows the RA smoothness in four finish examples of 304 Stainless Steel. In the study, the electropolished finish is more than six times smoother in RA readings than the Bead Blasted finish.

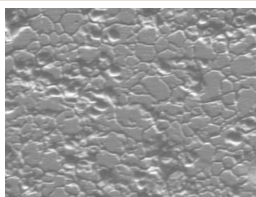
## SURFACE SMOOTHNESS TEST UNDER 200X MAGNIFICATION



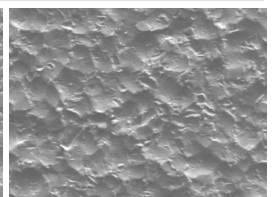
304 Stainless Steel 2B Finish 15 - 17 RA (12 gauge)



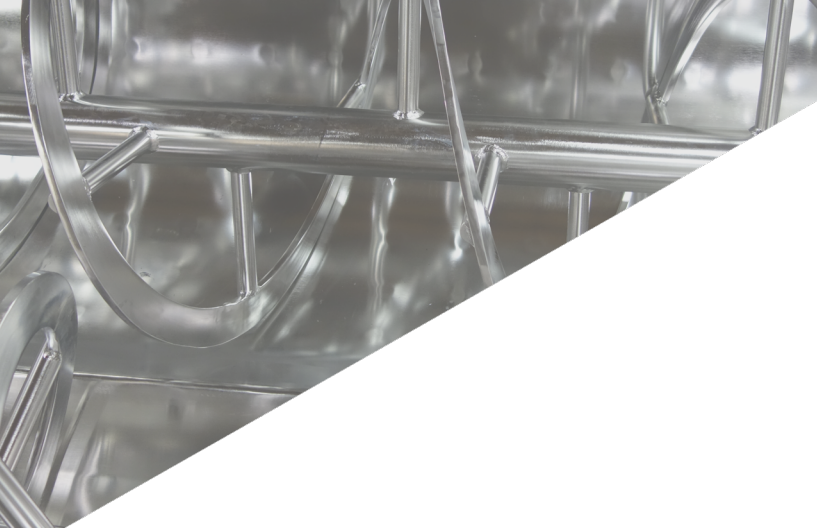
304 Stainless Steel Electropolished Finish 5 - 6 RA



304 Stainless Steel 2B Finish 20 - 30 RA (10 gauge)



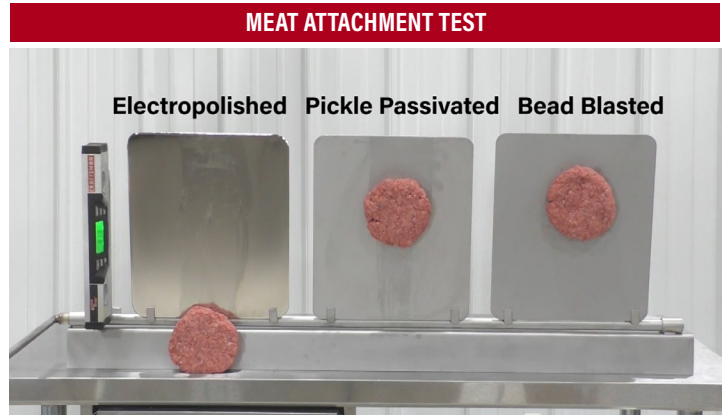
304 Stainless Steel Bead Blast Finish 35 - 45 RA



## On Food Contact Surfaces, Why Does RA (Roughness Average) Matter?



When weighing the advantages of food contact equipment finishes, the U.S. Dept. of Agriculture and Research Service offers a study conducted by the American Society of Mechanical Engineers on electropolishing and surface finishes. In the research, samples of stainless-steel finishes were exposed to bacteria to allow growth. As microorganisms became attached to surfaces, they became more resistant to both physical and chemical sanitation practices. It was determined that the electropolished finish was the most resistant surface to bacterial attachment out of 11 different finishes tested.



In an in-house test conducted by Mepaco®, a tilting device engaged three samples of stainless material. On the left was an electropolished material sample measuring an average of 12 RA. In the center, 2B stainless material was used measuring an average of 25 RA. On the right, a bead-blasted panel was used, measuring an average of 40 RA. A 70% lean beef patty with an internal temperature of 44 degrees was placed on each of three material samples. In our test, the beef patty detached from the electropolished finish material at a 70-degree tilt, and the patty on the pickle passivated and bead blasted material required a full 90-degree tilt and an additional 12 to 15 seconds before it detached from the material.

Mepaco® engineers and manufactures equipment specifically for the application goals of the system. Mechanical and chemical finishing has been a competency of Apache and Mepaco® for decades. Our company has expanded our in-house chemical finishing operations to meet the needs of processors who require the highest level of food contact surfaces available to meet their food safety and sanitation efficiency goals.

### References:

- The Fabricator, A publication of the Fabricators & Manufacturers Association, Intl.
- ISSF, International Stainless Steel Forum
- ASTM, International Standards Worldwide
- USDA Agricultural Research Service
- 3-A, Basics of Sanitary Design
- Apache and Mepaco® industry experts and reference documents

# Mepaco®

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