

The analysis of CG measuring machine using Gauge Repeatability and Reproducibility

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Abstract— The Center of Gravity (CG) is a significant parameter for military vehicles such as launching and amphibious vehicles. This paper presented the approach to evaluate the reliability of the CG measuring machine. The value of accuracy and uncertain of the machine was demonstrated by using Gauge Repeatability and Reproducibility (GR&R) method that repeatedly compares the value of the whole weight with the CG position of vehicle. The measured data, providing the official standard information, was compared with the commercial vehicle. The experimental results were verified the reliability of repeatability and reproducibility of the CG finding machine with acceptant value.

Index Terms— center of gravity, CG, repeatability, GR&R reproducibility

I. INTRODUCTION

For vehicle industry, the ability to reproduce parts or finished vehicles is very important. Equipment or measurement tools are necessary to reach the level of acceptable standard. One of values that has to be controlled is the total weight and the center of gravity (CG) of vehicle. These are the fundamental parameter that affects the vehicle handling and also the traffic safety. For military vehicle like amphibious vehicle, the CG is used to calculate the hydraulic power of each propeller to accomplish the swimming condition. Preliminarily, the CG was calculated from the shape of geometry. Thereafter, technological advances and engineering software are higher and more widespread. The total weight and the CG are principally calculated by using CG-measuring function on 3D CAD model, but there is difficulty to collect the density of each component and arrange layout. To minimize these disadvantages, the CG measuring machine was applied. In order to have high-quality product, the efficiency and the high reliability of the machine are very important. Therefore, this measurement machine is verified

This article represents the simple methods to qualify the CG measuring machine with nominal weight 1,000 kg the number of test is six and the variation is based on military and standard default vehicles. The result is analyzed using Gauge Repeatability and Reproducibility (GR&R) method to inspect the repeatability and uncertainty of the machine.

II. MACHINE DESCRIPTION

Fig.1 shows the block diagram of the CG measuring machine. Each axels cell represents one axle of a vehicle comprising two weight scales which have a capacity within range 0 – 1500 kg. The data of each cell is sent to the controller to analyze and show in display monitor in the form of digital numbers which are data weight of each wheel, each axle, each CG (CGx, CGy, and CGz) and the total weights of vehicle. The maximum and minimum number of axels cell is four and two respectively.

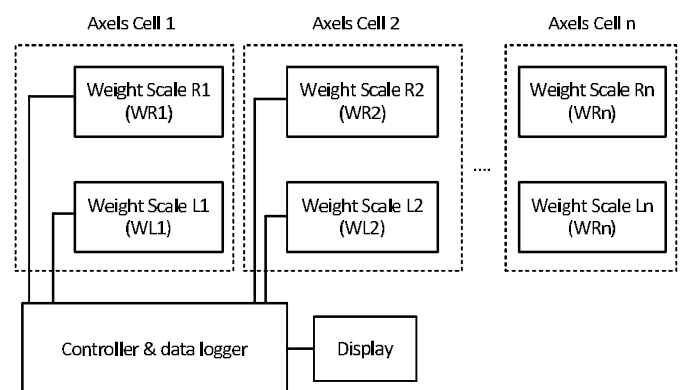


Fig. 1 Block diagram of the CG measuring machine



Fig. 2 the final result of the CG measuring software