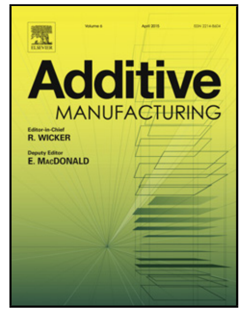
Accepted Manuscript



Title: Standardized X-ray tomography testing of additively manufactured parts: a round robin test

Authors: Anton du Plessis, Stephan G. le Roux

PII: S2214-8604(18)30579-7
DOI: https://doi.org/10.1016/j.addma.2018.09.014
Reference: ADDMA 503

To appear in:

Received date: 3-8-2018
Revised date: 5-9-2018
Accepted date: 11-9-2018

Please cite this article as: du Plessis A, le Roux SG, Standardized X-ray tomography testing of additively manufactured parts: a round robin test, *Additive Manufacturing* (2018), https://doi.org/10.1016/j.addma.2018.09.014

Standardized X-ray tomography testing of additively manufactured parts: a round robin test

Anton du Plessis [1,2*], Stephan G le Roux [2]

[1]Physics Department, Stellenbosch University, Stellenbosch, South Africa 7602

[2]CT Scanner Facility, Stellenbosch University, Stellenbosch, South Africa 7602

[*]email: anton2@sun.ac.za tel: +27 21 808 9389

Highlights:

- Successful round robin test conducted using various additive manufactured part producers of the same test parts
- Participants from various industrial and academic departments contributed identical parts
- Various intentional and unintentional defects identified
- Porosity/defect distribution extends from coupon samples to complex parts in general
- Witness specimen positively identifies layered stop-start flaw induced intentionally

Abstract

Micro computed tomography (microCT) allows non-destructive insights into the quality of additively manufactured parts and the processes that produce them. MicroCT has been used widely in this industry but the use of this technique is often time consuming and costly which reduces its potential impact and the benefits associated with its use. By using standardized test procedures, the analysis time and cost can be minimized and confidence in obtained results increased. A round robin test was conducted as follows: a series of standard test procedures (part sizes and shapes and test protocols) were applied - using one microCT system - to identical parts produced on a variety of metal additive manufacturing systems (specifically laser powder bed fusion systems). These are simple parts: a 10 mm cube, a 15 mm diameter vertical-built cylinder and a basic topology optimized example part – a bracket. The 15 mm diameter cylinder acts as witness specimen for the build of the complex part. All these were produced in Ti6Al4V, and in some cases parts were provided with variations in process parameters or manufacturing conditions which led to different types of intentional manufacturing flaws or defects. Various intentional and unintentional flaws were identified and quantified. The major result shown is that the analysis of a simple 10 mm cube clearly identifies incorrect process parameters even for very low levels of porosity, with unique porosity distributions and characteristics. It is found that generally this porosity extends to larger, more complex parts. The witness specimen (15 mm cylinder) allows clear identification of layered stop-start flaws, at a resolution better than a complex part built alongside it, allowing to identify defective builds. The