BARTEC

Hazardous Areas Wireless Buyers Guide

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Introduction

Deploying a successful wireless network in a process industry environment forms the backbone of any successful digital transformation. Accessing IoT data and improving operational efficiency using digital tools all requires a connected network.

BARTEC has decades of experience in connectivity and digitalization, which has driven the development of advanced technologies. By listening to trends and applying that to R&D and the inhouse engineering experience, BARTEC can offer the market a comprehensive range of solutions to enable the digital transformation seen across many industries.

Deploying a wireless network is more than just the technology you wish to use. Considerations, such as the physical environment, the atmospheric temperature, your particular use case, hardware, workforce buy in etc. all play a part in understanding what it takes to make it a success.

Not only do you need to design a solution that will work within the parameters of your site or area, but the solution must also consider the nature of each area and what problems must be overcome to satisfy your use case.

Installing wireless devices into a hazardous area is one such scenario which presents a unique set of challenges. Many companies that operate in the process industries are deploying increased wireless infrastructure as part of a wider digitalization strategy aimed at improving efficiency, increasing productivity, and enhancing worker safety. As companies push forward with their digitalization goals, it is important to consider what level of protection your chosen wireless devices need when installed in a hazardous area. Gaining data from within a hazardous area is critical to business operations, but it is also the most difficult to obtain. This eBook is designed to provide a guide to some of the key areas you must consider when installing wireless technology in a hazardous area.

A Note from BARTEC

Firstly, thank you for downloading your copy of our new Wireless Buyers Guide. BARTEC specializes in developing and manufacturing ATEX, IECEx, and North American- certified equipment for use in hazardous areas. We serve customers around the world in industries such as oil and gas, chemical, pharmaceutical, and mining. Our knowledgeable team of experts have a huge amount of experience in what is required to successfully deploy a range of wireless technologies. That experience has been gained from working with some of the world's largest companies, including BP, Shell, Cisco, Aruba, Petronas, and many more. It is our aim to ensure that our customers are fully aware of their options, and we offer our expertise to help them navigate what can sometimes be a tricky process. We recognize that no two use cases are the same and that each customer has a particular set of challenges that must be overcome. It is for these reasons that we have developed this Buyers Guide. We hope it serves as a useful resource for anyone looking to further their knowledge about hazardous area wireless, answer any questions they may have about deploying wireless devices into hazardous areas and support those already in the process of installing wireless equipment as part of their digitalization strategy. We hope you enjoy reading it!

In 2023, BARTEC acquired Extronics Ltd. The acquisition was a big part of BARTEC's commitment to enhancing our digital solutions to support customers with their digital transformation strategies. The combined expertise, product range and R&D resources mean together the range of wireless solutions available in the BARTEC portfolio is now the most comprehensive on the market.

"With its digital solutions, Extronics offers an excellent addition to our digitalization portfolio, which we intend to expand even further in the future. Together with Extronics and the know-how of its employees, we want to be the pioneer in the field of digital solutions for explosion protection in the future."

Martin Schefter

Dr. Martin U. Schefter

Chief Executive Officer

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1. Defining Hazardous Area Wireless

There are various reasons for deploying wireless technology into a hazardous area. In almost all cases, the goal is to achieve connectivity and gain access to critical data within the hazardous area in question.

As businesses operating in these environments strive to achieve their digitalization goals, more and more wireless radio devices, utilizing various wireless technologies, have entered the market.

Some common use cases for wireless connectivity in hazardous or industrial settings include:

- Personnel or asset location tracking
- IoT device connectivity
- Sensor data collection
- Preventative maintenance
- Asset utilization
- Personnel on Board and automatic mustering
- Security / access control
- Condition monitoring
- Remote maintenance using video collaboration
- Inspection and maintenance management
- VoiP or Push to Talk using mobile phones

With the development of Industry 4.0 and the Industrial Internet of Things (IIoT) revolution, the list of use cases continues to grow as all businesses strive to gain operational improvements, maximize productivity and improve worker safety.

This naturally leads to questions about the safety of wireless devices installed in hazardous areas and certification required.

A common misconception among buyers is that standard wireless devices can be easily certified retrospectively. This is rarely the case. Taking an existing device and getting it approved to standards required for hazardous areas is no easy process. It is neither low cost nor quick to do.

By taking advantage of pre-certified enclosure solutions, customers and OEMs have access to a method of expanding their specified devices into the hazardous area without the need for further certification work.

What is a Hazardous Area?

Before covering the standards that govern the use of wireless devices in hazardous areas, it is important to first understand the different types of hazardous areas. Industrial facilities may contain hazardous areas where there is flammable gas, vapors or liquids, combustible dust, or even ignitable fibers present. Equipment installed in these areas is subject to additional legal requirements to reduce the risk of explosion. These hazardous areas can be separated into designated zones depending on how present the hazards are.

Figure 1. Illustrates the different zones for flammable gas and dust environments. Depending on where in the world your hazardous area is located will determine how it is classified. Tables 1 and 2 define how each classification works. NEC500 (Table 2) is predominantly used in the USA, whereas ATEX and IECEx (Table 1) are widely used everywhere else around the world. The next section talks in more detail about the regional and local bodies that govern the standards.

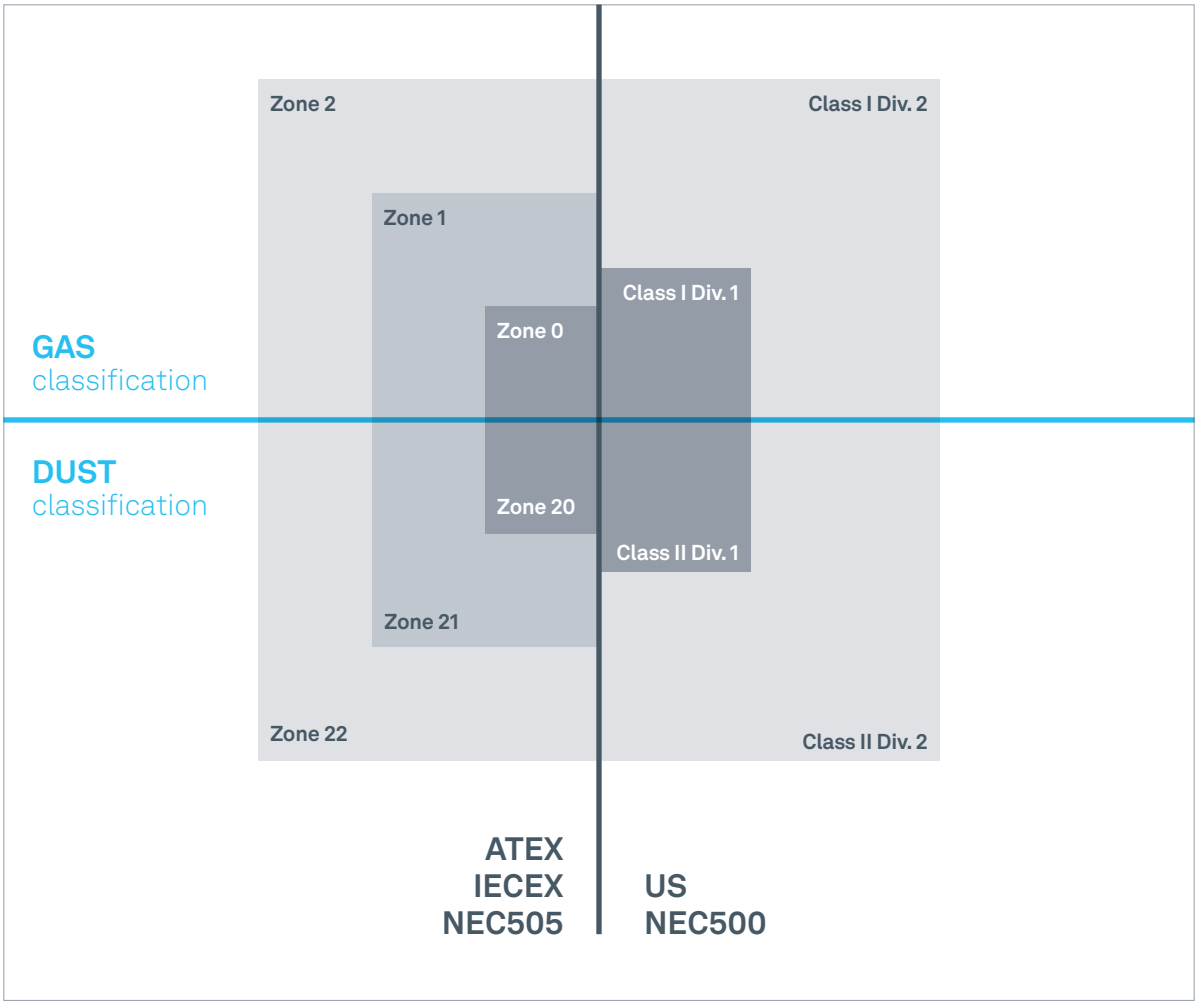


Figure 1: Different flammable gas and dust classification

Table 1: ATEX, IECEx and NEC505 hazardous area zone definitions.

Gas Zones	Dust Zones	Definitions
0	20	A place in which an explosive atmosphere is continually present.
1	21	A place in which an explosive atmosphere is likely to occur in normal operation occasionally.
2	22	A place where an explosive atmosphere is not likely to occur in normal operation. If an explosive atmosphere does occur, it is only likely to be for a short period of time.

Table 2: US NEC500 hazardous area division and class definitions

Class	Divisions	Definitions
	1	A place in which an explosive atmosphere is normally present.
	2	A place in which an explosive atmosphere is likely to occur in normal operation occasionally.
Class I		Gas
Class II		Dust
Class III		Fibers

Standards Governing the Deployment of Wireless Radio Devices into Hazardous Areas

The main standards for hazardous area equipment globally are ATEX, IECEx and North American NEC 500/505. For ATEX and IECEx, covering most of the world, the IEC 60079 series of standards are typically used for the approval of equipment installed in hazardous areas. Most national or regional domains derive their own standards from the IECEx standards and issue a version, often identical, as their own national or regional standard. The most frequently used electrical equipment protection standards are:

60079- 0	General requirements
60079-1	Explosion proof enclosures
60079-7	Increased safety
60079 -11	Intrinsic safety
60079 -15	Non sparking, hermetic sealing and restricted breathing
60079-18	Encapsulation

Who Governs the Standards?

The IEC's standardization work is organized across 150 Technical Committees (TC) and Subcommittees (SC) with various areas of focus. They are tasked with controlling and creating international standards.

The IEC TC 31 (TC 31) is one such TC, which controls the standards associated with equipment for explosive atmospheres. The IEC TC 31 is tasked with establishing and updating the IEC standard series IEC 60079 (electrical explosion protection) and IEC 80079 (non-electrical explosion protection).

In addition to the ATEX directives, the IEC standards set out the rules all manufacturers of electrical equipment destined for use in hazardous areas must follow.

The TC 31 exists to ensure a uniform set of standards and technical requirements are applicable worldwide in the field of explosion protection. This is intended to reduce the effort spent on certification so that the same products can be used globally.

In Europe, the ATEX directives ensure that every ATEX certificate must be recognized by a notified body. IEC standards are already fully accepted as part of national standards in some other countries as well. This means one IECEx certificate is currently sufficient for the international sale of explosion-protected equipment in the regions of Australia, New Zealand, Singapore, and Israel. No further national certificates are required. In Europe, only an additional ATEX label and the resulting ATEX certificate are required. In the USA and other regions, the IEC standards are applied with some differences.

Most Common Regional Standards

ATEX

ATEX is used mostly within the European Union, but many other countries in the Middle East or Asia Pacific region will also accept it.

IECEx

IECEx is generally considered a more global standard, but most countries will not accept this standard outright. IECEx is predominantly used for the basis of obtaining the local regional standards. Although countries such as Australia and Singapore accept these standards without requiring a national version, this also includes all offshore installations in the Gulf of Mexico.

NEC 500 North America

In the USA, all electrical equipment must be approved and certified by a Nationally Recognised Testing Laboratory (NRTL) accredited by Occupational Safety and Health Administration (OSHA).

In Canada, all electrical equipment must be approved by a certification body accredited by the Standards Council of Canada (SCC).

As with ATEX and IECEx, the certification must be displayed on the equipment, and a certificate or declaration of compliance alone is not sufficient proof of compliance.

In the USA, The National Electrical Code or NEC, specifically NEC500 or NEC505 stipulates the requirements for the use and installation of electrical equipment in hazardous areas. Workplace safety laws regulate all equipment and ensure that it must be approved/ certified by a NRTL accredited by OSHA.

How is Compliance with These Standards Managed?

Certifying the equipment is not the only cost you must consider for your business. There are also ongoing costs associated with quality assurance. All Ex-product manufacturers must get their Quality Management Systems certified to fully comply. In the case of NRTL approval, the manufacturing facility must be certified as well. ATEX requires an Ex-manufacturer to complete a Quality Assurance Notification or QAN as is more commonly known.

The CSA Group define the QAN as follow:

> **The Quality Assurance Notification** is therefore involved with the continued monitoring of systems and processes in relation to those Ex products. It involves periodic audit of the manufacturing process by a qualified auditor. For ATEX certification, this is called a Quality Assurance Notification (QAN).
>
> Source: CSA Group website

For IECEx it is called a Quality Assessment Report (QAR) and for North American Certification they have a requirement for auditing the actual factory where the equipment is manufactured.

In addition, a Certificate of Conformity (CoC) is required. The IECEx CoC comprises of two elements. The first element is the assessment of product samples against relevant standards. The second element requires an assessment of the manufacturer's quality systems based on parts of ISO 9001:2008 and ISO/IEC 80079 -34:2011.

It is also worth noting that certification aims to verify a compliant design, it is not intended to be the initial determination of compliance. Therefore, redesign or re-engineering is almost always required for products that were never originally intended for hazardous area use, further adding to the time and cost before certification can be assessed.

The certification process can cost upward of $50,000 to get approvals covering ATEX, IECEx and North American certification and require significant changes to your existing quality processes. As a business you are subject to a yearly audit at an additional cost to maintain your certification. For North American certified products, audits are required four times a year at a much higher cost to the business.

2. Typical Wireless Technology Used in Hazardous Areas

Often when we talk about wireless technology in the process industries, it is said in the context of the Industrial Internet of Things (IIoT) and industry 4 .0. As the digital transformation of process industries has evolved, the number of wireless devices being added has increased and forced companies to rethink their wireless network strategy.

There are several wireless technologies used for a whole variety of use cases associated with hazardous and harsh industrial environments typically seen throughout the process industries.

The fact is, deploying wireless in an industrial setting is not nearly as simple as deploying it in an office or factory environment. Heavy industrial environments pose unique challenges and conditions, including dense metallic infrastructure and hazardous environments such as potentially explosive atmospheres.

Here we look at some of the most common wireless technologies used and consider some of the pros and cons of each.

According to Statista, the global Industrial Internet of Things (IIoT) market it set to reach a value of **$321.68 Billion** in 2026

Source: Statista

Wi-Fi

Probably the most common and well-known wireless technology used globally. Wi-Fi is a wireless network standard designed to allow mobile devices to communicate with each other or servers to access and exchange data using IP connectivity. Wi-Fi operates in the ISM bands at 2.4GHz and the 5GHz band. It now also operates at the 6GHz band with the introduction of Wi-Fi 6e. With this technology being so mature, there are a lot of hazardous area certified devices available compared with some of the alternative wireless standards.

PROS:

- Well established.
- A number of Ex Wi-Fi offerings available.
- Most safe area connectivity is done over Wi-Fi.
- BARTEC offers purpose-built Ex solutions for standard Wi-Fi Aps that provide vendor agnostic enclosures for Zone1 and 2.

CONS:

- Can be expensive if deployed at scale.
- Wi-Fi access point manufacturers do not release Ex versions of latest variants until later if at all.
- Medium to large units can be difficult to install in confined spaces.
- Signals susceptible to interference from physical environment.
- Running power can be cost prohibitive.

Bluetooth Low Energy (BLE)

Bluetooth Low Energy (BLE) is a short-range wireless technology, although later iterations of the standard such as BLE 5 have a much longer-range capability of over 1Km in certain cases. BLE operates in the 2.4 GHz ISM band and consumes very little power compared to traditional Bluetooth. BLE is typically used to tether devices together, location tracking or IoT connectivity.

PROS:

- BLE devices are designed to operate with minimal power consumption, making them suitable for battery-powered devices such as sensors or BLE tracking tags.
- BLE technology is widely supported across various devices and platforms, offering ease of integration with existing IoT ecosystems and mobile devices.
- BLE hardware tracking and IoT hardware are generally affordable, which can reduce overall deployment costs for tracking and IoT applications in hazardous environments.
- BLE can support indoor positioning and proximity detection applications for tracking assets and personnel in hazardous areas.
- BLE includes built-in security features such as encryption and authentication protocols.

CONS:

- BLE devices typically have a limited range, up to 100 meters in open space. This range can be lower in hazardous areas where obstacles and metal structures can interfere with signal propagation.
- BLE operates in the 2.4 GHz frequency band, which is shared with other wireless technologies like Wi-Fi. In crowded or congested environments, interference can affect BLE performance.
- Only sufficient for transmitting small packets of data, such as sensor readings or location updates.

Cellular Network's (3G, 4G, 5G and LTE)

Cellular networks are widely used for mobile communication and are now increasingly supporting IoT through more recent NBIoT and LTE-M protocols. This enables low-cost, low-power, long-range connectivity for battery-powered sensors, and many sites are starting to adopt private LTE as an alternative or complement to Wi-Fi.

Mobile Network Operators have traditionally supported sites in two ways: by assigning a dedicated portion of bandwidth from the nearest public cell tower, or by installing a new tower specifically for the customer. Using the public network often leads to poor coverage in industrial areas, while installing a dedicated tower is costly and typically requires long-term contractual commitments. Coverage inside dense metal process areas can also be difficult, and Pico Cells installed in hazardous-area enclosures are often needed to achieve full coverage.

Private LTE and 5G now allow end users to set up their own networks in a similar way to Wi-Fi, without relying on an operator. In the United States this is known as CBRS, and similar approaches are emerging worldwide. Adoption is growing, although differences in available spectrum between countries mean that suitable mobile devices, especially those approved for hazardous areas, may remain limited for some time.

LTE and 5G provide stronger security, more predictable latency, and much greater coverage than Wi-Fi, typically around ten times outdoors and four times indoors.

PROS:

- Control and security of a private LTE network is a big benefit. Networks can be designed for optimal performance and protection for your site and use cases.
- Private networks can offer more reliable and predictable performance, as they are dedicated solely to your site.
- Private networks can achieve lower latency compared to public networks, which is beneficial for real-time applications.
- Private networks are scalable and can be expanded as needed to accommodate growing IoT
- Setting up a cellular network is often faster than deploying wired infrastructure.

CONS:

- Setting up a private cellular network can involve significant upfront costs, including infrastructure deployment (base stations, antennas), spectrum licensing (for 4G/5G networks), and integration with existing systems.
- Managing a private network requires specialized expertise in telecommunications and IT, as well as ongoing maintenance.
- Depending on the region and industry, acquiring spectrum licenses and complying with regulatory standards can be complex and time-consuming.
- Organizations may become dependent on specific vendors for equipment, support, and updates, which can limit flexibility.
- For smaller facilities or operations with less extensive needs, the benefits of a private network may not justify the investment.

LoRaWAN®

LoRaWAN® is a low power, wide area network protocol used for wireless connectivity of devices to internet networks. It is designed as a low power, low bandwidth technology especially for battery powered sensors. It is primarily used in the sub-GHz bands but there are lesser used variations that use the 2.4GHz band. Typical line of sight range for the sub-GHz band is over 10Km, which means fewer gateways are required to cover a large process plant.

Despite its impressive range, LoRaWAN is not without limitations. Like any radio frequency (RF) technology, it can struggle in industrial environments with extensive metallic structures that can interfere with signal transmission. However, the ability to effectively deploy gateways at ~500m intervals in process industries represents a significant improvement in infrastructure density compared to alternative wireless technologies, making it a compelling option for challenging industrial settings.

PROS:

- LoRaWAN devices are known for their low power consumption, which is beneficial in hazardous areas where minimizing heat generation and energy use is critical for safety.
- LoRaWAN technology can provide long-range communication, allowing devices to transmit data over several kilometers, which is useful in large industrial facilities or outdoor hazardous zones.
- It‘s relatively easy to deploy and scale up LoRaWAN networks by adding more sensors or gateways.
- LoRaWAN devices and gateways are generally cost-effective compared to other wireless technologies, making it feasible to deploy multiple sensors across hazardous areas.
- LoRaWAN operates in the unlicensed ISM bands, which can provide better resistance to radio frequency interference compared to licensed bands used by cellular or Wi-Fi technologies.
- LoRaWAN can be deployed in various configurations (public, private, or hybrid networks), offering flexibility in meeting specific operational and regulatory requirements of hazardous environments.

CONS:

- LoRaWAN coverage can be limited indoors or in areas with physical barriers, metallic structures, or dense equipment, potentially affecting signal propagation in complex hazardous area environments.
- LoRaWAN has lower data rates compared to cellular technologies like LTE, which may limit its suitability for applications requiring high-speed data transmission in hazardous areas.

WiHART / ISA100.11a

WiHART and ISA100.11a are two different protocols typically used for connection of battery powered sensors. Unlike LoRa it is much shorter range but running on 802.15.4 radio technology provides a higher degree of reliability as each device forms part of a self-healing MESH network.

This wireless technology is almost exclusively used in battery powered process instrumentation devices. Is it worth mentioning that these both operate at 2.4 GHz ISM band too.

PROS WiHART:

- WiHART is known for its robustness and reliability in industrial environments.
- It is designed for low-power operation, making it suitable for battery-powered devices and applications requiring long battery life.
- It is easy to add additional devices and sensors as needed in industrial IoT deployments.
- It can support real-time data transmission and control applications.
- Security features such as encryption and authentication are available, ensuring data integrity and protection.

CONS WiHART:

- WiHART has seen limited adoption compared to other industrial wireless standards, which may result in fewer compatible devices and ecosystem support.
- Compatibility with other wireless standards and legacy systems may require additional systems.
- Implementing and managing WiHART networks may require specialized knowledge and skills, particularly in configuring for hazardous area applications.

PROS ISA100.11a:

- ISA100.11a is designed for inter-operability with various industrial automation and control systems, making it easier to integrate with existing infrastructure and devices.
- Reliable communication in industrial environments, with mechanisms to reduce interference and ensure robust connectivity.
- Supports scalability, allowing networks to expand by adding more devices and gateways.
- Includes robust security features, such as encryption and authentication, to protect data.
- Being an international standard, ISA100 provides a common framework and guidelines, promoting consistency and compatibility across deployments.

CONS ISA100.11a:

- Implementing ISA100.11a networks may involve complexity for hazardous area deployments.
- The initial deployment cost of ISA100.11a networks, including hardware and infrastructure setup, can be higher compared to other wireless technologies.
- Depending on the implementation, ISA100.11a devices may be more power hungry compared to low-power wireless standards, impacting battery life in battery-operated devices.

Ultra-Wide Band (UWB)

Ultra-Wide Band (UWB) is a low energy radio technology for short-range, high-bandwidth communications over a wide range of frequencies. UWB is also capable of transmitting data at very high rates, meaning it is well suited for short range high bandwidth wireless data transfer. UWB has typically been used as a Real Time Location System (RTLS) solution for personnel and asset tracking in industrial settings because of its accuracy and low power consumption.

PROS:

- UWB provides high accuracy in location tracking, typically within centimeters. Although there are few use cases that need this level of accuracy, if you need pinpoint accuracy this is positive of UWB.
- UWB systems can provide high update rates, allowing real-time tracking and monitoring of assets and people.
- UWB signals are difficult to intercept or jam, providing enhanced security for location data.

CONS:

- Implementing UWB-based RTLS systems can be more expensive compared to other technologies.
- UWB tags typically require more power compared to other low-power technologies. While advancements have reduced power consumption, this remains a consideration for prolonged use in remote or battery-powered devices.
- Complex deployment considerations to ensure optimal coverage.
- More infrastructure is required for hazardous areas with dense metallic or metal infrastructure to ensure optimal performance, which increases costs.
- Integrating UWB RTLS systems with existing infrastructure or enterprise systems (such as ERP or asset management systems) may require additional effort and customization to ensure seamless data integration.

Passive RFID

Passive RFID tags are devices which, when energized by a reader, transmit their ID. They are used in asset tracking and identification applications and are available in three different frequency ranges: LF (125KHz), HF (13.56MHz) and UHF (900MHz)

PROS:

- Passive RFID tags are generally cheaper than active tags, making them more cost-effective for large-scale deployment in hazardous areas.
- Passive RFID tags do not have an internal power source, they do not require battery maintenance or replacement, which is beneficial in hazardous environments.
- Passive tags can be very small, which makes them easier to integrate into various items or equipment without adding significant bulk or weight.
- UHF passive tags, like the BARTEC iTAG500 range, are reliable readability even at long range.
- Installing passive RFID tags is often straightforward and non-intrusive.
- Robust materials mean they can always be read over long periods of time compared to options such as barcodes that can become worn or damaged in industrial environments.

CONS:

- Passive RFID tags require line-of-sight communication with RFID readers. Use case obstructions must be considered.
- In environments with rapid movement of tagged items or equipment, passive RFID tags may not provide real-time tracking capabilities.

Wirepas

Wirepas, is a wireless, fully meshed network architecture for IoT solutions. All the devices in a Wirepas IoT Mesh network can make the routing decisions locally, based on the present radio circumstances. The decentralized architecture of Wirepas Mesh provides high data transmission reliability and availability, even across large areas.

The devices make routing decisions autonomously, based on the available radio spectrum and energy. A central network hub device is not needed in Wirepas Mesh. Wirepas devices can transmit data over multiple hops from one node to another and towards the Cloud and back. For each device, there are multiple routing options at any time, and multiple IoT devices can be used in the same network.

Originally developed using the 2.4GHz ISM bands, Wirepas also has other options operating at 1.9GHz and 915Mhz. Wirepas were also a key contributor to the NR+ (otherwise known as DECT2020) standard which is the first and only non-cellular 5G connectivity network. Using Wirepas 5G, NR+ devices serve as access points to all other nearby devices ensuring seamless connectivity and expanded coverage.

PROS:

- Wirepas Anchors used to form a mesh are low cost compared to other hardwired wireless gateways used for RTLS.
- Wirepas technology is a decentralized mesh network architecture where each device can communicate with neighbouring device, forming a self-healing network. This brings robust connectivity even in hazardous areas with obstacles or interference.
- Wirepas networks can scale from small deployments to large-scale implementations covering extensive areas.
- Devices dynamically adjust their communication paths, maintaining reliable data transmission for accurate location tracking.

CONS:

- Although battery powered with long life times, Wirepas devices will require battery change or replacement eventually.
- Depending on the number of “hops” between mesh nodes, Wirepas low power mesh infrastructure does introduce latency.

3. Ex Solutions for Deploying Wireless and What to Consider

If you want to deploy wireless devices into hazardous areas, you have two option:

Option 1: **Buy a wireless device that has been fully certified by the manufacturer to relevant Ex standards.**

Option 2: **Buy a pre-certified Ex wireless enclosure solution to house your preferred hardware.**

The likelihood is that your chosen wireless device does not hold the required hazardous area certification. This is typically because it is a specialized market, and new technology is not often made available as a hazardous area version when it is first introduced. Furthermore, technology companies rarely develop a hazardous area version of their devices because the market size is too small for their business model.

The most likely option for end users is to use an Ex certified enclosure system. Without this solution you will not be able to install the wireless technology in your hazardous areas on site.

It is worth knowing a little more about the different Ex protection options available and which hazardous zones they are suitable for as this will help you make an informed decision when choosing your wireless enclosure system supplier.

Firstly, when you are considering Ex protection concepts for your wireless device there are several concepts available:

- Protection by encapsulation to contain an explosion
- Protection by keeping a flammable gas or dust out
- Quenching a flame
- Limiting energy to avoid spark or thermal ignition
- Installing the wireless device in a safe area and an Ex rated antenna in the hazardous area

There are various protection types that cover all the above, but the most common seen in industrial and process industry settings for wireless devices are Ex d and Ex n.

Ex d - IEC 60079-1
Typical Zone: 1, 2, 21, 22 and Division 1

An Ex d enclosure is designed to contain an explosion and stop any flames, sparks and hot gases from escaping into the surrounding atmosphere should an internal explosion occur. In addition, an Ex d enclosure protects the fitted equipment against external moisture, dirt, dust or water. Electrical equipment, such as a wireless radio device, can often operate with potentially hot surfaces, which could cause an explosion if not housed correctly with the relevant Ex protection. Often referred to as flameproof or explosion-proof, an Ex d enclosure also includes what is known as a flame path. The flame path design can vary depending on the construction of the Ex d enclosure system.

A flame path is a gap within the enclosure that, if an internal explosion occurs, ensures that by the time the flame has reached the end of the flame path it has been starved of oxygen or cooled down to such an extent that nothing, but air propagates from the explosion. The flame never escapes the enclosure and so cannot ignite an ambient gas.

Some flameproof boxes have flame paths that operate surface to surface, like a flange touching a joint, whereas others like a typical IIC gas group enclosure have a lid that screws into the body of the enclosure. In these enclosures, the flame path is in the thread, forcing the flame to move in and out of the thread quenching the flame.

Ex d enclosures are usually heavy and bulky due to the requirements of the Ex standard.

Ex nR - IEC 60079-15
Typical Zone: 2 , 22 and Division 2

An Ex nR or restricted breathing enclosure removes the fuel element of an explosion by stopping any flammable gases entering inside the enclosure. In doing so, potentially explosive gases never meet hot surfaces or an ignition source potentially present inside the enclosure.

Restrictive breathing enclosures are only certified to Zone 2 hazardous areas, where the area is considered safe in normal operation with flammable gases only present in fault conditions.

A Ex nR enclosure typically has the following characteristics:

- Lightweight metallic or non-metallic construction
- Designed to prevent flammable gases entering
- High ingress protection levels
- Tightly sealed

Ex i - IEC60079-11

The Ex i intrinsically safe protection concept is not available as an enclosure, it is designed into the electrical equipment so that the finished certified device is safe by design. This is achieved by limiting the amount of power fed into a circuit to avoid ignition by hot surfaces as well as limiting the amount of energy storage which could lead to spark ignition. This concept is specifically used in the context of Ex wireless enclosure systems as a method of protecting the RF output of the radio equipment rather than the radio device itself.

Installing the radio equipment in a safe area and the antenna in a hazardous area is the lowest cost solution as it does not require the use of a certified enclosure. If connecting the antenna to an uncertified radio you must consider that AC or DC could pass through the radio under a fault condition. If this was fed into a standard antenna this could lead to an unsafe condition. Therefore, there are two distinct options for this use case.

Option one uses an intrinsically safe RF isolator between the antenna and the radio, see Figure 2, which limits any hazardous fault current that could pass into the hazardous area mounted antenna. This method of protection allows the use of standard antennas in most types of hazardous areas.

Option two is to use an Ex-antenna where the antenna is designed and certified to the Ex-standards. This would typically be Ex d or in some cases Ex e (Increased Safety).

Figure 2: typical safe are installation

Understanding "Special Conditions of Safe Use" in Ex Certified Wireless Equipment

When specifying wireless solutions for hazardous areas, buyers may assume that Ex certification provides a simple green light for deployment. However, the reality is considerably more complex. The presence of "Special Conditions of Safe Use" on Ex certificates introduces critical requirements that can significantly impact installation, maintenance, and operational procedures. Ex certified wireless devices often carry specific conditions, denoted by an "X" in the certificate number, that must be adhered to for the certification to remain valid. These special conditions are mandatory requirements and so failure to observe these conditions can void the certification and potentially create dangerous situations in explosive atmospheres.

Routes to compliance when installing wireless devices in Ex Enclosures

There are many misconceptions when it comes to hazardous area wireless installations. One common area of misunderstanding is covered in the following questions: As an end user, can I buy and install non-certified wireless equipment inside a pre-certified hazardous area enclosure myself?

In this section, we will outline the typical routes to compliance when installing non-ex wireless devices in Ex enclosures for use in hazardous areas.

Complying with hazardous area directives

It is ultimately the end user's responsibility to ensure safe operation by procuring the correct equipment and verifying that it is installed properly. While customers may prefer to install wireless devices themselves in order to avoid bottlenecks and accelerate the onboarding of new technology, responsibility for compliance rests with the user—even when installation is performed by a vendor.

Installations of electrical equipment in potentially explosive atmospheres are governed by the international standard IEC 60079-14. This standard refers extensively to certification, which in this context means third-party certification by an independent, accredited, and verified body. Self-certification is not an option under this standard.

A key risk with self-declaration or self-attestation is that the individuals undertaking the activity may not have the necessary qualifications or expertise. This can lead to unintentional non-compliance, with the user assuming full liability for the equipment. Using properly certified equipment significantly reduces the likelihood of challenges from inspectors, insurers, or regulatory bodies such as the Health and Safety Executive. Moreover, it is often difficult for an organization to demonstrate sufficient internal competence to justify self-certification, making third-party certified equipment the safer and more reliable choice. These considerations are central to the value of formal certification.

Common Special Conditions and Their Implications

Enclosure Requirements

Many ATEX certified wireless devices specify requirements such as "Equipment must be installed in an IP54 enclosure meeting IEC 60079-0 standards." This condition immediately transforms what appears to be a simple device installation into a more complex engineering challenge requiring:

- Sourcing of appropriate IP54 rated enclosures
- Verification that the enclosure meets IEC 60079-0 requirements
- Consideration of heat dissipation within the sealed enclosure

Environmental Limitations

Pollution degree restrictions are another frequent special condition. A device marked "Only to be installed in an area of Pollution degree 2" cannot be deployed in environments with higher contamination levels, regardless of its Ex zone rating. This limitation can exclude the device from outdoor installations exposed to the weather. The device may need to be installed inside an IP rated box to stop the ingress of dust and liquids leading to further considerations).

Complying with hazardous area directives as a manufacturer

Certification processes such as ATEX, UKCA, and IECEx follow similar standards and require approval from accredited bodies. Typically, certification involves two stages: testing a sample device for safety and certifying the accompanying schedule drawings, which define how the product must be built. These drawings are the intellectual property of the manufacturer and are not shared with end users.

Strict adherence to these certified drawings is essential—any deviation, such as substituting components, risks invalidating the certification. Manufacturers also require a quality assurance notification (or equivalent audit) to produce certified units and are subject to regular audits to ensure compliance. This process ensures that end users receive equipment verified by an independent, accredited third party.

Where does the responsibility fall for conformity when the product is deployed?

Responsibility ultimately rests with the end user or operator. While purchasing third-party certified equipment ensures compliance with safety standards, users must also ensure correct installation, inspection, and maintenance—following applicable standards such as IEC 60079-14, -17, and -19.

Manufacturers are responsible for ensuring the equipment meets certification requirements, while end users are responsible for selecting the appropriate category or EPL (Equipment Protection Level) and for proper use in the intended environment. The complexity of these requirements highlights the need for specialist expertise in both equipment design and installation to ensure ongoing compliance and safety.

Routes to Compliance When Installing Wireless Devices in Ex Enclosures

Option 1

Ex Manufacturer purchases wireless device on behalf of customer

Customer sends wireless device to Ex enclosure manufacturer

QUALITY CONTROL SYSTEM
Controls required to ensure the final product assembly meets the type approval. E.g. goods inwards inspection, purchase control, document control, routine testing, calibration etc.

Depending on type of certification:

- Hold a QAN: an ATEX Quality Assurance Notification
- Hold a QAR: an IECEx Quality Assessment Report
- Listed as an inspected factory by an OSHA approved body

COMPLIANCE AUDITS

- ATEX and IECEx Annual audits of quality systems to 80079-34
- North American audit four times a year and listed as an inspected factory by an OSHA approved body

Option 2

Customer purchases an Ex wireless enclosure system and wireless device separately

Customer would be **required to be a part of the manufacturer's quality control system** to remain compliant to type approval.

The customer would need to **follow a procedure and provide evidence** of what was installed so the manufacturer has control over the product and the type approval.

Customers in North America would be required to **undertake four audits a year** by the OSHA approved body that did the type approval.

Compliant Installation

Customer purchases an empty Ex enclosure and wireless device separately

Classed as a certified component rather than an Ex certified apparatus

Customer installs their chosen wireless device and other electrical components required for the application.

NOT Compliant Installation

4. Hazardous Area Certified Antennas

When deploying antennas in hazardous areas, engineers have two primary approaches. The first involves using hazardous area certified antennas, typically Ex e (increased safety) certified products with pre-assembled RF cables. The alternative solution is to employ non-certified antennas protected by intrinsic safety (Ex i) principles. This approach allows passive antennas to be classified as "simple apparatus," providing greater flexibility in RF deployment strategies.

In recent years, antenna technology has evolved significantly, with some manufacturers introducing advanced features like „self-identifying antennas" (SIAs) to reduce manual errors and improve regulatory compliance. While the concept sounds innovative, these intelligent antennas face practical limitations in hazardous area applications. The self-identifying components typically require electrical power and use integrated circuits or EEPROMs, which create fundamental challenges for use in explosion-protected environments.

The key issue is that these active antenna components cannot meet the strict requirements for use in hazardous areas. They are not pre-certified and cannot be classified as „simple apparatus" and so are incompatible with RF isolation components like the BARTEC iSOLATE501. This limitation means that despite advanced features, such antennas cannot be directly used in critical industrial environments where safety is paramount. The good news is that most radio devices still provide provisions for connecting passive antennas through their system settings.

Integrated or externally mounted antennas?

In industrial environments with explosive atmospheres, specialized enclosure solutions are available for housing radio devices with either integrated or externally mounted antennas. These enclosures provide the essential Ex certification required for safely mounting wireless communication devices in hazardous areas such as Zone 1 or Zone 2. These solutions allow customers to deploy the same equipment they are using in their safe areas, into their hazardous areas.

Wireless radio hardware typically comes in two antenna configurations: integrated and externally mounted. These configurations significantly influence deployment strategies in hazardous areas. Take, for instance, a sealed metal enclosure —it poses a critical challenge for devices with integrated antennas, as metal walls completely block radio frequency signals. Fortunately, there are enclosure solutions that can accommodate integrated antenna hardware or externally connected antenna hardware, ensuring reliable wireless communication in challenging industrial environments.

Integrated Antenna Enclosure Solutions

Devices with integrated antennas require specialized enclosures that address unique signal transmission challenges. These solutions are engineered with RF-transparent materials, typically high-grade plastics, to ensure effective radio frequency signal propagation. The design considerations stem from the fundamental limitation of metal enclosures, which would completely block wireless signals.

Deployment Advantages:

- Optimal for space-constrained environments like production cells and offshore installations
- Enables ceiling mounting in manufacturing areas
- Minimizes obstruction in tight walkways
- Provides a compact solution for wireless connectivity

These enclosures allows for a more compact form factor, making them ideal for applications where space and streamlined installation are primary concerns.

External Antenna Enclosure Solutions

These enclosure solutions excel in demanding conditions, particularly in hotter climates, as the internal radio devise (with external antenna connections) typically have wider operating temperature ranges. By incorporating intrinsically safe RF barriers and specialized connector transits, these enclosures also allow for a strategic separation between the radio device and its antenna. This design approach offers advantages as engineers can mount the radio enclosure at a convenient, serviceable height while positioning the antennas remotely to optimize radio frequency coverage.

Deployment Advantages:

- Support for wider operating temperature ranges
- Enhanced RF signal optimization through remote antenna positioning

By selecting the appropriate enclosure solution, engineers can effectively deploy wireless communication devices in challenging industrial environments while maintaining the highest levels of safety and performance.

BARTEC Wireless Solution Value

BARTEC offers the most comprehensive range of wireless enclosure solutions covering all hazardous area levels and global certifications required making it easy for you to find the solution you need. Our solutions come in a range of sizes, materials and deployment options, with internal and external antenna arrangements available to support your use case.

Example of Simple Apparatus Assessment

Equipment Type: iANT 221 Antenna

Directional Dual Band 2x 2 MIMO Antenna

Assessing the equipment as simple apparatus only when connected to an Intrinsically Safe RF Source.

Standards and specifications used

IEC 60079-0:2018	Explosive atmospheres Part 0: Equipment General requirements
IEC 60079-11:2012	Explosive atmospheres Part 11: Equipment protection by intrinsic safety “i”
IEC 60079-14:2014	Explosive atmospheres Part 14: Electrical installations design, selection, and erection
Doc No. 413569	Extronics iSOLATE501 Operating Manual

Assessment summary / 11:2012 clause 5.7
SIMPLE APPARATUS

The iANT221 Antenna is a purely passive device and contains no energy storage, current limiting, or voltage enhancement components. It does not require separate power to operate.

Assessment summary / 60079 - 0:2018 clause 8
EXPOSED METALS

The iANT221 Antenna consists of a white Polycarbonate, UV stable radome with an aluminum backplate and a Nickle Plated Brass N-Type connector. There are mild steel bolts protruding for securing the antenna to the optional MNT-22 mounting bracket. The aluminum rear plate will be considered externally exposed for the purpose of this clause, and the high aluminum content of the alloy used means that this antenna does not comply with the criteria for equipment to be rated EPL Ma, Mb (Mining) or EPL Ga (Gas Zon e 0) Overall, the chemical composition of the exposed metallic elements detailed above, are in dividually each below 7.5% by mass of metals magnesium, titanium, and zirconium. There are no copper elements exposed which means the requirements of 8.5 in relation to copper content for Gas Group IIC applications have also been met. In summary, this means that the requirements of this clause for EPL Gb and Gc (Gas Zon e 1 and 2) and EPL Da, Db and Dc (Dust Zon e 20, 21 and 22) have all been satisfied.

Assessment summary / 0:2018 clause 8
EXPOSED METALS

Group I Mining	EPL Ma	FAIL
	EPL Mb	FAIL
	EPL Ga	FAIL
Group II Surface Gas	EPL Gb	PASS
	EPL Gc	PASS
	EPL Da	PASS
Group III Surface Dust	EPL Db	PASS
	EPL Dc	PASS

iWAP Range optimal for the following:

High temperature applications

Wireless hardware with external antennas typically have a higher operating temperature range

Oil Refineries, Large outdoor areas

Use of directional antennas and ability to remotely mount these can optimise wireless coverage on outdoor sites

Non-IECEx markets

iWAP107 and iWAPXN3 are certified for the US and Japanese markets

EXgate and GRP optimal for the following:

Pharmaceutical

With stainless steel material as standard, and no paint, EXgate is well equipped to survive a harsh chemicals and cleaning regimes

Indoor areas

With simple ceiling mount installation, EXgate is easy to install centrally for even coverage in rooms / booths / units

Offshore

With tight areas and lots of congested metalwork, EXgate is convenient to mount at key locations

5. Environmental Challenges

Now let's consider the installation of a non-certified wireless device into a hazardous area and look at the key considerations: Materials of construction, IP rating, Ambient temperature, Solar loading, Metallic environments and the effects of multipath interference.

Materials of Construction

Often hazardous areas are also subject to extreme weather conditions or corrosive substances. It is therefore extremely important that the materials of construction used in any Ex-enclosure be carefully considered to ensure the product can withstand the extreme condition long term.

For instance, when installing an Ex wireless enclosure into a marine environment the material of the enclosure becomes paramount for successful installation. When we think about marine environments in the process industries, we often think about offshore platforms, but the same material consideration must be given to process plants by the coast in a hot humid environment. In a hot humid environment, the saline atmosphere can be very corrosive and if the correct materials are not used the equipment will soon become corroded and eventually fail.

Typically, a high-grade marine aluminum with special coatings should be selected or stainless steel constructed enclosures. In some cases, nonmetallic enclosures that use glass reinforced polyester can also provide a high degree of environmental protection. It is very important to ensure the enclosure is designed for these extreme environments otherwise what looks good when first installed will soon be a liability.

IP Rating

The minimum level of IP rating for an outdoor Ex enclosure is IP54, but this level of protection is not suitable for extreme outdoor environments. In these environments the minimum level of protection that should be considered is IP65. IP66 provides a higher level of protection in applications that are exposed to high volumes of liquid for clean downs or deluges such as on an offshore platform or ship.

Ambient Temperature

When installing a wireless radio device into your hazardous area it is important to consider the operating temperature. Most standard indoor wireless radio devices will likely only have a 0°C to 40°C operating temperature range and would be unsuitable for extreme hot or cold environments. A truly industrial Ex wireless device must have an operating temperature range of - 40°C to over +50°C to provide reliable performance in the most extreme environments.

It is also important to consider the heat rise that your chosen wireless device will be subject to by being installed in an Ex-enclosure. It is not uncommon to see a heat rise of 0.5°C per Watt of power dissipated. For example, a 25W Wi-Fi access point could generate a 12.5°C heat rise. This heat rise must be added to the upper temperature limit. If your enclosure is subject to extreme cold, then enclosures can be fitted with heaters to ensure that the lowest temperature the wireless device is exposed to is within its normal operating temperature range.

For example, if an indoor rated Wi-Fi access point (AP) is only rated up to 40°C and there is a 10°C temperature rise within the enclosure, the enclosure should be installed in an area that would not exceed 30°C, otherwise the Wi-Fi AP will be exposed to temperatures outside of its rated range.

For this reason, it may be better to fit outdoor or industrial indoor AP's inside the enclosure because they typically offer a wider range of operating temperatures.

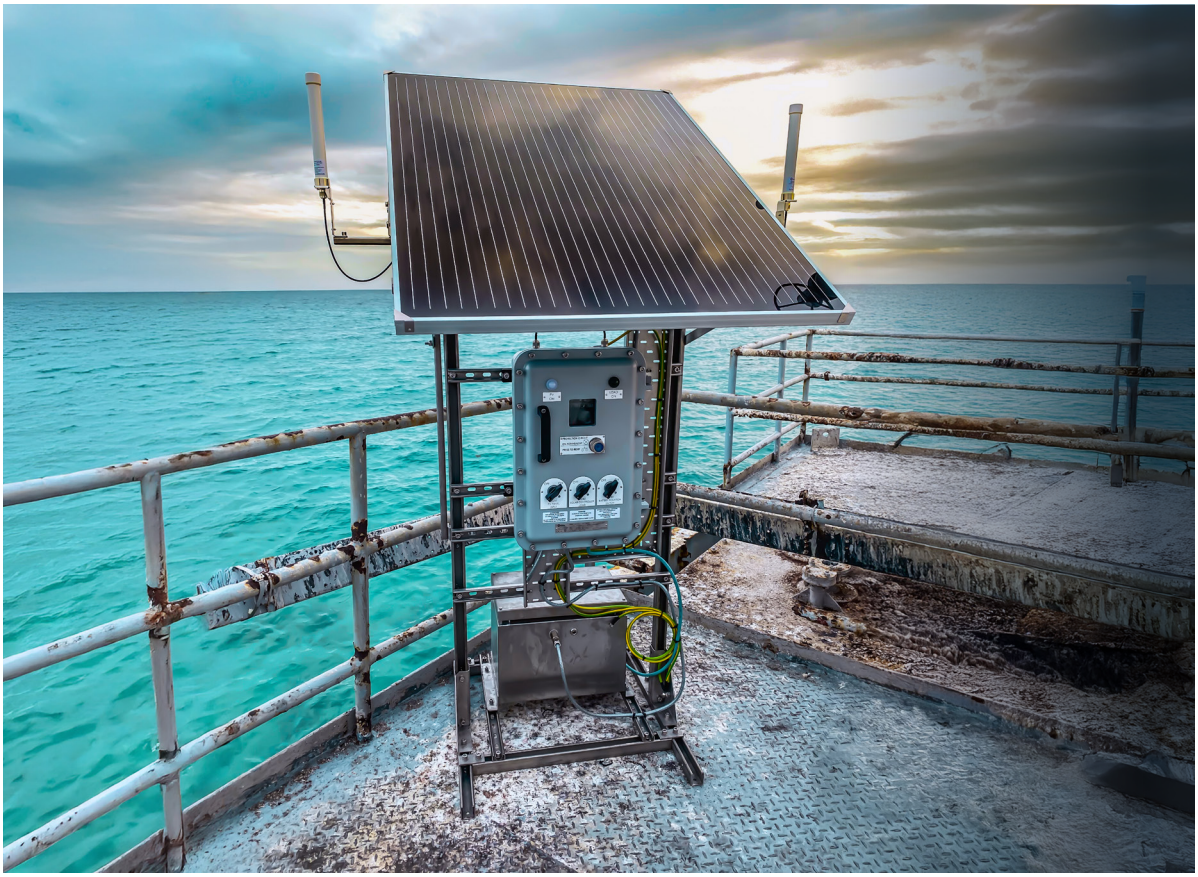
Solar Loading

Solar loading is often overlooked but can cause significant operating issues if not addressed. The heating effects of the sun can be considerable, especially in hot climates. If not properly protected the surface temperature can rise to considerably dangerous levels, especially if the enclosure is dark in color. When specifying your enclosure, be sure to understand the potential solar loading effects for the area where the enclosure will be installed.

Enclosures designed for outdoor high ambient temperature environments will have been thermally engineered. The use of light colors helps reflect the suns heating rays and minimizes the amount of heat conducted into the enclosure (see Figure 4).

It is also possible to provide sunshades if the heating effect is deemed to be too large. When using a sunshade, consideration should be given to the material of construction as it may affect the RF propagation and thus the wireless performance. It is also important to ensure the shade is made from an anti-static material. This is because the large surface area of the shade could become an electrostatic ignition hazard.

Figure 4: iWAP XN3 thermally engineered design



6. Metallic Environments and the Effects of Multipath Interference

One of the most common challenges seen in almost all process industry sites is the effect metallic structures have on the wireless signal. It is essential you choose a device and enclosure system capable of operating in a dense metallic environment. These tend to be on large process plants such as refineries, but they can also exist in smaller chemical plants or on offshore platforms and FPSO's.

Typical communication wireless signals will not penetrate metal, so the complete signal is attenuated and therefore no communication link is possible. Many of these areas include metal rooms or walkways with bulkheads, scaffolding and pipes, making it very difficult to obtain a strong signal. When designing wireless networks for these dense metallic environments you must consider the position of your wireless enclosures and the density you need to obtain the required performance levels.

Another phenomenon that must be considered is the effect of RF multipath interference (see Figure 5).

Radio signals will bounce off metallic structures and this causes the wireless signal to be received multiple times by a receiver. This can mean signals are received out of phase and cancel each other out. This results in a poor or no communication link.

Certain radio technologies have evolved to be tolerant to this and use multipath interference to increase the bandwidth. For instance, MIMO radios have become commonplace nowadays.

Technology, such as 802.11b/g Wi-Fi was fine in line-of-sight applications but became useless as soon as it was deployed in heavy metallic environments with severe multipath interference. This was one of the main reasons that held up the deployment of Wi-Fi in the process industries. The advent of 802.11n Wi-Fi was a game changer in that it was the first Wi-Fi standard to utilize this radio technology. It made it as practical to use in a refinery processing unit as it did in an office.

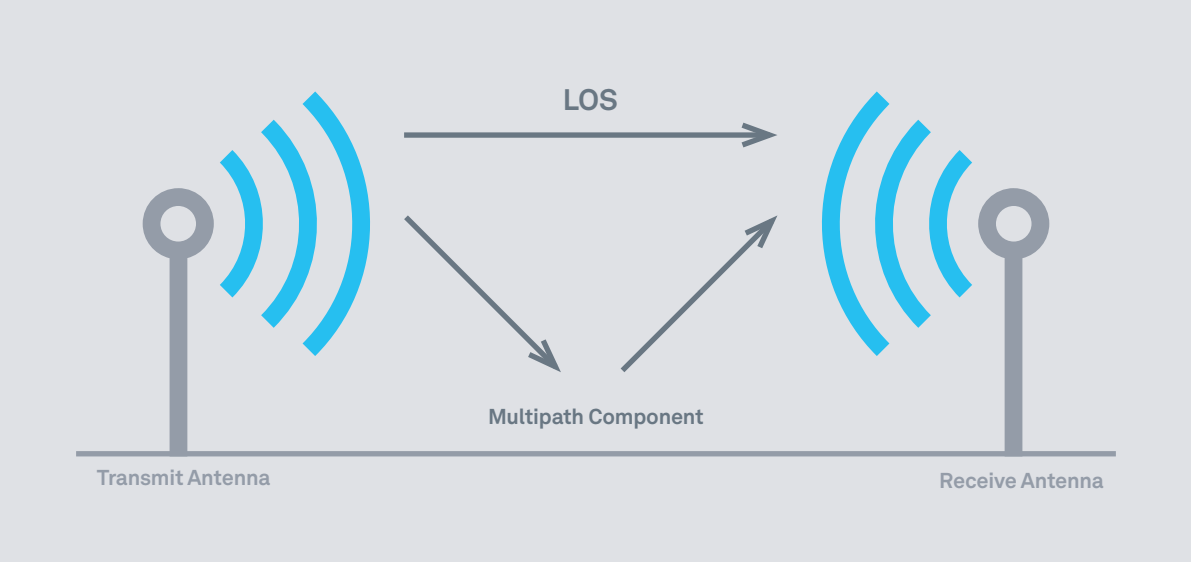


Figure 5: Multipath interference diagram

7. Design and Installation Considerations

There are a few important steps to go through when determining the suitability of an Ex-certified wireless enclosure system for the chosen wireless device.

It is important to ensure it is still compliant with the Ex-certification, does not invalidate other product certification such as product safety and make sure that the wireless device performs as the original manufacturer intended, especially from the RF signal perspective.

The key points you must go through when installing an Ex wireless solution into a hazardous area are summarized below:

Ex certification

Does the wireless device meet the typical parameters set out by the Ex-certification requirements?

- Operating voltage
- Regulatory compliance, such as product safety e.g. EN62368
- Maximum power dissipation allowed in the enclosure
- Cross sectional area and volume stipulations for Ex d explosion proof certified enclosures.

Device size

Will the wireless device fit inside the enclosure?

It is important that size is taken into consideration to ensure any future maintenance is trouble-free.

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It is also critical to avoid compromising the routing of the RF cables to the external antenna ports and tight bend radiuses of the internal RF cables to ensure RF performance is not affected.

It is also worth noting that in the US you cannot buy an empty enclosure and install your choice of wireless device yourself. This would invalidate the manufacturing facility and process audits required for all Ex-manufacturers. In the US, all installations must be checked and signed off by an Authority Having Jurisdiction (AHJ) appointed by the state to ensure OSHA rules are applied correctly.

North American certification

If the Ex-certification is for North America, the notified bodies stipulate that any equipment inside the enclosure must be certified to an appropriate UL safety standard by an NRTL. This can often be a challenge because many wireless devices will have been tested for product safety to a standard such as IEC62368, but they were not done by an NRTL.

They can still be sold in the North American market without concern because they are classed as low power equipment so do not need to have an NRTL safety approval, however, for Ex certification under the NEC500 or NEC505 it is a requirement. This can present a serious challenge and restrict the possibility of installing the chosen device in a hazardous area. BARTEC's wireless enclosures have been designed to overcome this issue, and our internal processes and protective components allow such devices to be installed.

RF path

The RF path is very important to achieve the same level of performance from the standard wireless device when installed in an enclosure.

High quality, low loss, RF cables and connectors with a minimum bend radius are essential to obtain maximum performance. If using intrinsically safe RF barriers, standard antennas can be used - ensure that these have a low insertion loss.

Finally, when direct mounting antennas to the enclosure it is important to ensure that the antenna ports are optimally spaced for the radio frequency concerned when using devices that have multiple antennas such as MIMO radios. If the antennas are installed too close or even too far apart this can affect the RF performance. These key considerations should be carefully addressed to ensure the standard wireless device will provide the required level of performance when installed in a hazardous area certified wireless enclosure system.

Multiple devices

In more recent times, it has become common place to install multiple wireless devices into the same enclosure system. This is often done to cater for specific use cases or to utilize the best wireless technology available from different manufacturers. For example, combining WiFi with WiHART or BLE with LTE is quite common across the process industries.

Ensuring that the antenna port spacing provides suitable RF isolation between the two radios is essential as they can interfere with each other if not done correctly. This only applies in applications where the antenna is directly mounted to the wireless enclosure. A typical value of isolation required to prevent a transmitting radio saturating the receiver of the other radio is 30dB to 40dB.

The wireless devices can even interfere with each other when working on different frequencies. Ideally, the devices would be spaced more than a meter apart but that is not possible when installed inside the same enclosure. There are two practical options available in this scenario.

- Option 1: one antenna can be remotely mounted to create the required distance.
- Option 2: if remote mounting is not an option, then mounting one radios antenna on the top of the enclosure and the other on the bottom will usually provide the appropriate level of isolation.

Antenna spacing

Antenna port spacing on the enclosure is important when using MIMO radios. MIMO radios typically have 3 or 4 antennas per radio, some devices have as many as 8 antennas. The spacing of these ports from one to the other is important to ensure optimal performance when omni directional antennas are mounted directly on to the enclosure.

8. Wi-Fi Use Case: Enclosure Design and Configuration

Wi-Fi devices are still some of the most common deployments in the process industry. Although many other wireless technologies are becoming more popular and regularly being deployed, for the purposes of this guide we will use the deployment of an uncertified WiFi Access Point into a hazardous area as an example.

Firstly, it is important to clarify with the end customer what the hazardous area classification is, Zone/ Division, Gas Group and Temperature Class.

Example Customer Specification

- Zone 1 IIB T3 hazardous area
- Ambient temperature range of -10°C to + 40°C
- WiFi Access Point Specification - indoor IP20 rated 4 x RF port 802.11AC device

Wireless Device Specification

- POE power input
- Power consumption of 25W
- Dimensions are 220 x 220 x 67 mm
- Operating temperature range of -20°C to +50°C
- Maximum RF power output of 23 dBm (200 mW)

Customer Requirements

The Access Point will be installed in a location on the plant that is too far away from a network switch to use copper ethernet cabling and PoE power. For this reason, fibre ethernet and 230 VAC power supply are required. Antenna pattern required is omni directional and direct mounted antennas would be preferable. The maximum ambient temperature is 40 ° C.

Solution

It is recommended that the customer use the Extronics iWAP107 Zone 1 hazardous area wireless enclosure with direct mounted iANT216 antennas.

Once it has been determined the wireless device will fit inside the enclosure, a check of the maximum power dissipation is assessed along with any other stipulations regarding product safety approvals that may be required, such as compliance to EN62368 for example. It's also a requirement to check that the max RF power output at the antenna ports does not exceed the allowed limits for the specific hazardous area where the device is being installed. In this case it is a IIB area meaning up to 3.5W is allowed and therefore well under the safe limits.

The maximum allowed ambient temperature must be calculated to ensure that the internal heat rise in the enclosure does not exceed the wireless devices' maximum operating temperature. In this example the wireless device has a maximum power consumption of 25W. The majority of this will be dissipated inside the enclosure. Therefore, the maximum ambient operating temperature will be less than the standard wireless device due to internal heat rise. Extronics have profiled the power dissipation, and the effects of heat rise on all iWAP enclosures. In this example, the heat rise will be approximately 10°C meaning the iWAP maximum ambient temperature will be reduced to 40°C to ensure that the wireless device is operating within its standard operating parameters. As all the Ex parameters are within the limits of the certification it is now confirmed that this WiFi Access Point is suitable for installation inside the iWAP107 enclosure system.

9. Ex Installation Considerations

How you install the enclosure should be at the forefront of any hazardous area installation planning. Firstly, you must decide how the wireless enclosure will be mounted onsite. The iWAP range of enclosures has standard fixing points for mounting to a wall or a frame. Alternatively, you may wish to mount the enclosure to a pole using a standard pole mounting bracket available for the iWAP enclosure range.

The next step is to look at the field cabling requirements. For instance, the AC power cable in this example will need to be mechanically protected. This is a mandatory requirement stipulated in the IEC60069-14 Electrical installations design, selection and erection standard. There are typically two approaches to meet this requirement:

- Option 1: the cable selected has an armored sheath, which can be in the form of metal tape or braid compliant with the standard.
- Option 2: the cable must be mechanically protected by other means such as installing it in a metal conduit or cable tray system.

When the cable type has been selected, a suitable Ex cable gland must be selected to match the cable and the hazardous area classification. BARTEC can offer advice on selecting suitable cable glands and can supply these as a separate item as part of the kit of parts to complete the installation in compliance with the standards.

Solar Loading

Consideration should be given to the amount of solar loading the enclosure will be exposed to as this will cause further heat rise inside the enclosure. It is important to check with a manufacturer of enclosure systems what the effect of solar loading is. If it is determined that the solar loading effect will cause heat rise that means the wireless devices operating temperature is exceeded, then a sunshade needs to be fitted to the wireless enclosure system to ensure the heat rise stays within the standard operating temperature for the device.

Location Performance

As with any wireless device it is important to consider where it is mounted from a wireless performance perspective. This will have been determined by undertaking a wireless design survey. It should not be underestimated the importance of carrying out a wireless network design review, which will often include carrying out a physical wireless survey. There are companies that specialize in this type of work. They will also consider interference from other wireless devices that may be deployed onsite. This is essential to ensure the wireless equipment being installed will perform to the manufacturers' specification and be reliable in operation.

Finally, it must be proven that the maximum RF field at the antennas does not exceed those allowed for the hazardous area classification where the enclosure is installed. In the above example: Max RF power is 23 dBm and the antenna gain is 6 dBi.

Calculation

Max EIRP = Max Radio Power + Antenna Gain - Cable Losses - Connector Losses

Radio frequency power thresholds

Equipment for	Threshold power (W)	Thermal initiation time (µs)
Group I	6	200
Group IIA	6	100
Group IIB	3.5	80
Group IIC	2	20
Group III	6	200

There are no cable or connector losses because the antennas are directly mounted. Therefore, the maximum power is 29 dBm, which is 794mW and well below the 3.5W allowed for a IIB hazardous area.

This means the installation is safe. More details on how to verify if an RF installation is safe can be found on our blog.

BARTEC makes it easy for you!

BARTEC has over 20 years' experience of developing and manufacturing hazardous area wireless enclosure systems. During this period, we have delivered a wide range of wireless configurations all over the world. There is a high degree of possibility that we have already delivered an identical system you may be looking for.

This means that the compliance checks, production process and procedures will have been completed, making it even easier for you to purchase. If it is a new wireless device then we must check a number of safety parameters that are stipulated in our notified body type approval for the enclosure system. The first thing to check is to make sure that the Access Point fits into the permissible area detailed in the notified body type approval. For instance, there can be limits on how close to the wall of the enclosure that heat generating parts can be mounted as this could affect the T class of the enclosure by increasing the surface temperature. In respect to Ex d explosion proof enclosures there are rules about the amount of free space that needs to be in the enclosure both dimensionally and volumetrically.

10. Maintenance of Ex Equipment

All Ex-equipment needs to be routinely inspected to a standard such as IEC 60079 -17:2014 Explosive atmospheres.

This standard stipulates the type of inspections and the frequency they must be carried out. These inspections must be documented, and it is only through compliance with this standard that an end user can be assured that they are operating their plant in the safest way possible.

When selecting a wireless enclosure system, it is important to check the details of the Ex-certificate for any special conditions of safe use. It is not uncommon for an Ex-certificate to have an 'X' after its number. The 'X Conditions' are clearly stipulated on the certificate and in the installation and maintenance manual of the product.

They cover things such as 'mounting in an area that is not of a high risk of mechanical impact' or 'routine pressure test needs to be carried out after installation and annually after that'. These can not only be a burden on an end user but very costly too. For instance, with Type nR protection restricted breathing, which is suitable for Zone 2 & Division 2 installations, there are certain conditions that stipulate if the enclosure must be pressure tested every year to ensure the method of explosion protection is maintained. BARTEC hazardous area wireless enclosures are engineered to the highest standard without the need of routine testing in the plant.

11. Working with a Specialist Can Save Time and Hassle

Whether you are an End User, OEM or System Integrator, working with specialists pays dividends in the long term. Reliable operation of the wireless device, the long-term total cost of ownership or the support during the design phase makes a big difference to the total costs.

BARTEC is vendor agnostic when it comes to wireless technology. We work with any wireless vendor or wireless standard. Our mission is to enable non-hazardous area certified wireless devices to be cost effectively installed in hazardous areas with the minimal effort required from our customers.

Being agnostic to one vendor or type of wireless technology means we are not bound by contractual relationships that stipulate you can only offer specific devices. It also means we can support all wireless vendors with our solutions without them being concerned that we favor one or the other.

Our goal is to offer the best solution to suit the customer's application. If the customer has a preferred wireless device, then that is the one we'll use. Equally, if a customer comes to us and has no preference, we will offer the solution that best matches their application.

We are wireless experts. We have been supplying engineered wireless solutions for deployment in hazardous areas since 2005. There are many companies in the market that sell Ex enclosures to install uncertified electrical equipment and they do a great job of this. However, when installing a wireless device in a hazardous area you need specialist knowledge and design considerations in the enclosure to ensure optimal performance. We do not just offer the enclosure; we develop and manufacture other components to enable wireless equipment to be deployed in hazardous areas cost effectively. For example, the BARTEC intrinsically safe RF isolators and antennas. These are available for purchase separately but are extensively used in our wireless enclosure systems and have been optimized for price and performance.

Working with OEMs

BARTEC is the ideal partner for OEMs looking to expand into hazardous area markets without the burden of developing their own explosion-proof (Ex) solutions. By leveraging our pre-certified Zone 1/ Div 1 and Zone 2/Div 2 enclosures, OEMs can quickly and seamlessly productize their existing safe-area technologies for hazardous environments. There's no need to navigate the complex and costly Ex certification process—our team of experts handles all certification, compliance, and auditing requirements. This means OEMs can avoid the time, risk, and expense of certifying a product themselves—often exceeding $50,000—while accelerating their time to market. Simply integrate your solution into our certified enclosures, and start selling into hazardous areas immediately, with full confidence in compliance and safety.

BARTEC offers an exceptional breadth of products within our portfolio, enabling us to collaborate closely with OEMs and leverage existing products and certifications in innovative ways—often beyond their original design intent. For example, the MODEX enclosure was initially developed as a communications I/O housing, but thanks to the way it is certified, it can also accommodate small OEM PCBs or gateways. This provides a lightweight, cost-effective solution for OEMs seeking to bring their products into hazardous areas quickly and efficiently. At our core, we excel at solving complex challenges with practical, agile solutions.

Using a Pre-certified Enclosure

There are several benefits to utilizing pre-certified Ex wireless enclosures. Firstly, the reduced time to market. Typically, an Ex-certification process will take up to 12 months but often it can be longer.

If you are an end user or System Integrator and you want to use wireless equipment that you are familiar with, then you don't have to compromise and try and find a wireless device that is already certified.

Our wireless enclosures are certified to many standards such as North American, ATEX, IECEx, UKCA, EAC, INMETRO and TIIS. It costs a lot of money to get such a range of Ex certificates as well as the time and the quality control considerations. It's important to note that all Ex-manufacturers not only have to obtain a type approval for their product but also need to have the appropriate quality system in place. It is a legal requirement that all Ex-manufacturers are audited frequently to ensure the equipment is being manufactured in accordance with the type approval. For example, North American certification requires 4 audits per year. ATEX and IECEx have an annual inspection regime but are typically of much longer duration and may take 2 to 3 days.

Working with a specialist like BARTEC removes all the hassle surrounding Ex certification.

An extensive range of wireless enclosures – we have the solution for you!

BARTEC and Extronics have a combined wireless enclosure offering covering all hazardous area levels and global certifications required making it easy for you to find the solution you need.

BARTEC

BARTEC GmbH
Max-Eyth-Str. 16
97980 Bad Mergentheim
Germany

Phone: +49 7931 597 0
info@bartec.com

bartec.com