



Designation: **B874 – 96 (Reapproved 2013) B874 – 96 (Reapproved 2018)**

Standard Specification for Chromium Diffusion Coating Applied by Pack Cementation Process¹

This standard is issued under the fixed designation B874; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for chromium diffusion of metals by the pack cementation method. Pack diffusion employs the chemical vapor deposition of a metal which is subsequently diffused into the surface of a substrate at high temperature. The material to be coated (substrate) is immersed or suspended in a powder containing chromium (source), a halide salt (activator), and an inert diluent such as alumina (filler). When the mixture is heated, the activator reacts to produce an atmosphere of chromium halides which transfers chromium to the substrate for subsequent diffusion. The chromium-rich surface enhances corrosion, thermal stability, and wear-resistant properties.

1.2 *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.*

1.3 *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:*²

[B374 Terminology Relating to Electroplating](#)

[B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section](#)

[B602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings](#)

[B697 Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings](#)

[B762 Test Method of Variables Sampling of Metallic and Inorganic Coatings](#)

[C664 Test Methods for Thickness of Diffusion Coating](#)

[D3951 Practice for Commercial Packaging](#)

[E766 Practice for Calibrating the Magnification of a Scanning Electron Microscope](#)

[E1077 Test Methods for Estimating the Depth of Decarburization of Steel Specimens](#)

[F1330 Guide for Metallic Abrasive Blasting to Descale the Interior of Pipe](#)

3. Terminology

3.1 Definitions used in this specification are in accordance with Terminology [B374](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *diffusion coating*—a diffusion coating is one produced by causing an element to react with or diffuse into, or both, the surface of a metallic substrate, thus, chemically altering the surface of the substrate.

3.2.2 *retorts*—containers in which powder and parts are packed for processing. They can be constructed of carbon, stainless, or high alloys and fabricated in all shapes and sizes to accommodate parts being processed.

3.2.3 *significant surface*—areas that are essential to the serviceability or function of the article. These surfaces must be identified on a drawing or marked-up sample of product. Areas can fall into one of three categories as follows:

¹ This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.03 on Engineering Coatings.

Current edition approved Dec. 1, 2013 June 1, 2018. Published December 2013 June 2018. Originally approved in 1996. Last previous edition approved in 2008 2013 as B874 – 96 (2008) (2013). DOI: 10.1520/B0874-96R13; 10.1520/B0874-96R18.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.4 *coating required*—these surfaces must be in accordance with all quality requirements of this specification.

3.2.5 *no coating required*—these surfaces are areas where no coating is allowed due to a number of reasons including dimensional, fabrication, and welding, as well as others. Materials used for masking are commercially available.

3.2.6 *optional*—these surfaces do not require coating, but at the same time do not require masking.

4. Classification

4.1 There are four classes of chromium diffusion defined by base (basis) metal category.

4.1.1 *Class I*—Carbon steel.

4.1.2 *Class II*—Low-alloy steels.

4.1.3 *Class III*—Stainless steels.

4.1.4 *Class IV*—Nickel-based alloys.

5. Ordering Information

5.1 In order to make the application of this specification complete, the purchaser shall supply the following information to the vendor through a purchase order and drawings:

5.1.1 Title, ASTM designation number, and date of issue of this specification.

5.1.2 Deposit by classification (see Section 4).

5.1.3 Composition and metallurgical condition of substrate to be coated.

5.1.4 Location of significant surfaces (see 3.2.3).

5.1.5 Samples for destructive metallurgical test (see 8.1).

5.1.6 Any post heat treatment required.

5.1.7 Acceptance inspection procedure to be used (see Section 9).

5.1.8 Any requirement for certification (see Section 11).

6. Processing Requirements

6.1 *Substrate Preparation*—The metal to be chromized shall be free of flaws and defects that will be detrimental to the coating. Thorough cleaning is essential to ensure satisfactory diffusion. Materials used for cleaning should not damage the base metal. Oils, dirt, grease, and stains must be removed. When blasting is also required, use aluminum oxide (90 to 220 mesh) at 60 to 80 psi from 4 to 6 in. standoff. (Refer to Guide F1330.)

6.2 *Materials:*

6.2.1 *Masteralloy with 50 to 100 % Pure Chromium*—Sold under a number of trade names, in various mesh sizes. Percentage in mix depends on material being processed.

6.2.2 *Activator*—Most commonly used is ammonium chloride, but many others are available. Percentage in mix depends on material and type of activity.

6.2.3 *Inert Filler*—Aluminum oxide or calcined alumina is used and commercially available in numerous mesh sizes. Percentage in mix depends on material being processed and mesh size being used.

NOTE 1—It is important that both proper equipment is used and time established to guarantee uniform blend of pack mix.

NOTE 2—It is common practice to rejuvenate used mixes by addition of coating elements, alloys, and activators. Chemical analysis of used mixes facilitates control of critical constituents. Disposal of used mixes must be performed in compliance with environmental regulations.

6.3 *Loading*—Place pack mix and parts in retorts. Retort size is limited by dimensions of furnace used for processing.

6.4 *Furnace Cycle*—Parts are heated to a temperature between 1900 and 2400°F depending on base material and pack mix and held for amount of time needed to produce desired depth of diffusion.

NOTE 3—Due to the high temperature of the process, a positive pressure of an inert gas, usually argon, must be maintained in retorts throughout the entire furnace cycle.

6.5 *Post-Cleaning*—Retorts should be allowed to cool sufficiently before opening. When parts are removed from retorts, residual pack mix is removed from surfaces by a supplier-approved method.

6.6 *Post-Straightening*—Long tubes may have distortion due to the high temperature of process. Use rotary straightener or hydraulic press to restore straightness and ovality.

6.7 *Visual Inspection*—Inspect in accordance with 7.3.

6.8 *Marking and Packaging*—To be defined by the purchaser in the purchase order. Parts processed for the U.S. government and military, including subcontract, shall be packaged in accordance with Practice D3951.

7. Coating Requirements

7.1 *Diffusion Thickness*—The following are minimums for the different classes of materials based on standard process parameters. Thicker coatings require special processing and must be called out for in the purchase order if required.