

## Lean Production to Increase Reproducibility and Work Safety in the Laser Beam Melting Process Chain

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**Abstract :** Additive Manufacturing processes are becoming increasingly established in the industry for the economic production of complex prototypes and functional components. Laser beam melting (LBM), the most frequently used Additive Manufacturing technology for metal parts, has been gaining in industrial importance for several years. The LBM process chain – from material storage to machine set-up and component post-processing – requires many manual operations. These steps often depend on the manufactured component and are therefore not standardized. These operations are often not performed in a standardized manner, but depend on the experience of the machine operator, e.g., levelling of the build plate and adjusting the first powder layer in the LBM machine. This lack of standardization limits the reproducibility of the component quality. When processing metal powders with inhalable and alveolar particle fractions, the machine operator is at high risk due to the high reactivity and the toxic (e.g., carcinogenic) effect of the various metal powders. Faulty execution of the operation or unintentional omission of safety-relevant steps can impair the health of the machine operator. In this paper, all the steps of the LBM process chain are first analysed in terms of their influence on the two aforementioned challenges: reproducibility and work safety. Standardization to avoid errors increases the reproducibility of component quality as well as the adherence to and correct execution of safety-relevant operations. The corresponding lean method 5S will therefore be applied, in order to develop approaches in the form of recommended actions that standardize the work processes. These approaches will then be evaluated in terms of ease of implementation and their potential for improving reproducibility and work safety. The analysis and evaluation showed that sorting tools and spare parts as well as standardizing the workflow are likely to increase reproducibility. Organizing the operational steps and production environment decreases the hazards of material handling and consequently improves work safety.

**Keywords :** additive manufacturing, lean production, reproducibility, work safety

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