Measuring of positioning, circularity and static errors of a CNC Vertical Machining Centre for validating the machining accuracy

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ABSTRACT

A CNC machine tool performance depends on the machine accuracy status which is very important to determine the end product compliance to the specification. The accuracy of the machine can be measured and analyzed; hence the errors’ impact can be predicted on a workpiece. This paper presents three types of accuracy tests performed on a CNC Vertical Machining Centre, how the accuracy status affect the end product quality and what are the corrective actions to be taken. First, the laser test to determine the linear positioning accuracy, second the ball bar test to determine the circularity accuracy and third, the static accuracy test to determine the machine current static accuracy status and finally the cutting test to determine the actual machine accuracy effect on a work piece. Machine tool’s errors can be diagnosed and minimize or eliminated by either electronic compensation or mechanical maintenance and sometimes both need to be done.

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1. Introduction

Manufacturing industries have been using CNC machine tools to control the quality of their product and to improve the production efficiency. The leverages of CNC machine tools in industries can improve the company capability to meet market demand which is fast and increasing. High demand in precision product manufacturing is one of the key elements of CNC machineries application in the manufacturing industries [1]. The accuracy of machining processes are very critical in meeting complex products with tight dimensional tolerances. The accuracy of machine parts depends on the machine accuracy. The state of machine tool accuracy has a huge impact on the quality of the end products [2].

However, errors in machining can cause inaccuracies to the process which directly affect the quality of the end products. The sources of the general machining errors include table positioning, cutting parameters, thermal response characteristics, geometric dynamic, machine geometric defect, vibration and wear of the cutting tools [3]. Many studies have been carried out on the methods to identify measure and overcome the errors.

Machining errors are unfavourable and hard to avoid once they emerge during machining, but they can be identified and measured, therefore counter measure can be taken to minimize or eliminate the source. Mekid and Ogedengbe [4] have identified three main sources of errors namely geometrical errors, thermal induced errors and load induced errors. They have also classified these errors...