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Additive manufacturing of metals - Non-destructive testing and evaluation - Defect detection in parts (ISO/ASTM TR 52905:2023)

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Additive manufacturing of metals - Non-destructive testing and evaluation - Defect detection in parts (ISO/ASTM TR 52905:2023)

Fabrication additive de métaux - Essais et évaluation non destructifs - Détection de défauts dans les pièces (ISO/ASTM TR 52905:2023)

Additive Fertigung von Metallen - Zerstörungsfreie Prüfung und Bewertung - Erkennung von Fehlstellen in Bauteilen (ISO/ASTM TR 52905:2023)

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Contents

Page

European foreword..... 3

European foreword

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Additive manufacturing of metals — Non-destructive testing and evaluation — Defect detection in parts

Fabrication additive de métaux — Essais et évaluation non destructifs — Détection de défauts dans les pièces

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Contents

Page

Foreword ... **v**

Introduction ... **vi**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 NDT potential for authentication and/or identification ... **2**

5 List of abbreviated terms ... **3**

6 Typical flaws/defects in AM ... **4**
6.1 Flaw origins/causes ... 4
6.2 Flaw/defects classification ... 4
6.3 Defect classification strategies for AM ... 12

7 NDT standards review ... **13**
7.1 Post-process NDT standards ... 13
7.1.1 ISO review ... 13
7.2 In-process NDT review ... 15

8 Standard selection structure for AM ... **18**

9 NDT techniques potential for AM only defects ... **19**

10 AM artefacts ... **28**
10.1 Design ... 28
10.1.1 Star artefact ... 28
10.1.2 À la carte artefact ... 34
10.2 Manufacturing ... 36
10.2.1 Star artefact ... 36
10.2.2 À la carte artefact ... 37

11 NDT method trials and validation using star artefact ... **38**
11.1 Experimental trials ... 38
11.1.1 X-ray Computed Tomography – XCT (MTC & GE & EWI) ... 39
11.1.2 Neutron Imaging — NI and Synchrotron radiation — SX (HZB & ESRF) ... 43
11.1.3 Thermography Testing — TT (University of Bath) ... 50
11.1.4 Resonant Ultrasound Spectroscopy methods — RUS ... 59
11.1.5 Ultrasonic testing — UT and Phase Array UT — PAUT (EWI and NIST and LNE) ... 75
11.1.6 Residual stress — RS (ILL) ... 80

12 Defect built validation star artefact (Cut-off MTC) ... **85**
12.1 Summary of procedure by XCT ... 85
12.1.1 Apparatus ... 86
12.1.2 Significance of data/interpretation of results ... 87
12.2 Summary of procedure by metallography ... 90
12.2.1 Apparatus ... 91
12.2.2 Significance of data/Interpretation of results ... 91
12.3 Comments/observations ... 93

13 NDT trials for à la carte artefact ... **94**
13.1 Summary of procedure ... 94
13.2 Apparatus ... 94
13.3 Significance of data/interpretation of results ... 94
13.4 Comments/observations ... 97

14 Summary of the trials findings by material ... **97**

15 Main conclusions ... **101**

Annex A (informative) **Causes and effects of defects in wire DED and PBF process** **104**

Annex B (informative) **Review of existing NDT standards for welding or casting for application of post build AM flaws** **106**

Annex C (informative) **Star artefacts using during the trials** **111**

Annex D (informative) **Summary of star artefact manufacturing and NDT technologies for trials** **115**

Annex E (informative) **XCT parameters and XCT set up used for inspection and validation** **118**

Annex F (informative) **Parameters and set up for Neutron Image (NI) and Synchrotron (Sx) inspection** **135**

Annex G (informative) **Set up for PT and SHT inspection** **141**

Annex H (informative) **Ultrasonic test** **144**

Annex I (informative) **Residual stress characterisation of Ti6Al4V by Neutron diffraction** **155**

Bibliography **157**

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM Committee F42, *Additive manufacturing technologies*, on the basis of a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on additive manufacturing, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 438, *Additive manufacturing,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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Introduction

In response to the urgent need for standards for Additive Manufacturing (AM), this document initially indicates Non-Destructive Testing (NDT) methods with potential to detect defects and determine residual strain distribution that are generated in AM processes. A number of these methods were verified. The strategy adopted was to review existing NDT standards for matured manufacturing processes which are similar to AM, namely casting and welding. This potentially reduces the number of standards required to comprehensively cover the defects in AM. For identified AM unique defects, this document proposes a two-level NDT approach: a star artefact as an Initial Quality Indicator (IQI) and *à la carte* artefact where an example shows the specific steps to follow for the very specific unique AM part to be built, paving the way for a structured and comprehensive framework.

Most metal inspection methods in NDT use ultrasound or X-rays, but these techniques cannot always cope with the complicated shapes typically produced by AM. In most circumstances X-ray computed tomography (CT) is a more suitable method, but it also has limitations and room for improvement or adaptation to AM, on top of being a costly method both in time and money.

This document includes post-process non-destructive testing of additive manufacturing (AM) of metallic parts with a comprehensive approach. It covers several sectors and a similar framework can be applied to other materials (e.g. ceramics, polymers, etc.). In-process NDT and metrology standards are referenced as they are being developed. This document presents current standards capability to detect which of the Additive Manufacturing (AM) flaw types and which flaws require new standards, using a standard selection tool. NDT methods with the highest potential will be tested.

TECHNICAL REPORT **ISO/ASTM TR 52905:2023(E)**

Additive manufacturing of metals — Non-destructive testing and evaluation — Defect detection in parts

1 Scope

This document categorises additive manufacturing (AM) defects in DED and PBF laser and electron beam category of processes, provides a review of relevant current NDT standards, details NDT methods that are specific to AM and complex 3D geometries and outlines existing non-destructive testing techniques that are applicable to some AM types of defects.

This document is aimed at users and producers of AM processes and it applies, in particular, to the following:

— safety critical AM applications;

— assured confidence in AM;

— reverse engineered products manufactured by AM;

— test bodies wishing to compare requested and actual geometries.

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 11484, *Steel products — Employer's qualification system for non-destructive testing (NDT) personnel*

ISO/ASTM 52900, *Additive manufacturing — General principles — Fundamentals and vocabulary*

ASTM E1316, *Terminology for Nondestructive Testing*

EN 1330-2, *Non-destructive testing — Terminology — Part 2: Terms common to the non-destructive testing methods*