

Scale Manufacturers Association

(SMA)

**Recommendation on
Electrical Disturbance**

(SMA RED-0499)



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Approved by SMA
Pending Final Comment**

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1.0 Purpose

1.1 The purpose of this document is to clarify the issue of electrical disturbances that may influence a weighing device or may be generated by a weighing device. These disturbances manifest themselves as Radio Frequency Interference; Electrostatic Discharge; Power Line Voltage Variations and Interruptions; Power Line Electrical Fast Transients; and Power Line Voltage Surges.

1.2 This document attempts to:

- a. Describe the nature and effects of electrical disturbances on weighing devices;
- b. Recommend various third party standards that are used to regulate electrical disturbance phenomenon;
- c. Serve as the SMA Electrical Disturbance Recommendation.

2.0 Descriptions

The following section describes the nature of the disturbances and the effects that disturbances can have on weighing devices.

2.1 Radio Frequency Interference

Radio Frequency Interference (RFI) is a disturbance caused by a radio frequency source that interferes with normal operation of a weighing device (or any electronic device). The source causing interference may be from two-way radios, citizen band radios, cellular and portable telephones, vehicle radio transmitters, and various other sources.

The RFI disturbance may be coupled directly into a weighing device by a radiated RF field, or may be coupled into the weighing device by attached cables that act as receiving antennas.

The RFI may manifest itself in a weighing device as weight instability or blanking of the displayed weight value. This can occur when the interference disrupts the balance of the analog circuits in the conversion process in the weighing device. The instability normally recovers when the RFI emissions cease.

A weighing device is said to be immune to the effects of RFI if the weighing device remains stable and oper-

ates properly in the presence of RFI.

An RFI immunity requirement normally consists of a field strength magnitude over a specified frequency range. The field strength magnitude of RFI is specified in units of volts per meter (V/M) and the radio frequency range is specified in units of Megahertz (Mhz). The test signal is typically modulated to provide a realistic interference.

It is important to note that it is difficult for a weighing device to demonstrate RFI immunity under all conditions. Hand held two way radios operated in close proximity to weighing devices may cause instability depending on the field strength created by the radio's transmitter and the orientation of the antenna. Very high field strengths can occur near radio transmitters.

The goal of an RFI immunity specification is to ensure proper weighing operation in the radio frequency environment normally encountered in commercial and industrial installations.

2.2 Electrostatic Discharge

Electrostatic Discharge (ESD) is the transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact. Proximity discharges usually result in a spark through the air. An electrostatic potential is caused by a difference in displaced charge. In general the rubbing together and the separation of two non-conductors cause charge disposition. Discharges may come from human operators, or they may come from weighing non-conductive materials (rubber, plastic items, and plastic film).

The ESD disturbance can manifest itself in various ways, depending on the amplitude of the discharge. At lower amplitudes, the weighing device's display may momentarily flicker. At higher amplitudes, the weighing device may lock up, lose stored data or lose calibration. At higher levels yet, permanent damage to the weighing device can occur.

The amplitude of ESD potential is measured in kilovolts (kV). Discharges are introduced either through the air or through direct contact with the device. A weighing device is said to be immune to ESD if it maintains proper operation at some specified amplitude of discharge potential

2.3 Power Line Voltage Variations and Interruptions

Power Line Voltage Variations and Interruptions are conditions where the power voltage being supplied to the weighing device is disrupted from nominal line voltage. The weighing device may be affected when supplied voltage is above or below nominal line voltage or by complete loss of voltage for short periods. When the supply voltage is below nominal this condition is sometimes referred to as a brownout. Complete loss of supply voltage for short periods is sometimes referred to as an outage. These variations can be caused by natural means (weather); by power distribution switching activity or generating problems from the distribution system; or by wiring faults at the installation.

The disturbance may affect the weighing device in several ways depending on the type of disturbance. Low line voltage conditions may result in unstable weight or dim displays. If the line voltage drops low enough, the device will turn off. High line voltage conditions could result in blown fuses. Momentary outages may result in the device turning off and on; if the device does not re-power properly, stored data could be lost. The weighing device is said to be immune from voltage variations and interruptions if it maintains proper weighing operation over the specified ranges.

2.4 Power Line Electrical Fast Transient

Power Line Electrical Fast Transients (EFT) are low energy disturbances on the power line that may be caused by changing inductive loads, relay contact bounce, and compressors or motors turning off and on. This activity creates undesirable voltage transient on the power line. These disturbances can be coupled onto weighing device cables (load cell, printer, and data cables).

The EFT disturbance can manifest itself in various ways, depending on the voltage level, duration, and frequency of the transient. At lower levels, the weight may become unstable. At higher levels, the weighing device may lock up, or lose stored data or lose calibration. EFT disturbances will normally not cause damage to the weighing device.

The amplitude of the Electrical Fast Transient disturbance is measured in kilovolts (kV), the rise time and transient duration are measured in nanoseconds (ns), the repetition frequency in kilohertz (kHz), and the burst rates in milliseconds (ms). The weighing device

is said to be immune to EFT if it maintains proper weighing operation at the specified levels.

2.5 Power Line Voltage Surges

Power Line Voltage Surge is a high-energy disturbance on the power line or interconnecting cables. Surge creates an over-voltage situation, which is potentially damaging to the weighing device. Surges can occur due to power distribution switching activity or faults; or lightning strikes near the weighing device or lightning strikes to and near power lines connected to the weighing device. These surge voltages are in the range of several thousand volts.

Surge suppression devices are often added to electrical circuits as protection from surge disturbance.

The magnitude of the surge voltage is measured in kilovolts (kV); the rise time and surge duration is measured in microseconds (us). The weighing device is said to be immune to surges if it survives without damage.

2.6 Radio Frequency Emissions

Weighing devices using digital circuits will create and emit radio frequency interference. These emissions can affect TV and radio receivers, or interfere with other electronic devices that are in the vicinity of the emissions source. In general, as the rate of the switching of the digital circuits increase, the magnitude of the emissions will increase. As circuits operate at higher rates and the volume of electronic devices increases, the amount of radio frequency emissions in the environment is increasing.

Various standards exist worldwide to measure and limit the amount of radio frequency emissions produced by electrical devices. In the United States, the Federal Communications Commission (FCC) governs the maximum limits for radio frequency emissions. Generally weighing devices used in commercial and industrial environments, the specified limit by the FCC is referred to as Class A. Class B is more restrictive and applies to the consumer environment.

Note that compliance to the FCC regulations is a legal requirement in the United States.

3.0 Recommendations

The following is the SMA Recommendation for Electrical Disturbances for Weighing Devices:

3.1 Immunity to Radio Frequency Interference

Immunity Recommendations:

- a. Field Strength Magnitude: 3V/m.
- b. Frequency Range: 26 to 1000 Mhz.
- c. Modulation: AM modulated at 80% with 1 kHz sine wave.

Acceptance Criteria:

- a. **No change in weighing devices displayed weight value greater than +/-1 verification scale interval, (e).**
- b. No display blanking or device lock-up permitted.

Reference:

- a. European Norm EN45501 (based on OIML International Recommendation R76-1), Section B.3.4.
- b. European Norm EN61000-4-3.

3.2 Immunity to Electrostatic Discharges

Immunity Recommendations:

Amplitude: 6 kV contact, 8 kV air gap. Source circuit capacitance of 150 pF with series resistance of 330 ohms.

Acceptance Criteria:

- a. **No change in weighing devices displayed weight value greater than +/-1 verification scale interval, (e), except for momentary display flicker.**
- b. No display blanking or device lock-up permitted.
- c. No loss of stored data.
- d. No loss of calibration.
- e. No damage to the weighing device.

Reference:

- a. EN45501, Section B.3.3.
- b. EN61000-4-2.

3.3 Power Line Voltage Variations and Interruptions

Immunity Recommendations:

- a. High and Low Line Voltage Conditions: 100 to 130 VAC or 200 to 250 VAC.
- b. Voltage Reductions and Short Interruptions: Line voltage reduction of 100% for 1/2 cycle, and Line voltage reduction of 50 % for 1 cycle.

Acceptance Criteria:

- a. Weighing device will continue to operate to maintenance tolerances.
- b. No loss of stored data.
- c. No loss of calibration.
- d. No damage to the weighing device.

Reference:

- a. High and Low Line Conditions: National Institute of Standards and Technology (NIST) Handbook 44, Section T.N.8.3.1.
- b. Voltage Reductions and Short Interruptions: EN45501, Section B.3.1 and A.5.4.

3.4 Power Line Electrical Fast Transients

Immunity Recommendations:

- a. Pulse Amplitude: 1000 V at 5/50 ns rise/duration time for Power Line Connections, 500 V at 5/50 ns rise/duration time for Peripheral Cables.
- b. Pulse Repetition Frequency: 5kHz with a burst duration of 15 ms and a burst period of 300 ms.

Acceptance Criteria:

- a. **No change in weighing devices displayed weight value greater than +/-1 verification scale interval, (e), except for momentary display flicker.**

- b. No display blanking or device lock-up permitted.
- c. No loss of stored data.
- d. No loss of calibration.
- e. No damage to the weighing device.

Reference:

- a. EN45501, Section B.3.2.
- b. EN61000-4-4.

3.5 Power Line Voltage Surges

Immunity Recommendations:

Apply 1 kV at 1.2/50 us rise/decay time line to line (differential mode), 2 kV 1.2/50 us rise/decay time line to earth (common mode).

Acceptance Criteria:

- a. No loss of stored data.
- b. No loss of calibration.
- c. No damage to the weighing device.

Reference:

- a. EN61000-4-5.

3.6 Radio Frequency Emissions

Emissions Compliance:

Code of Federal Regulations (CFR) 47, Part 15, Federal Communications Commission (FCC) Class A, radio frequency emissions limits for non-residential equipment. (Legal Requirement).

4.0 References

Note: European Norms (EN) are published by the European Committee for Electrotechnical Standardization (CENELEC).

EN61000-4-2, Electrostatic Discharge.

EN61000-4-3, Radio Frequency Interference.

EN61000-4-4, Electrical Fast Transient.

EN61000-4-5, Surge Immunity.

EN45501 based on International Organization for Legal Metrology (OIML), International Recommendation R76-1.

National Institute of Standards and Technology (NIST) Handbook 44.

Code of Federal Regulations (CFR) 47, Part 15. "Radio Frequency Devices".

5.0 Definitions

Coupling: Interaction between circuits, transferring energy from one circuit to another.

Disturbance: Any phenomenon that may degrade the performance of a device, equipment, or system.

Electrical disturbance: Any electrical phenomenon that may degrade the performance of a device, equipment, or system.

Electrostatic discharge: ESD: A transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact.

Immunity (to a disturbance): The ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

Surge: A transient wave of electrical energy propagating along a line or a circuit and characterized by a rapid increase followed by a slower decrease.

Transient: Pertaining to or designating a phenomenon or a quantity, which varies between two consecutive steady states during a time interval, which is short, compared with the time-scale of interest.

Weighing Device: a collection of components that constitute a system that weighs and provides a weight indication or value via a scale or display.



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