

# Scale Manufacturers Association

## Standard

### RFI/EMI Field Test Procedures For Electronic Scales



Second Edition

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## FOREWORD

The subject of Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI) and their effects on electronic equipment is extremely complex to predict or evaluate.

Comprehensive testing methods exist in both military and commercial documentation including standardized tests for OIML certification, but all of these methods are based on evaluation within a controlled laboratory environment. In the process of establishing a field test procedure, we have been cautious in applying simple methods of testing to evaluate complex problems. Acceptable performance of the scale system to the test procedures described in this document, will indicate/support claims that it is reasonably immune to EMI/RFI, acknowledging that the test may have been influenced by uncontrolled factors.

This procedure, therefore, can serve only as a guide to the Weights and Measures Official to help determine if the scale will perform in the presence of EMI/RFI that may be encountered in normal use and if not, to assist in identifying the source of the problem.

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## **1. Scope**

This document defines a field test procedure which applies to all electronic scales used for determining a weight value for the intent of indicating, printing or transmitting this value, or using this value as part of a price computing feature.

## **2. Purpose**

- 2.1 The procedure is intended to serve as a guide for use by Weights and Measures personnel in the evaluation of electronic scale susceptibility to Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI).
- 2.2 These tests are intended to provide a means to determine whether a reasonable confidence exists that the electronic scale will perform satisfactorily during normal operation while in the presence of potential EMI/RFI signals.

## **3. General**

### **3.1 Fundamental Considerations**

- 3.1.1 Radio frequency interference may originate from many common sources such as mobile communications equipment, commercial radio, TV broadcast transmitters, cell phones, and common wireless communication networks that are part of the scale or other electronic instruments. In some cases, the source of the interference may be located near the scale where in other cases the source may be several hundred feet or further from the scale.
- 3.1.2 Electromagnetic interference may originate from many sources but generally originate from industrial sources such as the starting and stopping of large AC or DC driven motors, electrical welding instruments, or even a faulty spark plug wire on a vehicle engine. Electromagnetic interference can be transmitted over open areas (this is called a radiated signal) or it can be transmitted on existing wiring (this is called a conducted signal.)
- 3.1.3 Electronic circuits can be affected in several ways by the presence of radiated or conducted signals. For example, these signals may result in an addition or subtraction of the voltage(s) used to determine the weight value. If strong enough these signals can seriously affect digital circuits and, in some instances, if not properly suppressed, can destroy these circuits. The overall result of the interference may cause weight indications to display inaccurately, printer devices to print erroneous information, and data transmission or processing equipment to malfunction in their handling of data.

#### 4. Minimum Performance Requirements

- 4.1 Performance in accordance with the requirements of NIST Handbook 44 will define the acceptable limits for all tests outlined in this document.
- 4.2 In areas where tolerance or operational limits of the scale equipment are not specified by Handbook 44, but satisfactory operation is both implied and expected, no deterioration of performance is acceptable.

#### 5. On-site Test

- 5.1 Tests outlined in this section are subdivided into two groups. The first test establishes a means of evaluating the scale to interference signals from equipment and conditions normal to the installation site. The second test establishes a means of evaluating the scale to interference signals from equipment and conditions uncommon to the installation site but from sources that roughly simulate potential interference sources.
  - 5.1.1 Before conducting these tests it is important to understand the level of protection a device has with respect to the intended application environment. Manufacturers design weighing instruments to meet a wide variety of requirements determined by national and international standards or for specific applications. RFI signal strengths' can vary based on the application environment; however, a 3 V/m signal strength is typical for testing a weighing instrument's immunity to RFI. Understanding the intended device application and the environment in which the device is installed will prevent unintentional under or over testing conditions.
- 5.2 Testing with Equipment Normal to the Installation
  - Confirm that the device or equipment installation is consistent with any installation requirements stated by the manufacturer.
  - 5.2.1 Take the scale off zero by applying a small load and allow the indication to come to rest.
  - 5.2.2 Operate one at a time<sup>1</sup>, if possible, all electrical or electronic equipment in the vicinity of the scale such as, but not limited to:

**Caution:** Before turning ON or OFF any equipment, it is necessary to obtain the owner's permission. Do not attempt to operate equipment you are not familiar with, properly instructed to operate or trained to operate.

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<sup>1</sup> Note: It may not be possible or safe to turn OFF all equipment. If the source cannot be turned OFF and the indication is stable it will have to be assumed that the source is not a problem. In actuality a permanent RF source may be generating a permanent but stable offset – this could cause a service call if the source ever shut off or was changed out.

- Electrical or electronic equipment located near the scale or sharing the same AC outlet or circuit as the scale or indicator (such as computer, computer monitor, water coolers or portable air conditioner, fan, refrigerators, microwave oven, etc.)
- Communications equipment and networked devices. (portable, fixed based, mobile, including cell phones.)
- Motor operated equipment (such as hoists, robots, sorters, electric tools, etc.).
- Request that any surrounding internal combustion engines that might be associated with power generators, etc., be started
- When tests are being performed on a vehicle scale or any scale that may be reasonably expected to be weighing vehicles, the following additional tests may be considered:
  - If the vehicles being weighed are equipped with radio transmitters, tests should be performed with the vehicle situated on the load receiving element, and the radio equipment in transmit mode. This test should be conducted independent of the distance rule established in 5.3.2.
  - After ensuring that the scale can safely accept the vehicle, request that this vehicle with electrical discharge ignition (gasoline or propane powered) be driven on the load receiving element. Observe the scale performance as the engine is idling and as its rpm is increased within safe operational levels.

5.2.3 During the operation of the appropriate equipment mentioned above, evaluate the scale's performance to the requirements of paragraph 4.0. If the performance of the scale appears to be affected by any of the equipment used during the tests, the suspected interfering equipment should be turned ON and OFF to verify it is the source of the problem. Findings shall be noted on the test or service report.

5.2.4 Failure of the scale to perform to the requirements stated in paragraph 4.0 may be cause for rejection. Removal or suppression of the interfering source or service modifications to the scale equipment should be recommended by the official.

### 5.3 Testing in the Presence of RFI Sources

#### 5.3.1 Equipment Required:

While it would be an improbable task to define all the equipment that could be used as a source of RFI signals; the following list suggests some of the equipment commonly found in industrial and retail environments that can be used to perform the test.

- 460 MHz (commercial band) 4 watt, hand-held communicator.
- 27 MHz (citizens band) 5 watt, hand-held communicator.
- Cell phone.
- Wireless land-line phones (These are low power devices operating in the 2.4GHz, and 5GHz frequency range and do not typically cause a problem.)

5.3.2 The testing is to be performed with the communicator antenna positioned no closer than 1 meter (~ 3 feet) from the scales components, (e.g. indication, platform, exposed cables).

5.3.3 It is important to understand that the power rating (watts) of a hand-held transmitting device is the minimum power level of the device. Often, these devices are capable of transmitting at levels far greater than their published rating. It is advised that a Field Signal Strength Test Meter be available and used during the conduct of the testing. The Field Signal Strength Test Meter should be placed directly next to the instrument under test and the hand-held communicator should be moved away from the meter until the power level shown on the Signal Strength Meter is the same as the rated signal strength of the device being used for the test.

5.3.4 Test Procedure:

- Operate the communicators individually in accordance with FCC regulations, in the transmit mode while observing operation of the scale.
- Scan the electronic equipment and interconnecting cables by repositioning the communicator, taking care to observing the specified distance.

5.3.5 During the test, evaluate the scale performance to the requirements of paragraph 4.0.

5.3.6 If performance is affected beyond the limits of paragraph 4.0, by any portion of the test, the scale is to be evaluated based on its application, noting the details of performance on the test report.



## **Appendix 1: Definitions**

**Electromagnetic interference (EMI)** is the disruption of operation of an electronic device when it is in the vicinity of an electromagnetic field (EM field) in the radio frequency (RF) spectrum that is caused by another electronic device.

**Radio frequency interference**, (or **RFI**) is a type of electrical disturbance that, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance.

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