

ISO/ASTM TR 52905:2023-06 (E)

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

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