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Additive manufacturing for automotive — Qualification principles — Generic machine evaluation and specification of key performance indicators for PBF-LB/M processes

Fabrication additive pour l'automobile — Principes de qualification — Évaluation générique de la machine et spécifications des indicateurs clefs de performance pour les procédés PBF-LB/M

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Foreword

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Introduction

This document provides a methodology to evaluate PBF-LB/M AM-machines in the context of automotive on an objective basis. The need to provide a document standardizing this topic exists because in high-volume industrial production, the reproducibility of the produced component is crucial to meet production goals. Therefore, reproducibility and capability of the machines used for manufacturing need to be evaluated upfront. A methodology and performance characteristics are introduced to enable the evaluation on an objective and quantitative basis. The documentation resulting from the AM-machine evaluation is used to obtain a reliable orientation selection and evaluation of PBF-LB/M AM-machines.

Moreover, the document provides guidelines for machine production key performance indicators (KPIs) which can be used in procurement, production planning and production to improve the understanding between the machine manufacturer and user. The KPIs to be determined within the scope of this document help to systematically evaluate the performance of PBF-LB/M machines. However, this does not necessarily guarantee that the KPIs can always be used to select the most suitable machine for a specific application scenario. Since a large number of very specific influencing factors affect the selection of an optimal machine, situational, individual parameters must be included in the decision. However, the KPIs can form the basis for this decision.

The requirements regarding quality and planning of build jobs are specific for the automotive industry. The introduced generic approach can be expanded to other industries.

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Additive manufacturing for automotive — Qualification principles — Generic machine evaluation and specification of key performance indicators for PBF-LB/M processes

1 Scope

This document specifies the methodology for generic AM-machine evaluation in automotive environment using objective test criteria and provides the framework for an objective AM-machine evaluation and comparison. This document finds application in benchmarks, in the preparation of purchase decisions, but also in AM-machine evaluation within the machine procurement, acceptance, and qualification processes. This document is specific to automotive, as it is related to existing series part requirements of various original equipment manufacturers, but the content can be transferred to other industries if necessary.

Furthermore, this document specifies machine KPIs in the context of machine procurement, production planning and production of PBF-LB/M components. It aims to reach a detailed understanding between machine supplier and machine user with respect to the acceptance criteria during the procurement process and evaluation of machine performance during running production. For using this document, all process parameters, such as scanning speed, laser power, etc., are fixed, since changing these parameters can affect the entire process performance and its stability. Therefore, variables are not changed any more during or after qualification. This document and the determination of the KPIs help in the evaluation of machine properties, but do not replace an application-specific approval process.

This document is applicable to the additive manufacturing technology PBF-LB/M.

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 3369, *Impermeable sintered metal materials and hardmetals — Determination of density*

ISO 4499-4, *Hardmetals — Metallographic determination of microstructure — Part 4: Characterisation of porosity, carbon defects and eta-phase content*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 25178 (all parts), *Geometrical product specifications (GPS) — Surface texture: Areal*

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

ISO/ASTM 52902, *Additive manufacturing — Test artifacts — Geometric capability assessment of additive manufacturing systems*

ISO/ASTM 52928, *Additive manufacturing — Feedstock materials — Powder life cycle management*

ASTM E8M, *Standard test methods for tension testing of metallic materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO/ASTM 52900 and the following apply.

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