

Manufacturing of Aluminum-Based Alloy Y-Axis of Laser Machines and Investigation of the Impact on Carbon Footprint

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Abstract: Nowadays, the rapid development of technology increase fiber laser cutting machine's cutting dynamics day by day, these dynamics, such as speed, acceleration, and jerk, refer to the quantitative measures used to describe the motion of an object. In order to enhance these dynamics, it is imperative to modify the design of the motion mechanism. We can employ more powerful electrical or magnetic motor for motion system however dimensional constraints limits this implementation. The aim of this study evolves mechanical design and manufacturing material of Y axis. "Y axis" significant part of the machine which assembly "fiber cutting head" resemblance bridge over the machine main body. Steel alloys predominantly recognize as preferred manufacturing alloy material for this part on account of manufacturing in addition processing of steel parts comparatively effortless than aluminum-based alloys additionally welding and assembly process require more knowledge than production of steel alloys-based material. Aluminum is an economically viable and lightweight metal with the ability to undergo heat treatment and withstand relatively high levels of stress. It ranks among the easily produced high-performance materials, thereby contributing to reduced manufacturing and maintenance costs. Aluminum production process known higher level carbon dioxide emission. "Aluminum Institute reported 11.2 t CO₂/t Al through primary aluminum production and 0.2 t CO₂/t Al through secondary aluminum production." "World Steel Association, in the year 2020 data's when examining the average emissions per unit of steel produced in 2020, it is each metric ton of steel contributed to the release of approximately 1.89 t CO₂/t into the atmosphere." Based on the presented data, it is evident that the carbon dioxide emissions associated with the production of 1 ton of aluminum are approximately six times higher than the carbon dioxide emissions from steel production. The incorporation of an aluminum-based Y-axis in the machinery has led to a notable reduction in weight. Consequently, the two servo motors responsible for actuating this component will consume less electrical current during its operation throughout the machinery's operational lifespan. This decrease in electrical power consumption is expected to translate into a discernible advantage in terms of CO₂ emissions over a specific timeframe, thereby will make aluminum bridge a probably more environmentally favorable choice. This article provides of how to enhance of machine dynamics with using aluminum based "Y axis" in addition that such as carbon footprint, manufacturing process. Upon the conclusion of the research, a comprehensive analysis will be provided regarding the advantages and disadvantages of employing an aluminum "Y axis" rather than a steel "Y axis" in terms of design considerations.

Keywords: Laser cutting machine, Carbon footprint, Manufacturing methods, Material and metallurgy.