



BSI Standards Publication

Evaluation of centreline segregation of continuously cast slabs

National foreword

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Evaluation of centreline segregation of continuously cast slabs

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coulée continue*

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and designations	3
5 Sampling and preparation	3
5.1 General	3
5.2 Position of extraction, extend of testing and lot size	4
5.3 Preparation of samples	5
5.4 Etching and post-treatment of the samples	6
6 Test methods	7
6.1 General	7
6.2 Evaluation by comparative charts (Method A)	8
6.3 Evaluation by measuring and counting (Method B)	8
6.3.1 General approach	8
6.3.2 Procedure	9
6.4 Measuring the area of the dark zones by digital image analysis (Method C)	10
7 Test report	11
Annex A (normative) Comparative charts for evaluating the severity of centreline segregation according to Method A	12
Annex B (informative) Example of a documentation table using Method B	16
Annex C (informative) Procedure for image evaluation according to Method C	17
Bibliography	19

Foreword

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This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Steel pipes produced from hot-rolled semi-finished products (strip or plate) are often used for the transport of different media (e.g. gas, oil, process- and waste water). Slabs from the continuously casting process are used as blanks for the production of these precursors. The solidification of the steel results in the formation of centreline segregation which is inherently caused by the casting process as well as the specific composition of the steel alloy. Depending on the specific conditions, centreline segregation occurs to varying degrees of severity and can affect the final material properties as well as the properties for further processing of the slab^{[1],[2]}. Several methods for quality monitoring and casting process control of steel grades for the production of pipes as for instance the “Mannesmann rating system” or the “dot technique” have been developed in the past^{[1],[2],[3]}, however, none of these methods have the status of a generally accessible standard or directive. In 2018, the industry standard SEP 1611 (Stahl-Eisen-Prüfblatt of German steel association Steel Institute VDEh)^[4] was published in order to establish a first, both supplier and customer independent document on evaluation methods^[5]. Methods for macrostructure examination rely on the fact that dark zones become visible in the centreline area of a slab after macroetching has been performed.

This document includes various test methods that have been established on a practical level and that reflect the current state-of-the-art for the evaluation of centreline segregation using macroetching techniques followed by visual inspection. For this purpose, the sampling, the sample preparation, the test method, the evaluation of the results as well as the required documentation are specified in this document.

The severity of centreline segregation can be evaluated in the following ways, enabling the choice between different options, addressing the wide range of available laboratory equipment at different testing centres:

- evaluation by comparative charts;
- evaluation by measuring and counting of the dark zones using circular templates;
- area measurement of the dark zones by digital image analysis.

In addition to macroetching and visual inspection, a couple of further methods are available in order to analyse the interior quality of steel slabs using more sophisticated techniques such as electron probe microanalysis (EPMA), X-ray fluorescence (XRF), optical spark emission spectroscopy (OES) or ultrasonic testing (UT)^{[1],[3]}. However, these will not be covered in this document, since an unambiguous correlation between the various methods has not been verified in general.

Evaluation of centreline segregation of continuously cast slabs

1 Scope

This document specifies a procedure for the evaluation of centreline segregation of continuously cast slabs, including sampling, sample preparation and evaluation method.

This document is applicable for low carbon steel slabs for pipe production manufactured by continuous casting. These steels have a typical chemical composition as follows (mass percentages):

- $C \leq 0,12 \%$
- $Mn \leq 2,0 \%$
- $Si \leq 0,5 \%$
- $Ti + Nb + V \leq 0,2 \%$

The common dimensions of these slabs are in the following ranges:

- Slab width: 800 mm to 2 600 mm
- Slab thickness: 150 mm to 450 mm

The evaluation methods covered by this document are based on macroscopic etching of slab samples followed by visual inspection by means of human eye or camera systems.

The procedures for sampling described in 5.1 to 5.3 of this document are applicable to steels slabs in general (e. g. other steel grades or dimensions). However, the etching procedure (see 5.4) in combination with the evaluation methods described in Clause 6 have been developed especially for the application on pipeline steels as given above. Thus, they are not applicable to other steel grades, product types or dimensions without a prior validation. Any extension or modification beyond the scope of this document necessitates a separate agreement between producer and customer.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4969, *Steel — Etching method for macroscopic examination*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>