

AWS A4.2M:2006 (ISO 8249:2000 MOD)
An American National Standard

**Standard Procedures
for Calibrating
Magnetic Instruments
to Measure the Delta
Ferrite Content of
Austenitic and Duplex
Ferritic-Austenitic
Stainless Steel
Weld Metal**



American Welding Society



Key Words— Instrument calibration, delta ferrite, stainless steel weld metal, austenitic stainless steel weld metal, duplex stainless steel weld metal

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Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal

Supersedes ANSI/AWS A4.2M/A4.2:1997

Prepared by the
American Welding Society (AWS) A5 Committee on Filler Metals and Allied Materials

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

Calibration procedures are specified for a number of commercial instruments that can then provide reproducible measurements of the ferrite content of austenitic stainless steel weld metals. Certain of these instruments can be further calibrated for measurements of the ferrite content of duplex ferritic-austenitic stainless steel weld metals. Calibration with primary standards (nonmagnetic coating thickness standards from the U.S. National Institute of Standards and Technology) is the preferred method for appropriate instruments. Alternatively, these and other instruments can be calibrated with weld-metal-like secondary standards.

Reproducibility of measurement after calibration is specified. Problems associated with accurate determination of ferrite content are described.



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Welding — Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals

1 Scope

This standard specifies the method and apparatus for

- the measurement of the delta ferrite content, expressed as Ferrite Number (FN), in largely austenitic and duplex ferritic-austenitic stainless steel¹⁾ weld metal through the attractive force between a weld metal sample and a standard permanent magnet;
- the preparation and measurement of standard pads for shielded metal arc covered electrodes. The general method is also recommended for the ferrite measurement of production welds and for weld metal from other processes, such as gas tungsten arc welding, gas shielded metal arc welding and submerged arc welding (in these cases, the way of producing the pad should be defined);
- the calibration of other instruments to measure FN.

The method described in this standard is intended for use on weld metals in the as-welded state and on weld metals after thermal treatments causing complete or partial transformation of ferrite to any non-magnetic phase. Austenitizing thermal treatments which alter the size and shape of the ferrite will change the magnetic response of the ferrite.

The method is not intended for measurement of the ferrite content of cast, forged or wrought austenitic or duplex ferritic-austenitic steel samples.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/TR 15510:1997, *Stainless steels — Chemical composition*.

3 Principle

The measurement of the ferrite content of largely austenitic stainless steel weld metal through the attractive force between a weld metal sample and a permanent magnet is based upon the fact that the attractive force between a two-phase (or multiphase) sample containing one ferromagnetic phase and one (or more) non-ferromagnetic phase(s) increases as the content of the ferromagnetic phase increases. In largely austenitic and duplex ferritic-austenitic stainless steel weld metal, ferrite is magnetic, whereas austenite, carbides, sigma phase and inclusions are non-ferromagnetic.

1) The term “austenitic-ferritic (duplex) stainless steel” is sometimes applied in place of “duplex ferritic-austenitic stainless steel”.