



# SURFACE VEHICLE INFORMATION REPORT

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## Electroplating and Related Finishes

### RATIONALE

The technology in this specification is stable and no further technical revisions are applicable at this time.

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**Foreword**—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. **Scope**—Electroplating is a process whereby an object is coated with one or more relatively thin, tightly adherent layers of one or more metals. It is accomplished by placing the object to be coated on a plating rack or a fixture, or in a basket or in a rotating container in such a manner that a suitable current may flow through it, and then immersing it in a series of solutions and rinses in planned sequence. The advantage to be gained by electroplating may be considerable; broadly speaking, the process is used when it is desired to endow the basis material (selected for cost, material conservation, and physical property reasons) with surface properties it does not possess.

It should be noted that although electroplating is the most widely used process for applying metals to a substrate, they may also be applied by spraying, vacuum deposition, cladding, hot dipping, chemical reduction, mechanical plating, etc. The purpose for applying an electroplate and the metals used for various applications follow.

## 2. References

- 2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

- 2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J207—Electroplating of Nickel and Chromium on Metal Parts—Automotive Ornamentation and Hardware

- 2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM Book of Standards—Part 7

ASTM A 164—Electrodeposited Coatings of Zinc on Steel

ASTM A 165—Electrodeposited Coatings of Cadmium on Steel

ASTM B 177—Chromium Plating on Steel for Engineering Use

ASTM B 200 —Electrodeposited Coatings of Lead on Steel

ASTM B 253—Preparation of and Electroplating on Aluminum Alloys by the Zincate Process

ASTM B 254—Preparation of and Electroplating on Stainless Steel  
ASTM B 456—Electrodeposited Coatings of Nickel Plus Chromium  
ASTM B 503—Use of Copper and Nickel Electroplating Solutions for Electroforming  
ASTM B 545—Electrodeposited Coatings of Tin

### 2.1.3 OTHER PUBLICATIONS

Allen Gray, *Modern Electroplating*. The Electrochemical Society, Inc. Vols. 1 and 2, New York: John Wiley & Sons.  
Herbert H. Uhlig, *Corrosion Handbook*. The Electrochemical Society, Inc. New York: John Wiley & Sons.  
William Blum and George B. Hogaboom, *Principles of Electroplating and Electroforming*. New York: McGraw-Hill.  
A. K. Graham and H. L. Pinkerton, *Electroplating Engineers Handbook* (Second Edition). New York: Reinhold Publishing Co.  
*Metal Finishing Guide Book and Directory*. Westwood, N.J.: Metal and Plastics Publications.  
Lester F. Spencer, "Electroplated Coatings—Selection Factors." *Metal Finishing*, Vol. 69, No. 9 (September 1971) and No. 10 (October 1971).  
J. B. Mohler, "Primer on Electrodeposited Coatings." *Materials Engineering*, Vol. 75, No. 1 (January 1972).

3. **Decorative-Protective Coatings**—This type of coating has as its prime purpose the maintenance of an acceptable appearance on a product exposed to various service conditions involving wear and/or corrosion. Typical examples are door handles, bumpers, nameplates, and other bright finished hardware. For this application the copper/nickel/chromium, the nickel/chromium, or other combinations of these metals are most frequently used. However, zinc, brass, tin, cadmium, gold, silver, and rhodium may also be used where a unique appearance and/or a specific protective quality is desired. (See SAE J207.)

4. **Protective Coatings**—Protective coatings can be classified as either sacrificial or barrier type. Both cadmium and zinc are well known as sacrificial coatings, being more active chemically than the substrate and offering protection by being preferentially attacked. Since it is relatively inexpensive and readily applied in a plating barrel or tank, or mechanically applied, zinc is often preferred for coating ferrous parts. However, due to the lesser amount of corrosion products that may form under similar corrosive conditions, cadmium is preferred over zinc in applications where the buildup of corrosion products would have a detrimental effect, such as restricted movement of closely fitted parts or the prevention of current flow in electrical components. In addition, cadmium is more readily solderable.

Tin and its alloys are examples of barrier-type coatings. These coatings protect by serving as an inactive barrier between the substrate and the environment. Such coatings must be thick enough to be free of discontinuities, otherwise corrosion will take place at any void in the coating. Applications of protective coatings include screws, nuts, bolts, and other fasteners; components of mechanical assemblies, and control mechanisms.

5. **Engineering Coatings**—Functional enhancement of a component by the use of an electroplated coating is recognized. Among the many applications, the more important usages include:

- a. Abrasion and scratch protection as provided by a coating that is harder than the basis metal. Coatings of chromium, nickel (both electrodeposited and electroless), tin-nickel, or iron are examples of hard coatings.
- b. Use of soft electrodeposits, such as silver, lead, tin-lead, indium, or lead-indium which adjust to minor imperfections in mating surfaces, are suitable as bearing surfaces.
- c. Use of electrodeposits such as chromium, iron, or nickel for rebuilding undersized parts.
- d. The use of various electrodeposits in specialized fields such as in coating of conductors and plating of plastics and ceramics, in both the electrical and electronic fields.

6. **Electroforming**—Electroforming is the production or reproduction of articles by electrodeposition. Typical applications are the production of printing plates, phonograph matrices, patterns, molds, dies, and paint masks made of electrodeposited copper, iron, nickel, and other metals.

NOTE—It should be stressed that this writing is only a very brief introduction to the subject of electroplating and related finishes. Detailed information on the subject may be found in one or more of the publications appearing in the bibliography and in the specifications listing.

7. **Bibliography**

1. Allen Gray, *Modern Electroplating*. The Electrochemical Society, Inc. Vols. 1 and 2, New York: John Wiley & Sons.
2. Herbert H. Uhlig, *Corrosion Handbook*. The Electrochemical Society, Inc. New York: John Wiley & Sons.
3. William Blum and George B. Hogaboom, *Principles of Electroplating and Electroforming*. New York: McGraw-Hill.
4. A. K. Graham and H. L. Pinkerton, *Electroplating Engineers Handbook* (Second Edition). New York: Reinhold Publishing Co.
5. *Metal Finishing Guide Book and Directory*. Westwood, N.J.: Metal and Plastics Publications.
6. Lester F. Spencer, "Electroplated Coatings—Selection Factors." *Metal Finishing*, Vol. 69, No. 9 (September 1971) and No. 10 (October 1971).
7. J. B. Mohler, "Primer on Electrodeposited Coatings." *Materials Engineering*, Vol. 75, No. 1 (January 1972).

8. **ASTM Specifications**<sup>1</sup>

9. **Decorative-Protective Coatings**—B 456 Electrodeposited Coatings of Nickel Plus Chromium

B 253 Preparation of and Electroplating on Aluminum Alloys by the Zincate Process

B 254 Preparation of and Electroplating on Stainless Steel

10. **Protective Coatings**—A 165 Electrodeposited Coatings of Cadmium on Steel

B 545 Electrodeposited Coatings of Tin

A 164 Electrodeposited Coatings of Zinc on Steel

11. **Engineering Coatings**—B 488 Electrodeposited Coatings of Gold for Engineering Uses

B 200 Electrodeposited Coatings of Lead on Steel

B 177 Chromium Plating on Steel for Engineering Use

12. **Electroforming**—B 503 Use of Copper and Nickel Electroplating Solutions for Electroforming

PREPARED BY THE SAE NONFERROUS METALS COMMITTEE

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1. These and other specifications related to electroplating may be found in ASTM Book of Standards, Part 7.