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STN P	**Nedeštruktívne skúšanie Skúšobná metóda na stanovenie zvyškových napätí röntgenovou difrakciou použitím synchrotrónu**	**STN P CEN/TS 18094** 01 5045

Non-destructive testing - Test method for determining residual stresses by synchrotron x-ray diffraction

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 03/25

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English Version

Non-destructive testing - Test method for determining residual stresses by synchrotron x-ray diffraction

Essais non-destructifs - Méthode d'essai pour l'analyse des contraintes résiduelles par diffraction des rayons X au synchrotron

Zerstörungsfreie Prüfung - Prüfverfahren zur Bestimmung von Eigenspannungen mittels Synchrotron-Röntgendiffraktometrie

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (CEN/TS 18094:2024) has been prepared by Technical Committee CEN/TC 138 “Non-destructive testing”, the secretariat of which is held by AFNOR.

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Introduction

This document has been developed with support from the EASI-STRESS project which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 953219.

Much of the content of this document has been supplied by the partners from EASI-STRESS either by converting information from EASI-STRESS deliverables or through direct engagement with individuals to draft and review different parts of this document.

The engagement of experts in CEN/TC 138/WG 10 not affiliated with EASI-STRESS who also made essential contributions to this document has been equally important. A heartfelt gratitude is extended to these individuals whose exceptional dedication and voluntary contributions have significantly enriched the work.

The EASI-STRESS project (active from January 2021 until June 2024) aimed to increase industrial trust in synchrotron X-ray and neutron diffraction-based residual stress characterization techniques by validation and benchmarking, developing standard operating procedures and creating this document. The industrial aim was to revolutionize industrial residual stress management in metals, potentially enabling up to 15 % material savings from reducing over-dimensioning of components due to lack of knowledge of residual stress levels.

In order to improve industrial accessibility, the project also focused on professionalising the measurement service by harmonizing data formats and developing software tools for data analysis and establishing an industrial service function for residual stress measurement.

EASI-STRESS has also been used as practical case study on adopting advanced characterization principles according to the CHADA (CHAracterization Data).

Another source of inspiration comes from the VAMAS initiative (Versailles Project on Advanced Materials and Standards), which ultimately led to the establishment of the standard for neutron residual stress measurement, EN ISO 21432:2020.

The following EASI-STRESS deliverables are available online at the European Commission CORDIS website for EASI-STRESS[1] and have been used for the drafting of this document:

— D2.1 Benchmark samples and relevant information for their manufacture

— D2.2 Development of best practice in correlation of modelled and measured stress data. This includes details to consider during modelling and experiments and reporting formats.

— D2.3 Round-robin results from laboratory techniques and synchrotron and neutron facilities.

— D3.1 Report on technical specifications as identified in collaboration with the industrial users and at the interface with WP2, WP4 and WP5.

— D3.2 Report on SOPs (Standard Operating Procedures) for instruments dedicated to bulk analysis and to near-surface analysis.

— D4.2 Technical report with mathematical formalisms (equations), dedicated technical drawings and diagrams that describes coordinate systems, variables, workflows for data processing, and that includes the description of the experimental parameters to be included in FE-modelling software.

[1] : https://cordis.europa.eu/project/id/953219/results

1 Scope

This document describes the test method for determining residual stresses in polycrystalline materials by the synchrotron X-ray diffraction method. The method can be applied to both homogeneous and inhomogeneous materials including those containing distinct phases.

Information on how to carry out residual stress measurements by the synchrotron X-ray diffraction technique is provided as:

— the selection of appropriate diffracting lattice planes on which measurements should be made for different categories of materials,

— the specimen directions in which the measurements should be performed,

— the volume of material examined in relation to the material grain size and the envisaged stress state,

— the selection of the stress-free reference (sample) facilitating the residual strain calculation, and

— the methods available for deriving residual stresses from the measured strain data.

Procedures are presented for calibrating synchrotron X-ray diffraction instruments, enabling:

— accurately positioning and aligning test pieces;

— precisely defining the volume of material sampled for the individual measurements;

and also for:

— making measurements;

— carrying out procedures for analysing the results;

— determining their uncertainties.

The principles of the synchrotron X-ray diffraction technique are described and put into perspective with EN 15305:2008 and EN ISO 21432:2020, which are used to measure stresses in the bulk of a specimen.

2 Normative references

There are no normative references in this document.