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Advanced Optimization of Grooving and Boring Bar Operations in CNC Turning for Superior Precision, Efficiency, And Surface Quality

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ABSTRACT- This abstract outlines the critical aspects of boring and grooving operations performed on CNC turning centers. These essential machining processes enable the creation of internal cylindrical features and precise circumferential recesses, respectively, crucial for manufacturing complex components. The abstract will delve into key considerations for successful boring, including tool selection (boring bars, inserts), cutting parameters (spindle speed, feed rate, depth of cut), and strategies for achieving desired bore diameters and surface finishes while mitigating issues like chatter and tool deflection. Similarly, the abstract will address grooving operations, focusing on tool selection (grooving tools, insert widths), feed and speed optimization, and techniques for effective chip evacuation and achieving accurate groove dimensions and profiles. Furthermore, common challenges encountered in both operations, such as tool wear, vibration, and dimensional inaccuracies, will be discussed, along with potential solutions and best practices for maximizing efficiency and part quality in CNC turning center environments.

INTRODUCTION *(Size 11, Times New roman)*

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METHEDOLOGY-

1. Experimental Methodology

1.1Experimental Setup,

1.1.1 CNC Machine and Controller Details:

Experiments were conducted on a HAAS ST-20 CNC Lathe equipped with a Haas CNC control system. [Specify machine specifications like spindle power.

1.1.2 Workpiece Material Specification:

Workpieces were made of Aluminum 6061-T6, a commonly used aluminum alloy known for its machinability and good strength-to-weight ratio. The material was in the form of cylindrical bars with a diameter of [e.g., 50mm] and length of [e.g., 100mm].

1.1.3 Cutting Tools Used:

Grooving Tool:

[Specify manufacturer, tool style, insert grade, e.g., Kennametal KGTGR1616J-26, KC725M grade carbide insert, 3mm groove width]. Tool overhang was maintained at [e.g.,20mm].Boring Bar:[Specify manufacturer, boring bar type (steel, carbide, damped), shank diameter, insert type, e.g., Sandvik Coromant A25T-SVUCR 16, steel boring bar with VBMT 160404-UF 4325 insert]. Boring bar overhang was [e.g., 80mm].

DIAGRAM;

BORING AND GROOVING OPERATION as shown in Figure 1&2

1 . BORING OPERATION

2 . GROOVING OPERATION

CONCLUSIONS

The defect analysis of CNC-turned top bearing housing components using the 4M approach (Man, Machine, Material, and Method) has provided valuable insights into the root causes of defects and their potential solutions. Through systematic evaluation, it was observed that common defects such as dimensional inaccuracies, surface roughness issues, and chatter marks primarily stem from improper tool selection, worn-out inserts, machine misalignment, and inconsistencies in raw material properties. Addressing these issues requires a multi-faceted approach. Proper training and skill development of operators (Man) can significantly reduce manual errors and enhance process efficiency.

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