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Abstract

Modeling of Laser-Assisted Cutting of Thin-Walled Steel Gears †

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The article provides information on the theoretical foundations, technological processes, and equipment used for the laser cutting of gears from thin-walled (4–10 mm thick) steel, which has received the widest industrial application of all laser processing technologies. The process of cutting a light flux incident on a material, partially absorbed by the surface of the material, the molten film, and the side surfaces of the cut, and partially reflected, has been studied.

Physical phenomena in the cutting cavity and models for calculating the main technological parameters of the process are considered. In addition, an assessment is made on the dry laser cleaning technology used on the surface of a solid from contaminated particles based on the rapid heating and thermal expansion of radiation-absorbing particles or the surface layer of the base material via a pulse of laser radiation. Recommendations are given for the selection of cutting modes for steel materials using continuous and pulse-periodic radiation from industrial lasers.

The measurements made it possible to determine the values of the specific radiation energy for different thicknesses of the material being cut. According to our calculations, the specific energy required to heat up to the melting temperature and melt a unit volume of steel was 12 J/mm^3.

The specific radiation energy decreased monotonically after increasing the thickness of the material being cut. However, the measured p value was greater than the calculated value. It can be assumed that the decrease in specific radiation energy when cutting thick workpieces may be due to a more efficient use of the oxygen jet.

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