

## Achieving ASTM 1318-02 WIM Functional Performance Requirements

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January, 2003

### Introduction

Weigh-in-Motion (WIM) systems for vehicle weighing consist of a dynamic vehicle tire force sensor and the associated electronics for interpreting, recording, and communicating weight data. The primary purposes of WIM systems are to:

1. Record weight data for road use analysis and pavement research projects.
2. Pre-screen trucks to aid the commercial vehicle weight enforcement operation.
3. Use weight information to calculate tolls on toll roads, bridges, or tunnels.

Many papers have been written comparing the various WIM technologies, installation criteria, and life cycle costs. The purpose of this paper is to highlight WIM scale design principles that METTLER TOLEDO believes to be critical to achieving the ASTM 1318-02 functional WIM performance requirements.



Figure 1: ASTM 1318-02

ASTM 1318-02, Standard Specification for Highway Weigh-in-Motion (WIM) Systems, is referenced in many State Department of Transportation weigh station specifications. ASTM 1318-02 has allowed state highway engineers to reference a performance based specification, installation practices, and test methods that are also available to equipment vendors and contractors. The overall objective is to ensure that capable WIM equipment is installed properly and performs in such a way that accurate data will be reported.

Section 5 of ASTM 1318-02 outlines the performance requirements of a WIM system. The required performance requirements and the typical applications by Type are summarized in Table 1.

Function	Tolerance for 95% Probability of Conformity				
	Type I	Type II	Type III	Type IV	
				Value (lb)	Tolerance
Speed Range	10 - 80 mph	15 - 80 mph	10 - 80 mph	2 - 10 mph	
Application	Data collection	Data collection	Aid weight enforcement	Weight enforcement	
Wheel Load	+/- 25%	n.a.	+/- 20%	5000	300
Axle Load	+/- 20%	+/- 30%	+/- 15%	12000	500
Axle Group Load	+/- 15%	+/- 20%	+/- 10%	25000	1200
GVW	+/- 10%	+/- 15%	+/- 6%	60000	2500
Speed	+/- 1 mph				
Axle Spacing	+/- 0.5 ft				

Table 1

**Linearly Proportional Load Sensing**

Section 5.13.1 states that sensors shall be linearly proportional, within 2% of applied load, at 10%, 50%, 90% of sensors rated capacity. Additionally, it is stated that the applied load shall be placed at the center and approximately 18" from each end of the sensor. In order to achieve this accuracy it is critical to design the sensor such that location of the applied load on the weighing platform doesn't significantly affect the measured weight. For a load cell base system it is therefore important that multiple load cells for each platform be used. METTLER TOLEDO uses four load cells for each six foot wide weighing platform.

METTLER TOLEDO WIM systems are designed to weigh uniformly across the full width of the scale platform. Prior to commissioning each WIM system is certified to meet ASTM 1318 Type III tolerance values both statically using NTEP certified test weights, as well as dynamically using a certified test truck.

**Acceptance Testing**

Section 7.6 defines recommended on-site acceptance tests for WIM systems. It is recommended that a minimum of 20 test runs using two different test vehicles be made to determine if the tolerance defined in Table1 are achieved. It is also stated that at least two of the runs shall be with the tires near the edge of the scale.

METTLER TOLEDO believes that it is critical to have a more rigorous acceptance test to confirm the WIM system's performance over an extended time period with many different vehicle types. Typically a 56 consecutive days acceptance period is used in METTLER TOLEDO WIM installations. Thousands of WIM readings are compared to static scale values to ensure compliance with ASTM 1318-02 performance requirements. METTLER TOLEDO hardware and software design provides an automatic link between WIM and static scale weight data, with fast, simple accuracy reports being created. Acceptance period test data from many METTLER TOLEDO installations indicates a gross weight tolerance of +/- 3% at a 95% confidence level.

**Calibration**

Section 7.5 recommends a minimum of annual calibration of WIM systems. For weigh stations with both an ASTM Type III WIM system and a static scale, METTLER TOLEDO's closed loop calibration technology provides continuous WIM scale calibration.

Moving forward, METTLER TOLEDO will continue working with state highway departments and other WIM system users to ensure that the latest WIM technology is employed, and that even newer technology will continue to be developed which will lead to the most accurate, reliable in-motion weighing possible.



WIM Platform                      WIM Controller Enclosure  
Figure 2: Typical Type III WIM Scale