

Global EMC Requirements for Gas and Flame Products

Introduction

When certification is considered for Hazardous Location (HazLoc) products, the first thought that comes to mind is safety. Safety has a very specific meaning in the context of HazLoc certifications – the instrument itself, by its design or construction, must not be the cause of a safety problem or incident. Gas or flame detection instruments are capable of rapid, accurate detection of flame or gas events that could lead to a safety incident if present in those environments. The assumption is that the gas or flame detectors will work as intended in a hazardous location under any condition, normal or abnormal.

What is not generally considered is the electromagnetic environment in which these devices are expected to function reliably. Radio Frequency (RF) energy can also affect safety by interfering with the intended function of a gas or flame detector, causing false readings, spurious alarms and other serious malfunctions.

There are several sources of unwanted RF energy present in hazardous locations that could cause disruptions to the instrument function itself or to communications between a control network and the instrument;

- Push-To-Talk (PTT) VHF and UHF radios and other intended communication devices such as cellphones or even nearby transmitter towers;
- Large inductive motors that when switched on and off through distributed DC power networks, causing high magnitude RF noise;
- Lighting ballasts can also be a source of impinging RF energy that could potentially cause interruptions of service to critical hazard detection equipment.

Poor electrical circuit design can actually radiate RF energy and interfere with itself or equipment co-located with it.

The net result is that HazLoc equipment has to be able to perform its intended function reliably in a potentially harsh RF environment, and this is measured and validated by conformance to specific Electromagnetic Compatibility (EMC) standards.

As with HazLoc certifications, there are several different EMC standards that need to be met depending on the market being targeted and the type of equipment being examined.

In most countries except the United States, it is mandatory to prove that products can function as intended in an unfavourable RF environment. The required Immunity to interfering sources depends on the intended location of installation. Equipment destined for installation in an industrial location is required in most cases to be more immune than equipment destined for the residence.

Certification organizations such as Factory Mutual (FM) specify tests aimed at simulating RF conditions likely to be encountered in the workplace, such as the keying of a Push To Talk VHF or UHF radio by a member of a maintenance crew in proximity of a detector or its wiring.

Emissions Overview

All electronic equipment produced globally for commercial or industrial use must demonstrate compliance to mandated RF radiation limits, commonly known as “radiated emissions”. Emissions can be intended (such as the radio transmission of a cellphone or Wi-Fi device) or unintended (emissions that are a byproduct of the circuit function). Radio-frequency emissions can also be propagated through a cable; such emissions are known as “conducted emissions”.

In the United States, the Federal Communications Commission (FCC) established its rules regarding Emission limits in 1975 with the creation of Part 15(B). Emissions testing is required on any device that satisfies the following definition:

- *Digital device*: "An unintentional radiator...that generates and uses timing signals or pulses with a frequency > 9 kHz, and uses digital techniques." This applies to personal computers, peripherals, and other equipment using clocks and logic circuitry.

This statement applies equally to gas or flame detection equipment. All modern equipment uses digital techniques, software and logic circuits to process signals.

There are two classes of Emissions defined; Class A is defined as equipment intended for commercial purposes and Class B is equipment intended for consumer use. This is a universal definition recognized globally.

Globally, EMC compliance required by most countries is derived from standards published by the International Electrotechnical Commission (IEC). Specific European standards may also be asserted that may be more stringent. The standards that are developed and regulated are called European Normes (EN's). Designers for a company designing its products for global application, such as Emerson, need to be aware of the design implications of these worldwide EMC standards.

Depending on the type of equipment, both radiated and conducted Emissions testing is required. The FCC Emissions limits are different than those used globally although the FCC does allow compliance to global limits as sufficient proof of conformity to Part 15B, the opposite however is not true.

European Emissions requirements are defined by CISPR (Comité International Spécial des Perturbations Radioélectriques) which is part of the International Electrotechnical Commission (IEC). The technical standards defined by CISPR have been adopted by CENELEC which is the European Committee for Electrotechnical Standardization. Industry Canada has adopted the CISPR limits in ICES-003 (Interference Causing Equipment Standard).

It is worth mentioning that almost all products sold into Europe require that conformity to the required standards is assured by affixing the "CE" Mark to the product. Almost without exception, finished goods require a CE Mark. The CE Mark in turn requires that the manufacturer demonstrates compliance with all of the relevant Directives. Because of the size of the European Market, the CE Mark carries great value to manufacturers worldwide to be able to sell their products in the EU and other markets that accept CE as proof of conformity to the Directives. CE Mark requires that the product(s) in question conform to all of the directives applicable to it.

FCC part 15B is considered to be a generic requirement for radiated emissions compliance for any equipment that falls within the scope of the definition previously mentioned. Internationally, the CISPR standard has similar, but more stringent standards for radiated emissions than FCC Part 15B. As the capability of electronic equipment to operate at higher and higher frequencies has improved, these standards have been updated to require compliance to higher frequencies as well.

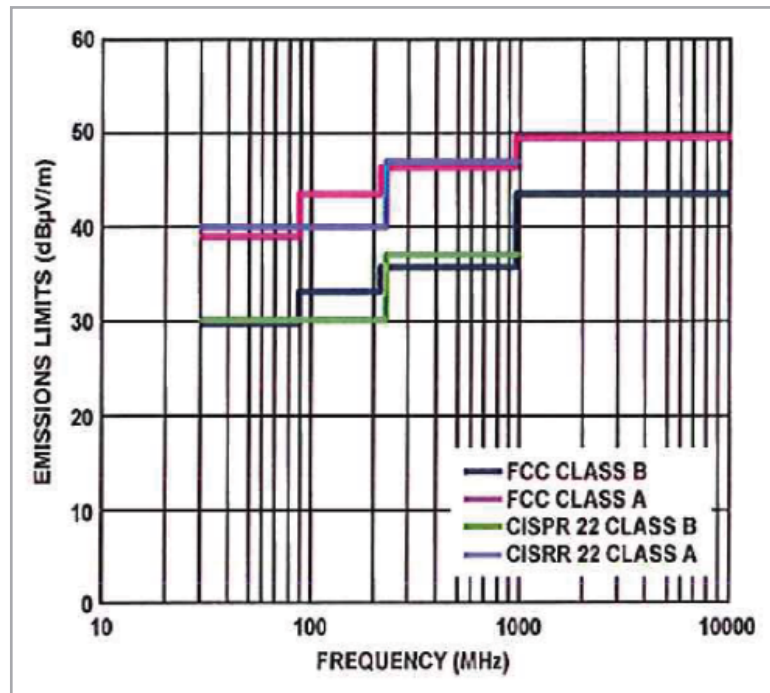


Figure 1: A comparison of CISPR and FCC Radiated Emissions Limits

As safety of process facilities has become more prominent, product-specific European Norme standards for toxic gas and combustible gas detection and flame detection have been developed in the past decade. Additionally, specific EMC standards are called out for these applications that sometimes exceed the standards typically used for commercial or industrial products, to further reduce the probability of a disruption of the instrument function.

Gas Detection

EMC requirements for Gas detection equipment is defined in EN 50270, first published in 1999. It will sometimes be referenced as EN 50270 (1999). EN 50270 calls up a family of basic EMC standards that can be found in almost every other product specific, family or generic EMC standard. The basic standards cover both emissions and immunity. What makes EN 50270 Gas Detection "specific" is a definition of the performance requirements of a particular type and range of a gas detector under impinging RF while test gas is being applied; namely, the product must continue to operate properly (detect gas and generate alarms when necessary).

GD Instrument Emissions

EN 50270 calls up as a reference CISPR 11 or CISPR 22. CISPR 11 is the Emissions standard for Industrial, Scientific and Medical (ISM) radio frequency equipment, CISPR 22 is for Information Technology Equipment. For most Gas Detection equipment, CISPR 11 is a better "fit" and the test methods and limits contained in it apply. EN 50270 also calls up the "generic" Emissions standards EN 61000-6-3 (Light Industry) and EN 61000-6-4 (Heavy Industry). The Emissions limits in EN 61000-6-4 are the same as those defined for CISPR 11 Type 2 (Industrial) equipment.

EN 50270 also calls up the "basic" family of Immunity tests. This includes:

- Radiated immunity (RF energy is directed at the unit under test through an antenna).
- Conducted immunity (RF energy is coupled into the cables that supply data and power to the instrument through a capacitive clamp).
- Fast transient / burst: where a pulse of defined rise time and energy is directed through the cables to attempt to overwhelm the protection devices in the product interface.
- ESD (electrostatic discharge): where static electricity of a specific voltage is directed at specific points of the device to attempt to disrupt or damage the device.

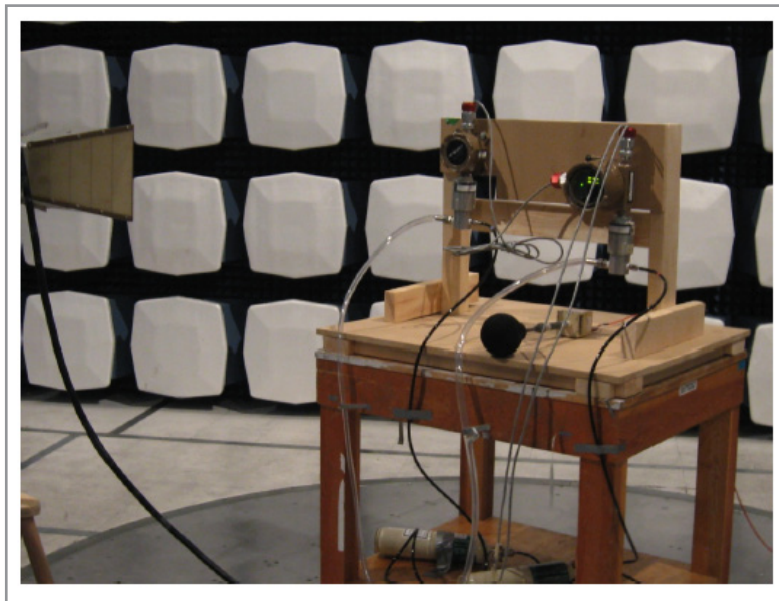


Figure 2: Radiated Immunity Testing - Millennium II with CO Sensors

If a product intended for use in a Hazardous Location has either power or signal cables typically >3 meters in length in a normal installation, the full suite of Immunity testing is required. If the device is AC powered, EN 61000-4-11 is also required. Most functional safety equipment is DC-powered from a 24VDC instrumentation power supply specifically installed in the facility to power sensitive and critical equipment.

EN 61000 Immunity Series

- EN 61000-4-2 ESD (Electrostatic Discharge)
- EN 61000-4-3 Radiated E Field (Electric) Immunity
- EN 61000-4-4 Electrical Fast Transient/Burst (on cables)
- EN 61000-4-6 Conducted Immunity (on cables)
- EN 61000-4-8 Radiated H Field (Magnetic) Immunity
- EN 61000-4-11 Voltage Dips and Interruptions (AC input)

Flame Detection

As with the Gas Detection equipment, if a Flame detector satisfies the FCC definition of an unintentional radiator then it is subject to Emissions evaluation to FCC Part 15B.

European EMC requirements for Flame detection equipment are defined in EN 50130-4 (1996). EN 50130-4 also calls up the basic EMC standards described above and applied to gas detectors. What sets EN 50130-4 apart from generic standards is that verification of the function of the Flame detector must be made before and after the EMC tests have been applied. The standards committee for EN 50130-4 did not specify radiated or conducted emissions requirements for flame detectors during flame detection.

Compliance Obligations

North America

As previously stated, Emissions compliance is mandatory for North America via either the FCC or CISPR. A manufacturer is obliged to mark their products according to the rules as defined in FCC §15.19, and to provide information to the consumer as defined in §15.105. Essentially compliance is a self-declaration process in which by marking the product according to §15.19, the manufacturer is making claims of conformity to all of the regulations imposed upon the products.

Manufacturers must understand and test their products to meet FCC EMC standards. In most cases, the FCC data is “self-declared” and valid test data from an accredited EMC test facility must be available for the FCC to examine upon request.

Europe

For entrance into Europe and other countries which accept CE Marking, the manufacturer must affix the CE Mark on the product and along with it, issue an EC Declaration of Conformity that lists all of the directives and standards the product conforms to. This includes EMC as well as ATEX, CPD (Construction Products Directive) and any other applicable directives for flame detectors.

- ATEX directive - 94/9/EC (Hazardous Location Safety and Combustible/Oxygen Performance, with Toxic performance on the horizon)
- EMC Directive - 2004/108/EC

For gas and flame products sold into the EU, the manufacturer works with an accreditation agency known as a Notified Body. The Notified Body is a European-resident office that is responsible for reviewing manufacturer testing for products of interest to public safety such as flame and gas detectors.

Global

Many countries around the world also look to European standards to develop their own country-specific regulations. For instance, China maintains its own system of testing and product labelling that must be respected by companies selling into that market. Typically the standards are similar to European standards. Many countries maintain Mutual Recognition Agreements (MRA's) with member states of the EEC, APEC or similar bodies so that each other's standards can be accepted to allow for market access for products.

Summary

Conformity to EMC requirements for products used in Hazardous Locations is mandatory to some degree in every market. This conformity assures companies using safety equipment that that systems using that equipment that the failure of the system (and consequent worker or facility risk) is unlikely to occur due to problems with EM interference.

Designing products to meet European and Global EMC requirements is not only mandatory, it can also be used as a competitive advantage.

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