



Standard Test Method for Detecting Detrimental Phases in Lean Duplex Austenitic/ Ferritic Stainless Steels¹

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1. Scope*

1.1 The purpose of this test method is to allow detection of the presence of detrimental chromium-containing phases in selected lean duplex stainless steels to the extent that toughness or corrosion resistance is affected significantly. Such phases can form during manufacture and fabrication of lean duplex products. This test method does not necessarily detect losses of toughness nor corrosion resistance attributable to other causes, nor will it identify the exact type of detrimental phases that caused any loss of toughness or corrosion resistance. The test result is a simple pass/fail statement.

1.2 Lean duplex (austenitic-ferritic) stainless steels are typically duplex stainless steels composed of 30 to 70 % ferrite content with a typical alloy composition having Cr > 17 % and Mo < 1 % and with additions of Nickel, Manganese, Nitrogen and controlled low carbon content as well as other alloying elements. This standard test method applies only to those alloys listed in [Table 1](#). Similar test methods for some higher alloyed duplex stainless steels are described in Test Methods [A923](#), but the procedures described in this standard differ significantly for all three methods from the ones described in Test Methods [A923](#).

1.3 Lean duplex stainless steels are susceptible to the formation of detrimental chromium-containing compounds such as nitrides and carbides and other undesirable phases. Typically this occurs during exposures in the temperature range from approximately 300 to 955°C (570 to 1750°F) with a maximum susceptibility in the temperature range around 650 to 750°C (1200 to 1385°F). The speed of these precipitation reactions is a function of composition and the thermal or thermo-mechanical history of each individual piece. The presence of an amount of these phases can be detrimental to toughness and corrosion resistance.

1.4 Because of the low molybdenum content, lean duplex stainless steels only exhibit a minor susceptibility to sigma and

other types of molybdenum containing intermetallic phases. Heat treatment, that could lead to formation of small amounts of molybdenum containing intermetallics, would result in a large amount of precipitation of detrimental nitrides or carbides, long before any signs of sigma and similar phases would be observed.

1.5 Correct heat treatment of lean duplex stainless steels can eliminate or reduce the amount and alter the characteristics of these detrimental phases as well as minimizing Cr-depletion in the matrix phase in the immediate vicinity of these phases. Adequately rapid cooling of the product from a suitable annealing temperature provides the maximum resistance to formation of detrimental phases by subsequent thermal exposures. For details of the proper annealing temperature recommendations for the alloy and product in question, the user is referred to the relevant applicable ASTM product specification.

1.6 Compliance with the chemical and mechanical requirements for the applicable product specification does not necessarily indicate the absence of detrimental phases in the product.

1.7 These test methods include the following:

1.7.1 *Test Method A*—Etch Method for detecting the presence of potentially detrimental phases in Lean Duplex Stainless Steels

1.7.2 *Test Method B*—Charpy V-notch Impact Test for determining the presence of detrimental phases in Lean Duplex Stainless Steels.

1.7.3 *Test Method C*—Inhibited Ferric Chloride Corrosion Test for determining the presence of detrimental phases in Lean Duplex Stainless Steels.

1.7.4 Examples of the correlation of thermal exposures, the occurrence of detrimental phases, and the degradation of toughness and corrosion resistance are given in [Appendix X2](#), [Appendix X3](#), and the References.

1.8 Guidelines for the required data needed for subcommittee [A01.14](#) to consider listing a lean duplex stainless steel in this standard test method are given in [Annex A1](#).

1.9 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to other units that are provided for information only and are not considered standard.

¹ This test method is under the jurisdiction of ASTM Committee [A01](#) on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee [A01.14](#) on Methods of Corrosion Testing.

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