Whitepaper:

Do Passive RFID Tags need Hazardous Area certification?

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Introduction

Radio signals are potential causes of explosions in hazardous areas. As such, the use of Radio Frequency Identification, known as RFID, needs to be carefully considered.

Versatile and low cost, passive RFID systems can improve efficiency, reduce downtime and aid productivity. These systems have proven valuable to industrial companies, helping with asset and personnel tracking, inventory management, maintenance planning, and more. As such, they are becoming more and more commonly found in hazardous areas.

This rise in popularity is reflected in the latest update to the IEC 60079-14 standard. The June 2014 addition of a new clause concerning RFID tags in particular has potential ramifications for their use in hazardous areas. Clause 5.15 states that passive tags don't have to be certified if they meet the criteria for simple apparatus; seemingly clear. However, the electromagnetic field generated by most readers exceeds the RMS value limits stated in the standard mentioned above. Therefore, to read passive tags in hazardous areas, the tags must be certified as safe by a notified body.

Awareness of this issue needs to be raised as adoption of passive RFID technology becomes more widespread, and as readers become smaller, handheld, and more mobile – and therefore more likely to be carried into and used in hazardous areas.

USES OF RFID TAGS AND BARCODES IN HAZARDOUS AREAS

RFID tags and bar codes have been used for many years in the process industries, including in their hazardous areas, to identify items of inventory, work in progress, batches, and pieces of equipment. Clear, accurate identification is a key aspect of production control and maintenance programs.

WHY USE RFID TAGS INSTEAD OF BARCODES?

An RFID tag, particularly the latest Ultra High Frequency (UHF) type, has several advantages over a barcode:

- The RFID reader does not have to be pointing directly at the tag, as a barcode scanner must. As a result, an RFID tag can still be read easily in a less accessible place, or on items in an automated line where the tag cannot be in the same position every time.

- The environment may be harsh or dirty, causing a barcode to become damaged or too dirty to read. An RFID tag can be completely obscured, yet still be perfectly readable.

- Multiple RFID tags can be read at the same time. For example, several tagged items on a pallet can be identified without searching for their individual bar codes, speeding up processes without losing accuracy.

TYPES OF RF BAND USED IN RFID TECHNOLOGY

Over the years, different versions of RFID technology have been used. The original tags were Low Frequency (LF), first used in animal husbandry, but their slow read rate makes them less suitable for industrial applications. Next came High Frequency (HF) tags, commonly used in applications such as passports or credit cards, but their short read range is also not ideal for the process industries.

There are often legacy applications where LF and HF tags are used, but the latest Ultra High Frequency (UHF) technology is generally considered to be most appropriate for general manufacturing and process industries going forward. Their fast read rate, long range, and relatively low cost make them a practical option.

Figure 1: Table of RF frequency bands

Type of passive RFID tag	Frequencies used
UHF	865.6 to 867.6 MHz (ETSI EN 302 208 v. 1.4.1 Europe) 902.0 to 928.0 MHz (FCC part 15.247 U.S.)
HF	13.56 MHz
LF	125.0 KHz

Figure 2: Examples of UHF RFID tags

HOW DOES A PASSIVE RFID TAG WORK?

RFID tags vary in size from very small items (for example, a rigid case or flexible label less than 10mm long) to much larger devices (for example, over 200mm long). What all passive RFID tags have in common is that they contain an integrated circuit (IC) with an antenna and memory, but do not have their own source of power.

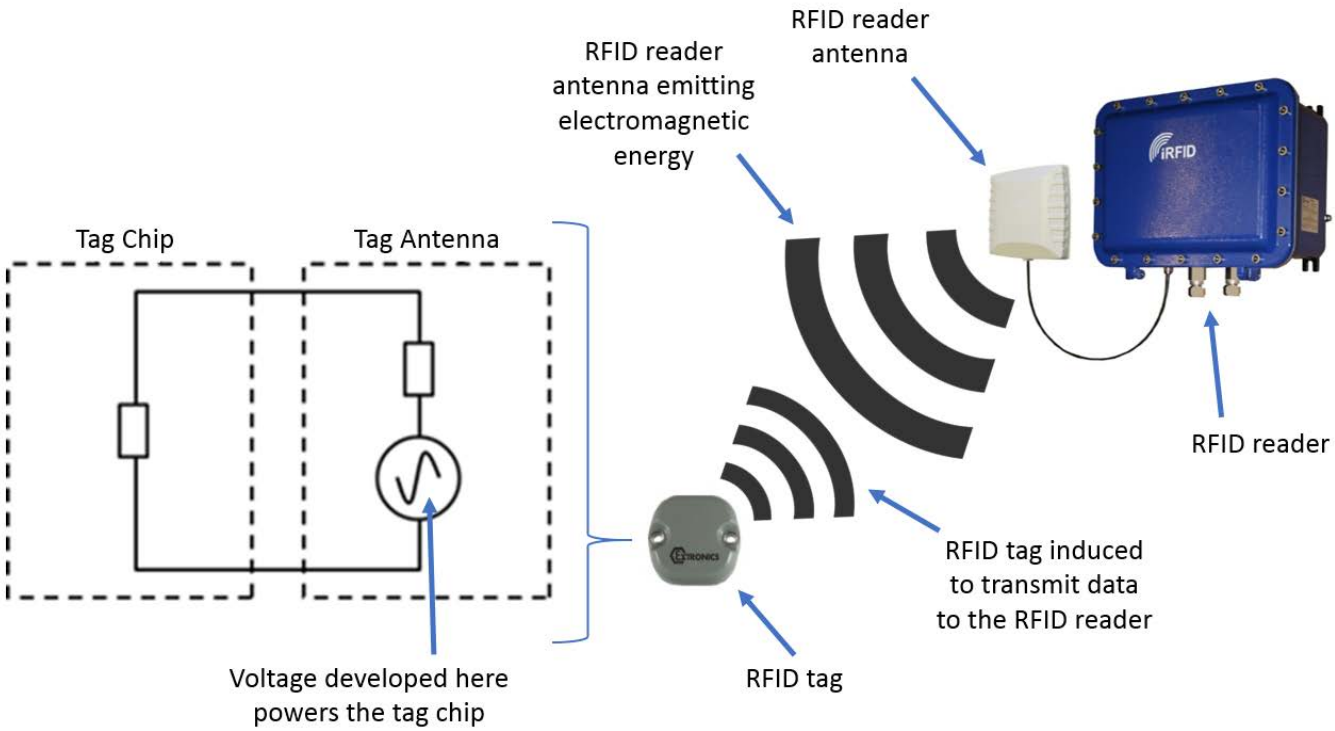
The tag is activated when it comes under the influence of electromagnetic energy at a frequency accepted by the antenna in the tag. For UHF RFID tags, this will typically be between 860 and 960 MHz.

This electromagnetic energy may come from a tag reader designed to activate the tags, either handheld or fixed. Equally, that electromagnetic energy could come from an undisclosed source in the environment – for example, created by nearby electrical sources, machinery, or processes.

Figure 3: A UHF RFID tag being read

When the RFID tag is influenced by the correct frequency, it becomes energised via its antenna. The RFID tag will then transmit its data (such as ID code) to the RFID reader. Read/Write RFID tags can also have their data updated by the RFID reader.

Figure 4: Example of an RFID system and RFID tag circuit



WHAT DO THE HAZARDOUS AREA STANDARDS SPECIFY?

Hazardous area certification of the RFID reader has always been the norm, as it is a piece of active electrical equipment that must meet the relevant approvals. However, certification of the RFID tags has previously been considered a grey area, as they have no internal power source.

In the latest 2014 version of the standard EN 60079-14, clause 3.15 defines Radio Frequency Identification (RFID) as:

> "Data collection technology that uses electronic tags for storing data. The tag, also known as an Electronic Label, Transponder, or Type Plate is made up of an RFID chip attached to an antenna. Transmitting in the kilohertz (KHz), megahertz (MHz) and gigahertz (GHz) ranges, tags may be battery-powered (active tags) or derive their power from the RF (radio frequency) waves coming from the reader (passive tags)."

EN 60079-14, clause 5.15, states that passive RFID tags **may be assessed as simple electrical apparatus** if they are used in environments where the electromagnetic field strength is below 3V/m or 1A/m. If this field strength is exceeded, the passive RFID tag **must be certified by a Notified Body.**

There are several definitions for what constitutes Simple Apparatus in a hazardous area, but perhaps the most relevant is "a device that does not generate or store energy."

A more detailed definition from EN 60079-14, clause 3.5.5 states:

> "Simple Apparatus: Electrical component or combination of components of simple construction with well-defined electrical parameters which is compatible with the intrinsic safety or energy-limited safety of the circuit in which it is used."

The standard makes no mention of the **source of the electromagnetic field**. Both fields generated by the environment (such as in an electrolysis plant) and fields generated by RFID tag readers will induce energy into the tag circuits via the tag antenna. Depending on the energy levels involved, this is a **potential cause of incendiary risk.**

INTERPRETING THE STANDARDS

Hazardous area RFID readers, which must be certified, are permitted to output an RF radiated power of 2W for group IIC. This level of output can generate a high electromagnetic field surrounding the passive RFID tag.

Figure 5: Table showing the relationship between power, distance, and electrical field strength

	Example 1		Example 2	
Power	2.00 W		200 mW	Reader Transmit power in Watts / mW
Gain *	2.14 dBi		2.14 dBi	Linear Dipole Antenna gain in dBi
Distance	1.00 m		250 mm	Distance between Tag and Reader's Antenna
Field Strength	9.91 V/m		12.50 V/m	Electric Field Strength in Volts per metre

* In order to compare differing types of device, the constant of a linear dipole antenna with a 2.14 dBi gain has been used

Example 1:
A fixed RFID reader using a linear dipole antenna of 2.14 dBi gain, supplying 2W RF power will generate a field strength of almost 10V/m at a distance of 1m from the reader.

Example 2:
Even a handheld reader with an output power of just 200mW will generate a field strength of 12.5V/m when used in close proximity to the tag (e.g. 250mm away). This far exceeds the limits for non-certified passive RFID tags that are classified as simple apparatus.

A tag positioned within such an electromagnetic field (such as a tag left near to a continuously operating wall mounted reader) could have a large amount of energy induced into its circuits. Without being tested and certified, there is **no way to ensure that the tag cannot produce a spark** through stored energy or become hot enough that it could ignite a potentially explosive atmosphere.

Figure 6: Example of a wall mounted RFID reader

Figure 7: Example of a handheld RFID reader

RESPONSIBILITY FOR ASSESSMENT

If you choose to use generic RFID tags without certification, it is the user's responsibility to ensuring the RFID tag is suitably assessed as Simple Apparatus for use in hazardous areas.

Additionally, the user must ensure that each batch of tags is assessed, unless the manufacturer of the tags has a robust, audited quality management system such as ISO9000 to ensure that no changes to the design or components used has taken place between batches.

However, if you choose to use certified RFID tags, that responsibility lies with the supplier / manufacturer. The end user has no liability or need to carry out batch quality control.

Figure 8: Close up view of iTAG500 hazardous area markings

CONSIDERATIONS FOR TAG ASSESSMENT

The table below shows a detailed list of the considerations when assessing the suitability of an RFID tag to be read in a hazardous area.

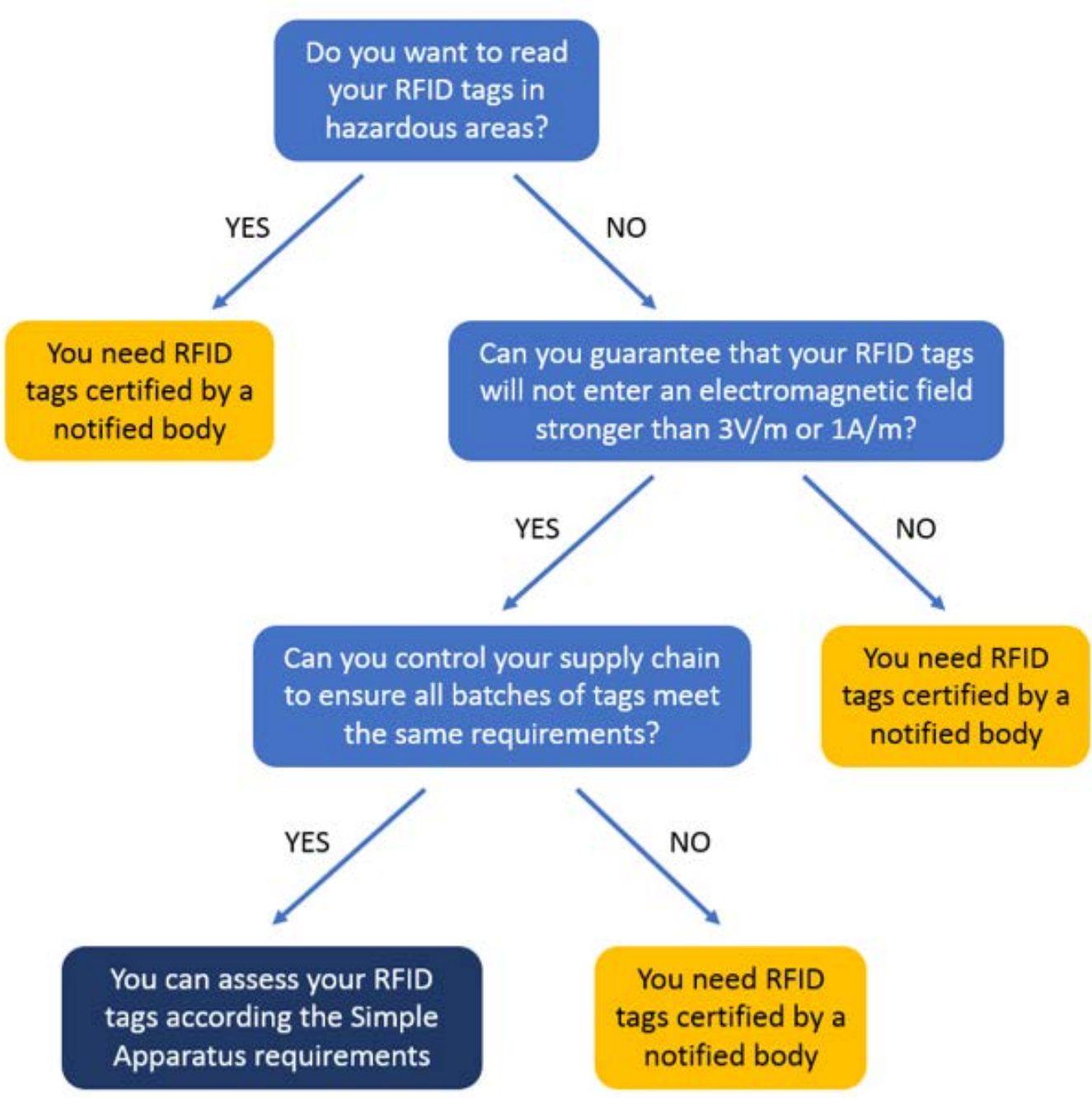
Figure 9: Table comparing ATEX and IECEx certified passive RFID tags with simple electrical apparatus

	Notified Body-Approved Devices	Simple Electrical Apparatus
Responsibility	The manufacturer will have installed a production quality system and an EU Acknowledgement of Conformity to Type. They are **fully responsible** for the Hazardous Area Approvals of supplied devices.	The installation company / operator takes over the **complete responsibility for the tags' suitability** to be used in a Hazardous Area.
Marking	The manufacturer will provide a **unique Ex marking** according to EN 60079-0 and -11, either printed on the device or in accompanying paperwork if the devices are too small to carry the label.	A marking according to a norm is **not permissible**. Another type of unique marking such as "For Intrinsically Safe Equipment Only" has to be chosen by the installation company / operator.
Operating Temperature	Typically, certified devices will be suitable for use in a **wide range of ambient temperatures**, dependant on the design and materials used in the device. **Full details will be shown** on the Ex marking or certificates.	Commonly down to -20 °C and up to +40 °C in T6. Proof will be required. The installation company / operator takes over the **complete responsibility for the safe temperature range** of the tags.
Ignition Protection in Gas Ex-Areas	Typically, Ex ia IIC and IIB certified. Risk from Electrostatic discharge is **assessed and approved within the certification**.	The Electrostatic risk **has to be assessed** by the installation company / operator. The installation company / operator takes over the **complete responsibility for this**.
Power	The transmitted power allowed in the Hazardous Areas where devices are present will tend to vary according to the ambient temperature and T-Class. Certified devices will allow a sufficient level of power to be used that will **allow them to be read** by intrinsically safe readers / antennas.	Transmitted power limited to 25 mW; Electric Fields limited to 1 A/m or 3 V/m. Many intrinsically safe readers / antennas will operate with a power higher than 25 mW, which is **outside the permitted limit**.

CONCLUSION

It is clear from the Standard EN 60079-14 that RFID tags do need to be approved if they are to be read in the Hazardous Area or if certain environmental factors apply.

In cases where they are not being read, they need assessing and the supply chain controlled to ensure they meet the requirements of environmental conditions in the Hazardous Area.



Extronics has dedicated over 25 years to helping customers in hazardous areas and harsh industrial environments work smart, safe, and connected.

We provide a range of asset management and auto-ID solutions, including ATEX, IECEx, and North American hazardous area certifications.

Our friendly team are here for you. Call +44 845 277 5000 or email info@extronics.com and we'll help you find the right solution for your application.

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