

Method for

Determination of ferrite number in austenitic weld metal deposited by covered Cr-Ni steel electrodes

[ISO title: Welding — Determination of ferrite number in
austenitic weld metal deposited by covered Cr-Ni steel
electrodes]

UDC 621.791.053:620.179.14:669.112.228.1

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- British Association for Brazing and Soldering
- British Railways Board
- British Shipbuilders
- British Steel Industry
- British Steel Industry (Wire Section)
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Process Plant Association
- Society of Motor Manufacturers and Traders Limited
- Water-tube Boilermakers' Association
- Welding Institute
- Welding Manufacturers Association (BEAMA Ltd.)
- Coopted member

This British Standard, having been prepared under the direction of the Welding Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 January 1987

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The following BSI references relate to the work on this standard:
Committee reference WEE/39
Draft for comment 84/71741 DC

ISBN 0 580 15661 3

Amendments issued since publication

Amd. No.	Date of issue	Comments

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National foreword

This British Standard has been prepared under the direction of the Welding Standards Committee and is identical with ISO 8249:1985 “*Welding — Determination of ferrite number in austenitic weld metal deposited by Cr-Ni steel electrodes*” which was prepared by Technical Committee ISO/TC 44 of the International Organization for Standardization (ISO) and in the development of which the UK played an active part.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

Cross-references. The Technical Committee has reviewed the provisions of ISO 525, ISO 683-13 and ISO 4954, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. The British Standards related to ISO 525 and ISO 683-13 are BS 4481 “*Bonded abrasive products*” Part 1:1981 “*Specification for general features of types of abrasive wheels, blocks, honing stones, segments and profiles*” and BS 1449 “*Steel plate, sheet and strip*” Part 2:1983 “*Specification for stainless and heat resisting steel plate, sheet and strip*”, respectively.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

At present, experimental methods are not available that give an absolute measurement of the amount of ferrite in a weld metal, either destructively or non-destructively. This situation has led to the development and use, internationally, of the concept of a “ferrite number” or FN. A ferrite number is a description of the ferrite content of a weld metal determined using a standardized procedure. Such procedures are laid down in this International Standard and AWS Standard A4.2-74, these being essentially equivalent. The ferrite number of a weld metal is approximately equivalent to the percentage ferrite content, particularly at low FN values.

Although other methods are available for determining the ferrite number, the standardized measuring procedure, laid down in this International Standard, is based on assessing the tear-off force needed to pull the weld metal sample from a magnet of defined strength and size. The relationship between tear-off force and FN is obtained using primary standards consisting of a non-magnetic coating of specified thickness on a magnetic base. Each non-magnetic coating thickness is assigned an FN value.

The ferrite content determined by this method is arbitrary and is not necessarily the true or absolute ferrite content. In recognition of this fact, the term “ferrite number” (FN) shall be used instead of “ferrite per cent” when quoting a ferrite content determined by this method.

1 Scope

This International Standard specifies the method and apparatus for

- the measurement of the delta ferrite content in largely austenitic stainless steel weld metal through the attractive force between a weld metal sample and a standard permanent magnet;
- the preparation and measurement of standard pads for manual 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 TIG, MIG and submerged arc (in these cases, the way of producing the pad should be defined);
- the calibration of other instruments to measure FN.

2 Field of application

The method laid down in this International Standard is intended for use on weld metals in the as welded state. It is also applicable to 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 steel samples.

3 References

ISO 525, *Bonded abrasive products — General features — Designation, marking, ranges of outside diameters and tolerances.*

ISO 683-13, *Heat-treated steels, alloy steels and free-cutting steels — Part 13: Wrought stainless steels¹⁾.*

ISO 4954, *Steels for cold heading and cold extruding.*

4 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 stainless steel weld metal, ferrite is magnetic, whereas austenite, carbides, sigma phase and inclusions are non-ferromagnetic.

5 Calibration

5.1 Coating thickness standards

The coating thickness standards shall consist of non-magnetic copper coating applied to an unalloyed steel base of size 30 mm × 30 mm. The thickness of the unalloyed steel base shall be equal to or greater than the experimentally determined minimum thickness at which a further increase of the thickness does not cause an increase of the attractive force between the standard permanent magnet and the coating thickness standard. The thickness of the non-magnetic copper coating shall be known to an accuracy of ± 5 % or better.

¹⁾ At present at the stage of draft. (Revision of ISO 683-13:1974.)

The chemical composition of unalloyed steel shall be within the following limits:

Element	Limit, %
C	0,08 to 0,13
Si	0,10 max.
Mn	0,30 to 0,60
P	0,040 max.
S	0,050 max.

The copper coating may be covered by a chromium flash. The force required to tear off a given permanent magnet from the copper coating side of such a standard increases as the thickness of the copper coating decreases.

NOTE To ensure adequate reproducibility of the calibration, the coating thickness standards defined above should be used. [In particular, coating thickness standards produced by the US National Bureau of Standards (NBS) may be used.]

5.2 Magnet

The standard magnet shall be a permanent magnet of cylindrical shape, 2 mm in diameter and about 50 mm in length. One end of the magnet shall be hemispherical, with a 1 mm radius and polished. As an example, such a magnet can be made of 36 % cobalt magnet steel, $48,45 \pm 0,05$ mm long, magnetically saturated and then desaturated to 85 %. The magnetic strength of the magnet shall be such that the force needed to tear off the standard magnet from the different coating thickness standards is within ± 10 % of the relationship shown in Figure 1 (the weight of the magnet excluded).

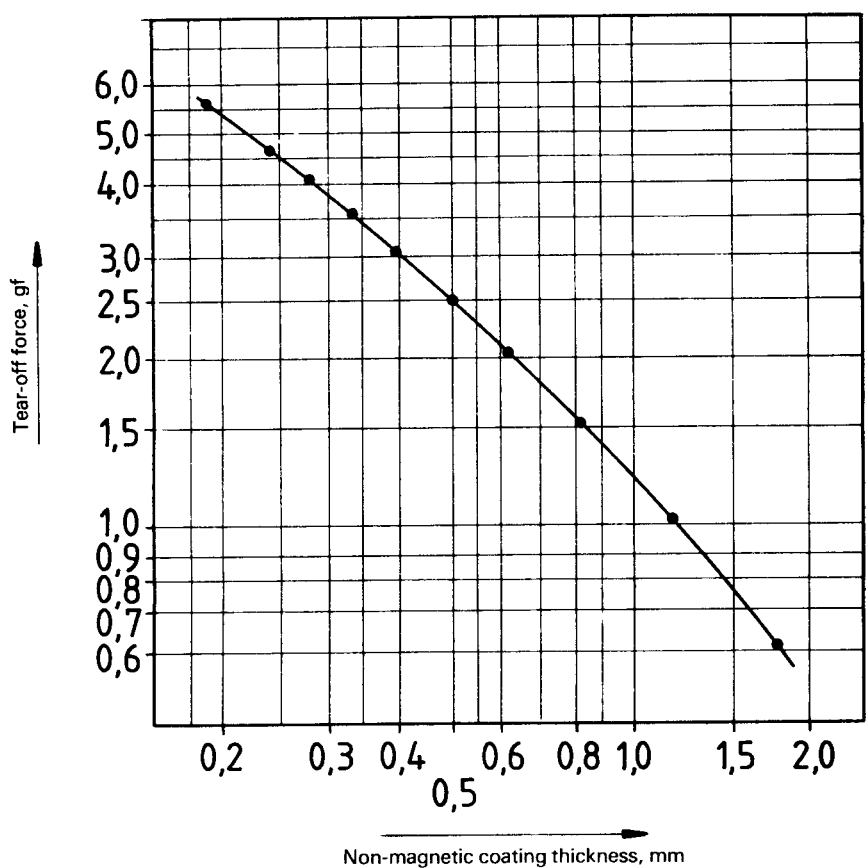


Figure 1 — Relationship between the tear-off forces of the standard magnet defined in 5.2 and the coating thickness standards defined in 5.1