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Defectoscopy of Direct Laser Sintered Metals by Low Transmission Ultrasonic Frequencies

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Abstract:

This paper focuses on the improvement of ultrasonic defectoscopy used for machine elements produced by direct laser metal sintering. The direct laser metal sintering process introduces the mixed metal powder and performs its subsequent laser consolidation in a single production step. Mechanical elements manufactured by laser sintering often contain many hollow cells due to weight reduction. The popular pulse echo defectoscopy method employing very high frequencies of several GHz is not successful on these samples. The aim of this paper is to present quadraphonic transmission ultrasound defectoscopy which uses low range frequencies of few tens of kHz. Therefore, the advantage of this method is that it enables defectoscopy for honeycombed materials manufactured by direct laser sintering. This paper presents the results of testing performed on AlSi12 sample.

Keywords: *Direct laser metal sintering; AlSi12; Ultrasonic defectoscopy; Quadraphonic transmissional ultrasonic defectoscopy.*

1. Introduction

Laser metal sintering, also known as a generative production procedure, is a process that enables the manufacture of individual prototypes of machine elements. This technology can be successfully used for the production of individual prototypes of small series machine elements [1]. Conventional subtractive processes that have significant circular and linear tool movements such as drilling, milling, polishing etc., are used for material modelling. Laser sintering uses three-dimensional CAD data to create one by one thin layers of metal powder [2]. Energy source for sintering are various types of lasers that have power range from 200 W to 400 W. Next to the gas lasers types HeCd, Ar or CO_2 laser, the most common used solid state lasers are Nd:YAG or YAG-lasers.

Laser sintering has a range of advantages:

- increasing the production procedure ("time to market") in just a few hours (5 to 20 cm^3 per hour), starting with a CAD construction of a complete product,
- high level of automation and high product precision,
- reduction of production and labour costs,
- new possibilities of logistics: reduction of storage expenses, ability to produce small series and a wide range of products,

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