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Standard Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement¹

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INTRODUCTION

When atomic hydrogen enters steel, it can cause a loss of ductility, load carrying ability, or cracking (usually as submicroscopic cracks), as well as catastrophic brittle failures at applied stresses well below the yield strength or even the normal design strength for the alloys. This phenomenon often occurs in alloys that show no significant loss in ductility, when measured by conventional tensile tests, and is referred to frequently as hydrogen-induced delayed brittle failure, hydrogen stress cracking, or hydrogen embrittlement. The hydrogen can be introduced during cleaning, pickling, phosphating, electroplating, autocatalytic processes, porcelain enameling, and in the service environment as a result of cathodic protection reactions or corrosion reactions. Hydrogen can also be introduced during fabrication, for example, during roll forming, machining, and drilling, due to the breakdown of unsuitable lubricants, as well as during welding or brazing operations.

1. Scope

1.1 This guide covers procedures for reducing the susceptibility in some steels to hydrogen embrittlement or degradation that may arise in the finishing processes.

1.2 The heat treatment procedures established herein may be effective for reducing susceptibility to hydrogen embrittlement. This heat-treatment procedure shall be used after plating operations but prior to any secondary conversion coating operation.

1.3 This guide has been coordinated with ISO/DIS 9588 and is technically equivalent.

NOTE 1—The heat treatment does not guarantee complete freedom from the adverse effects of hydrogen degradation.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

¹ This specification 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.

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2. Referenced Documents

2.1 *ASTM Standards*:²

A919 Terminology Relating to Heat Treatment of Metals (Withdrawn 1999)³

B374 Terminology Relating to Electroplating

B851 Specification for Automated Controlled Shot Peening of Metallic Articles Prior to Nickel, Autocatalytic Nickel, or Chromium Plating, or as Final Finish

2.2 *ISO Standards*:

ISO 2080 Electroplating and Related Processes—Vocabulary⁴

ISO DIS 9588 Post-Coating Treatments of Iron or Steel for Reducing the Risk of Hydrogen Embrittlement⁴

2.3 *Federal Standard*:

QQ-C-320 Chromium Plating (Electrodeposited)⁵

3. Terminology

3.1 *Definitions*—Many of the terms used in this guide can be found in Terminology B374, A919, or ISO 2080.

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 The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098