



# Standard Practice for Preparation of and Electroplating on Stainless Steel<sup>1</sup>

This standard is issued under the fixed designation B254; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

<sup>ε1</sup> NOTE—An editorial correction was made to [X2.1.2](#) in December 2020.

## 1. Scope

1.1 Various metals are electrodeposited on stainless steel for color matching, lubrication during cold heading, spring-coiling and wire-drawing operations, reduction of scaling at high temperatures, improvement of wettability (as in fountain pens), improvement of heat and electrical conductance, prevention of galling, jewelry decoration, and prevention of superficial rusting.

1.2 This practice is presented as an aid to electroplaters and finishing engineers, confronted with problems inherent in the electrodeposition of metals on stainless steel. It is not a standardized procedure but a guide to the production of smooth adherent electrodeposits on stainless steel.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[A380 Practice for Cleaning, Descaling, and Passivation of](#)

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.02 on Pre Treatment.

Current edition approved Nov. 1, 2020. Published December 2020. Originally approved in 1951. Last previous edition approved in 2014 as B254 – 92(2014). DOI: 10.1520/B0254-92R20E01.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## Stainless Steel Parts, Equipment, and Systems

### 3. Nature of Stainless Steel

3.1 Because previous metal treatment may have a more pronounced effect on the final finish when stainless steel is being electroplated, the metal finisher should become acquainted with the fabrication procedure, grade, and mill finish of the stainless steel with which he is working before outlining his electrodeposition procedure (see [Appendix XI](#)).

3.2 Stainless steel surfaces are normally resistant to a wide variety of corrosive elements. This property is the result of a thin transparent film of oxides present on the surface. Because this film rapidly reforms after it has been stripped off or penetrated, it protects stainless steel against corrosion. An adherent electrodeposit cannot be obtained over the oxide film normally present on stainless steel. However, once this film is removed by surface activation and kept from reforming while the surface is covered with an electrodeposit, any of the commonly electroplated metals may be electrodeposited successfully on stainless steel.

3.3 Where the finished product is to be subjected to severe exposure, the deposit produced by the proposed electroplating sequence should be tested under similar exposure conditions before adoption, to determine whether the natural corrosion resistance of the stainless steel has been impaired by the presence of the electrodeposit.

### 4. Nature of Cleaning

4.1 The preparation of stainless steel for electroplating involves three basic steps in the following order:

4.1.1 Removal of scale. If scale removal is necessary, one of the methods outlined in [Appendix X2](#) may be used ([Note 1](#)). See also Practice [A380](#).

4.1.2 Removal of oil, grease, or other foreign material by cleaning, and

4.1.3 Activation immediately before electroplating.

4.2 *Precleaning*—Removal of fabricating lubricants and finishing compounds from the stainless steel may have to be undertaken immediately following the fabrication or finishing operation (Note 2).

4.3 *Electrocleaning*—Anodic cleaning is generally preferred (Note 3).

4.4 *Metal Lubricants*—Metal lubricants such as copper, lead, or cadmium, applied to stainless steel wire for cold heading, wire drawing, or spring forming are removed by immersion in a solution of 200 mL of concentrated, 67 mass %, nitric acid (density 1.40 g/mL) diluted to 1 L at 50 to 60 °C. See Practice A380.

NOTE 1—Oil, grease or other fabricating lubricants should be removed by cleaning before heat treating.

NOTE 2—Spray cleaning with a nozzle pressure of 200 to 400 kPa (30 to 60 psi) in a power washer, using an alkaline or emulsion-type cleaner, is the generally preferred method, especially for the removal of heavy drawing, buffing, or polishing compounds. Soak cleaning or vapor degreasing may also be used. Extreme examples of such compounds are drawing or stamping lubricants containing unsaturated oils, which if left on the surface, form by air-oxidation tenacious films that are very difficult to remove.

NOTE 3—When brightness is important, alkalinity, current density, and temperature should be kept as low as the part will permit. This is an essential requirement when cleaning work on racks bearing auxiliary lead anodes or when high chromium alloys (such as UNS Types S44200 and S44600) are being cleaned.

## 5. Cleaning Solutions

5.1 The types of solution control, electrodes, heating coils, and rinse tanks normally used for cleaning carbon steel are satisfactory for stainless steel. Equipment previously used for the cleaning or processing of carbon steel should not be used. See Practice A380.

## 6. Racking

6.1 The general principles of good racking as used in chromium electroplating processes apply. However, the high electrical resistance of stainless steel requires rack construction methods that minimize potential contact problems and increase the number of contact points.

NOTE 4—Because of the high electrical resistance of stainless steel, especially in fine-coiled wire articles such as watch bands, chains, jewelry, etc., it is necessary to provide a larger number of contacts. As an example, a watch band 110 mm long made of 1.0-mm diameter wire has been found to require at least three contacts.

## 7. Activation

7.1 After the cleaning operation and before the electroplating operation, the parts must be completely activated, that is, the thin transparent film of oxides must be removed from the surface to be electroplated (Note 5). This film will reform if the parts are allowed to dry or are exposed to oxygen-containing solutions. For this reason, the shortest interval practicable should elapse between the time the parts are removed from the activating solution and covered by the electrodeposit, unless a simultaneous activation-electroplating procedure is used.

NOTE 5—The etching practice may be more severe for nondecorative applications than for decorative applications.

7.2 The following activating procedures have been used. The procedure selected will depend upon the nature of the part and preceding or subsequent processes (see 7.7). In the following solution formulas, the concentrations are expressed on a volume basis as follows:

Liquids: as volume per litre of solution

Solids: as mass per litre of solution

7.3 The commercial grade acids and salts used in the formulas include:

Sulfuric acid: 93 mass %; density 1.83 g/mL

Hydrochloric acid: 31 mass %; density 1.16 g/mL

Nickel chloride: NiCl<sub>2</sub>·6H<sub>2</sub>O

Copper sulfate: CuSO<sub>4</sub>·5H<sub>2</sub>O

**Warning**—Sulfuric acid should be slowly added to the approximate amount of water required with rapid mixing, and then after cooling, diluted to exact volume.

### 7.4 Cathodic Treatments:

7.4.1	Sulfuric acid	50 to 500 mL/L
	Water	to 1 L
	Temperature	room
	Time	1 to 5 min
	Current density	0.54 A/dm <sup>2</sup>
	Anodes	pure lead
7.4.2 <sup>A</sup>	Hydrochloric acid	50 to 500 mL/L
	Water	to 1 L
	Temperature	room
	Time	1 to 5 min
	Current density	2.15 A/dm <sup>2</sup>
	Anodes	electrolytic nickel strip or nickel bar

<sup>A</sup> See Patent No. 2,133,996.

7.4.3 After immersion in a solution containing 100 to 300 mL/L of hydrochloric acid diluted to 1 L at room temperature for 30 to 60 s, treat cathodically in:

Sulfuric acid	50 to 500 mL/L
Water	to 1 L
Temperature	room
Current	0.54 to 2.7 A/dm <sup>2</sup>
Anodes	pure lead

### 7.5 Immersion Treatments:

7.5.1 Immerse in a solution of sulfuric acid containing 200 to 500 mL of acid diluted to 1 L at 65 to 80 °C (with the higher temperature for the lower concentration) for at least 1 min after gassing starts. If gassing does not start within 1 min after the parts have been immersed, touch them with a carbon-steel bar or rod. This activation treatment will produce a dark, adherent smut that is removed in the electroplating bath. A cathodic current of at least 0.54 A/dm<sup>2</sup> may be used to accelerate activation. Lead anodes are suitable for this solution.

7.5.2 Immerse in the following solution:

Hydrochloric acid	1 mL
Sulfuric acid	10 mL
Water	to 1 L
Temperature	room
Time	26 s

NOTE 6—This practice has been used with success for chromium electroplating on stainless steel automobile parts in a conveyORIZED process. It is not recommended before copper or nickel electroplating.