The Ohio Department of Transportation
Office of Research & Development
Executive Summary Report

Portable Bench Tester for Piezo Weigh-in-Motion Equipment

Start Date: 1 March 2004

Duration: 26 Months

Completion Date: June 2006

Report Date: June 2006

State Job Number: 134157
Agreement No.: 20358
CFDA No.: 20.205

FHWA Report Number:

Funding: $ 129,455.00

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Problem

The Ohio Department of Transportation's (ODOT) piezo weigh-in-motion (WIM) equipment must be tested for initial working operation and to insure continued correct operation. Currently, the only available method to verify the vehicle classification parameters of the piezo WIM equipment is field-testing. Field-testing requires either duplicate WIM equipment and sensor installations or a single sensor installation site coupled with manual counts to provide the basis for evaluation of the device under test. Both the duplicate equipment and the manual counting methods are expensive, time intensive, and expose the field personnel to roadway hazards. Manual counting may also introduce human error, and provides no basis of evaluation for the weighing accuracy of the device under test.

Objectives

The objective of this proposed effort was to develop a bench-top WIM tester, similar to the ATSI model ATRT-1700, that tests the counting, classification, and weighing capability and accuracy of ODOT's piezo WIM equipment. The tester setup method was to provide flexibility and ease of use through a setup program which operates on a modern Microsoft Windows-based PC. The tester simulates up to eight lanes of sensor outputs (piezo-loop-piezo). The output signals produced should allow testing of different classification schemes on ODOT's piezo WIM equipment. The tester will adjust all pulses, depending on the user choice of vehicle type, axle weights, and speed. All timings and output waveforms should be accurately simulated by the tester outputs.

Description

ATSI examined the available data on impedance of typical piezo sensors. Small circuits were prototyped to test only output signal characteristics with the WIM devices provided by ODOT.

The communications and other necessary components were then added. ATSI and ODOT developed the details for cabling and PC software.

The prototype was built and used for firmware development as well as testing the complete system, including the Microsoft Windows XP-based PC.

The simulated loop and piezo outputs were tested to ensure quality of signals. The amplitude, pulse width and shape of the waveforms were measured and analyzed. The inductance changes of the loop outputs were measured and verified.

The outputs were then connected to a WIM vehicle classifier to test for compatibility and viability.

A hardware unit was constructed. The unit includes power supplies and all other necessary electrical hardware. The tester interfaces with WIM vehicle classifiers via removable cabling.

A final PCB was manufactured to include all necessary changes made to the prototype, and the proper working functionality was ensured.

ATSI developed software with ODOT review and feedback. The interface software was tested to ensure Microsoft Windows XP (TM) compatibility, as well as upload and download of information to the tester. Total system testing was accomplished and demonstrated with the piezo WIM classifier supplied by ODOT.

The complete WIM tester unit was delivered to ODOT.

Conclusions & Recommendations

The WIM Tester can be used to answer questions about the accuracy and effectiveness of current WIM data collection, and the relative performance of WIM devices. This will allow flexibility and reduced costs in testing these devices. Almost any imaginable vehicle can be easily simulated and repeated over multiple channels (lanes) will little effort from the user and safe from all roadway hazards.

Implementation Potential

ODOT can verify that new equipment is working properly before being used in the field, reducing errors in data collection. The WIM Tester will be capable of bench testing piezo WIM systems before returning them for repairs and, upon return, verify repairs were correctly carried out.

ODOT will also be able to verify the accuracy of their piezo WIM equipment in a more timely, automated fashion. The various classification schemes can be tested without having to subject its field crews to roadway hazards.

ODOT can better define the minimum values required by WIM equipment. These values will result in field technicians having better acceptance values for testing existing piezos.

The WIM Tester provides a new tool to improve the quality of roadway usage data for the transportation profession.