



# RFID for High Temperature and Demanding Applications

## Introduction

Radio Frequency Identification (RFID) technology continues to expand past supply chain to more demanding applications in manufacturing, healthcare, pharmaceutical, automotive and rugged asset tracking. This whitepaper addresses the applications where the RFID tag will face high temperatures, autoclave processes, harsh cleaning cycles, and automotive manufacturing processes. The paper introduces a newly enhanced RFID-in-metal tag family, the X II Series that allows implementation of the RFID tag directly on the asset early in the production process to provide management with tracking information as specific to better identify where the product is, where this product is stored and detect bottlenecks within the manufacturing process.

A properly designed RFID system can greatly improve efficiencies, control costs and streamline overall production processes. Additional benefits of applying the RFID tag at the source level is to assist in inventory control, quality and returns and counterfeiting prevention. Many applications exist where a label cannot be mounted on a surface. The current challenge from customers is for a tag that has exemplary performance on metal and can survive high temperatures, pressures, and harsh environments of demanding applications.

# Hospital Instrument Sterilization

Hospitals and medical care facilities need to have absolute sterilization when it comes to instruments used for surgical procedures. The degree of sterilization required for a medical instrument is so critical that it literally can mean life or death for a patient.

Therefore, strict sterilization standards, including the use of an industrial autoclave for sterilization, have been developed and ratified by the AORN (Association of periOperative Registered Nurses) Recommended Practices Committee and Board of Directors. As part of these standards, after an instrument goes through a thorough alcohol and water clean treatment, any item that is heat and moisture tolerant will go through a steam autoclave. Temperatures reach 134°C (272°F) for duration of 18 minutes in a pre-vacuum sterilizer or at 121°C (250°F) for one hour in a gravity displacement sterilizer. In some cases, instruments may be soaked for up to one hour in sodium hydroxide and are then rinsed and then go through the autoclave process.

Metal trays serve dual purpose for medical instruments. One is to contain necessary instruments for an operating room and the other is to hold instruments together while going through the sterilization process. Trays of instruments are put into an autoclave as a whole, ensuring that not only are the instruments sterile, but the tray containing the instruments is also sterile and does not introduce germs into a sterile operating room. Of importance is ensuring that trays of instruments have gone through proper sterilization. Presently trays are tagged with barcode labels and also tracked via “pen and paper”.

The problem is, after repeated exposure to moisture and heat, labels tend to start peeling and eventually fall off. Another problem is trying to scan a barcode printed on a label that has been obscured or faded completely by moisture and heat. For the latter method, human error is inevitable and eventually a tray or two will slip through the cracks.

RFID offers a method of automatically tracking when a tray enters and exits an autoclave. Time and date of entry, duration and exit in the autoclave are automatically updated to a central database. This information is retrievable by a nurse or doctor with a handheld RFID scanner. However, due to extreme heat exposure and repeated exposure to moisture, most RFID tags (even mount-on-metal RFID tags) cannot ultimately survive the process. A RFID tag not only moisture proof, but also heat resistant for long durations, is required for this application. The Xerafy X II series have an environmental duress rating of IP68 that ensures the survival of the tag through the autoclave process.



**FIGURE 1: AUTOCLAVE FOR STERILIZATION**

## Tracking Inventory and Sterility of Pharmaceutical Products

Pierrel-Ospedali, an Italian pharmaceutical company, manufactures a product line including intravenous solutions. Government regulations mandate that all bottles of solution complete a rigorous sterilization process through an autoclave. Bottles of solution must be sterilized at a temperature of 120°C for at least 10-15 minutes. Consequently, the process must have strict documentation and control.

If any batch is questioned in terms of having successfully completed the sterilization process, the entire batch must be discarded. Considering a bottle of solution may cost around \$110 and a tray contains around one hundred and sixty 3 mL bottles, a complete tray that must be discarded because of doubt has a value of \$17,600 that is literally thrown away.



**FIGURE 2: INTRAVENOUS SOLUTIONS PUMPS**

## Instruments Ready for Surgery



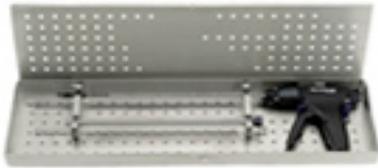
**FIGURE 3: RFID FOR PHARMACEUTICAL PEDIGREE**

RFID has proven to be a reliable mechanism for ensuring instrument trays and accompanying instruments go through proper sterilization. Trays with a tag attached such as the Pico<sup>x</sup> II may be automatically scanned upon entering and exiting an autoclave. Time, date and duration inside autoclave are automatically captured and in some cases written directly to the RFID tag and sent to a central database.

Sterile processing department (SPD) technicians are able to scan each tray and instantly know if it has gone through the proper sterilization process. This not only saves time identifying trays of instruments ready for the operating room, but also saves patients lives. In addition, the Xerafy Pico<sup>x</sup> II is able to survive repeated exposure to autoclave heat as well as moisture, providing a reliable mechanism for repeated cycles.

ROI for having such a mechanism amounts to almost \$275,000 per year (assuming \$84 per hour in delays and staff overtime) in savings not having to either search for a sterile tray of instruments or re-run a tray of instruments through the sterilization process even if there is a slim shadow of doubt to it's sterility. With rugged RFID enabled trays, this is no longer the case.

## Safe Medication Available To Cure Illness



**FIGURE 4: MEDICAL STERILIZATION TRAY FOR MINIMALLY INVASIVE SURGERY**

With the introduction of RFID tagged metal trays, Pierrel-Ospedali is now able to trace when a tray of bottles enters the oven (tray ID is reconciled with entry time/date stamp) and exits after the tray concludes its conveyor ride through the autoclave. The tray is now instantly and accurately identifiable as having completed the autoclave process. Before this process was in place, all information was entered by hand. This method was frequently prone to human error and more often than none would result in entire trays of solution being scrapped because they could not be verified as having been properly sterilized.

Moreover, RFID tags such as the Xerafy Nano<sup>X</sup> II are able to survive the harsh temperature of an autoclave for extended periods of time, compared to a manual tracking process such as a paper barcode or even a conventional mount-on-metal RFID tag, could never have survived repeated cycles through the autoclave. In addition, the accuracy and completeness of the RFID tray tracking system allow the allocation of only one employee to manage the process versus two to three with the manual process.

## Roadmap for Automotive Manufacturing

The complex process of manufacturing an automobile involves many measures and steps to ensure that what starts out as a bare chassis becomes a complete automobile able to be driven out of the factory. Ensuring that all stages of assembly are completed correctly and in a timely manner is critical.

Therefore, it is critical that each chassis has a mechanism that allows tracking at any point during the manufacturing process. In addition, the chassis goes through a paint process and a high-heat oven to rapidly cure the paint before moving to the next stage. Currently chassis are tagged with a barcode label often accompanied with a paper “traveler”. For the barcode label, physical and mechanical handling of the chassis during the manufacturing process may damage the label to the point it cannot be scanned, or the label may fall off completely. Particularly during the paint process, the label will be painted over and therefore completely unreadable. For the paper “traveler”, more often than none they are simply lost along the way due to handling.

An automatic mechanism that allows a seamless and contact-less method of tracking work in progress (WIP) of an automobile, including identification of the vehicle VIN number cross-referenced with build-sheets ensures that the proper parts and even paint colors are used. Likewise, when the chassis reaches the paint booth, the mechanism must not only survive the paint process, but also the baking process involving a heavy-duty oven reaching between 110°F to 140°F during a very short period of time.

## Xerafy X II Series

Xerafy's X II tag family is about creating the toughest ultra-high frequency (UHF) tag on the market in the smallest form factor tag (the size of a dime) but with the read distance of a school bus in length. The X II factor is an indescribable quality that defines how Xerafy tags survive the extreme applications. With a temperature resistance of up to +250°C, these tags may be used in applications involving extreme heat (autoclave, painting, high heat metal form casting, construction etc.) without damage and sacrificing performance. Also for extreme cleaning regimens involving high temperature water baths and often solvents and acids, the Xerafy tags are designed for the long haul.

## Conclusion

All of the aforementioned industries are not new to the RFID landscape. They have all tested and benefited from RFID technology in one form or another. Missing however, was the ability for a RFID tag to not only survive, but also function after long term exposure to heat and extreme conditions such as autoclaves, hot water wash cycles and paint applications involving post-paint high heat oven baking.

Technology from Xerafy offers the ability to track and verify in real time:

- Critical sterilization process of surgical instruments and pharmaceutical solutions
- Automobile manufacture work in progress

Contribute to the reduction/elimination of:

- Instruments not properly sterilized actually used in surgery
- Trays of pharmaceutical solution bottles trashed because of doubt of sterility
- Incorrect parts or color paint used during built process of a specific automobile chassis

## About Xerafy

Xerafy is committed to bringing customers the world's smallest and most durable passive UHF RFID-on-metal and RFID-in-metal tags qualified and tested to meet extreme conditions over the lifetime of the asset. Xerafy's innovative packaging technology offers the automotive manufacturing, aerospace, energy, IT, and construction market, an affordable, durable, high temperature smart tags that can be easily be attached to or embedded in metal assets. With these tags, customers can achieve automatic tool check in/out, MRO, WIP, process control and logistics. Xerafy is headquartered in Hong Kong and maintains sales and support offices in Dallas, Texas, Washington, DC and Shanghai, China.

Learn more about Xerafy by visiting us at: [WWW.XERAFY.COM](http://WWW.XERAFY.COM).