

# Intelligent Foreign Object Prevention

## Introduction

In the vast world of aviation, a clean and properly maintained aircraft is key to the very safety of those who operate, work and ride on it. The same applies to the airport/airbase where aircraft fly in and out every day. Foreign objects (FO) is any substance, debris or article alien to a vehicle or system, which would potentially cause damage. Millions of dollars of damage each year are caused by FOD at airports and affect airports, airport tenants and the airlines. In addition, aircraft damage and airline/airport personnel injury may also occur due to FOD.

Foreign Material Exclusion, or FME, is an alternative term used by the nuclear industry, oil refineries, and other high-risk facilities requiring the same type of foreign object prevention. In the construction world, it is often referred to as Dropped Objects Prevention or Falling Object Prevention. Whatever the name, the idea is the same: prevent debris and objects that will potentially damage equipment and the workers who work with and on them.

The aerospace industry spends in excess of \$4 Billion each year on repairing damage caused by FOD. An aircraft engine damaged by FOD can cost upwards of \$1 Million alone in repairs. Outages already cost the power generation industry overall as much as \$150 billion per year.

# Foreign Object Damage Prevention with RFID

Radio Frequency Identification (RFID) has a long history in detecting foreign objects in aviation. RFID technology was invented to identify friend vs. foe aircraft in World War II. Airbus and Boeing have joined together to create the ATA's SPEC 2000 to utilize RFID to overcome challenges that have plagued the industry's supply chain for decades. The RFID tags or labels can be attached to aircraft parts, tools, and equipment. The tags are used for inventory management, maintenance recording, FME procedures and quality control.

Recently, the National Aerospace FOD Prevention, Inc. (NAFPI), has reviewed technical advances in FOD control utilizing RFID for new prevention and detection methodologies. The NAFPI is a nonprofit, educational organization developed to standardize terms and methods for the prevention of foreign object damage to aircrafts. The collective case studies within the airline industry, demonstrate an accurate, easy and inexpensive method of data entry and data storage for the tracking and traceability of aircraft parts and tool tracking.



The key challenge in the aviation maintenance industry is to maintain high equipment availability with low service costs. The Federal Aviation Administration says that 26 million aircraft parts are changed each year. In 2002, the holding cost of service parts for the aviation industry was estimated to be US\$50 billion.<sup>1</sup>

The problems faced with the manual system is:

- Redundant inventory ordering
- Wait time for manual data entry
- Inventory stock-outs
- Accountability issues
- Inefficient work-flow processes



<sup>1</sup> Multiobjective coordination models for maintenance and service parts inventory planning and control by Martinez, Oscar E., Ph.D., UNIVERSITY OF CENTRAL FLORIDA, 2008,



The automated system with RFID works to store all information real-time. For instance, when the maintenance engineer requires material from the tool crib, a hand-held scanner is used to collect three critical pieces of data. First the employee ID badge, second the material being taken, and last the project or aircraft bay assignment. When the repair is completed, the returned material is scanned back into the tool crib.

The ability to accurately track inventory management means aviation companies can monitor equipment usage, track calibration, track costs and plan what materials the maintenance engineers need in maintaining the aircraft fleet.

More benefits include:

- Reduction of inventory
- Increased capacity due to less storage space for MRO inventory creating more space for parts
- Reduced consumption

## Case Study: Airbus

Airbus has been using RFID for a decade. In one application, the company embedded RFID on the very expensive servicing tools that Airbus leases to its MRO partners. RFID on tools makes it easier for Airbus to track who has tools and what condition they receive are in when the tool has been returned and is being recalibrated. The tool history and specifications recorded on the RFID tag can be easily compared with those being measured on the test bench, and the appropriate changes made.

The efficiencies made possible by RFID have already allowed Airbus to improve the refurbishment of returned tools by up to 27 percent. What used to take Airbus from 19 to 25 days to prepare such tools for future leases with the help of RFID, the timeline has been cut to 16 to 19 days.



## Case study: CribMaster and Lockheed Martin

Lockheed Martin sets the benchmark for their maintenance and construction of fighter jets. The large aerospace and defense company utilized RFID technology to reduce the risk of FOD and found a return on investment for tool maintenance.

At five Lockheed Martin manufacturing site's in Palmdale, CA; Marietta, GA; Fort Worth, TX; Meridian, MS; and Clarksburg, WV, Lockheed has installed WinWare tool cribs that use passive RFID tags to log when a tool leaves or returns to its kit, as well as who takes it and where that worker plans to use it. If a tool goes missing, a supervisor can pull up the most recent log for details on where it likely ended up.

The system started to reduce lost and delinquent tools because the workers know the system is tracking each tool that they check

out. However, the system's integration into the larger enterprise has created even greater savings such as a reduction in maintenance time and costs with the wireless tool-dispensing technology.

The CribMaster RFID system is integrated throughout the facility allowing workers to check in tools anywhere. The system identifies the tool as safe and secured, and pings the appropriate personnel to collect and return the tool to its point of origin.

The biggest benefit of the system is the redundant FOD control the system provides. The CribMaster system adds a second level of security that tools aren't left inside a plane' during assembly. The added safeguard pays for itself in a hurry when it prevents the destruction of millions of dollars in aircraft.

The instant success of the project has made Lockheed consider extending the RFID tracking program to other sites and other company lines.



# RFID for Nuclear Foreign Material Exclusion

The development of specialized RFID on metal technology has significantly affected maintenance methodologies by enabling power generation and aviation organizations to track objects with real-time visibility in foreign material exclusion zones (FME). RFID provides a low cost, highly reliable device to reduce the human element from the prevention and detection. Ultimately, could result in reduced FOD costs and decreased safety risks.<sup>2</sup>

RFID in FOD control methodologies is used to track objects entering aircrafts or high-risk FME areas. Most commonly, an RFID solution uses a tool directly tagged with a RFID tag. The FME zone contains a RFID point-of-use device or portal to automatically capture and record the tools and most importantly, the person who was responsible for taking the tool is now accountable. If the tool is misplaced and is not shown as exiting then a hand-held RFID scanner can be used to help locate a tool where foreign material or object is lost, dropped down a reactor, or is simply not returned when the user came out of the FME Zone.

## Case Study: Xerafy Technology for FME

Recently, a team of students from California Polytechnic State University, San Luis Obispo, successfully designed an RFID tool tracking system for Pacific Gas & Electric's (PG&E) Diablo Canyon Nuclear Power Plant using

[http://www.fodnews.com/documents/ProcaccioGRPEffectivenessofFODControlMeasuresFinal\\_000.pdf](http://www.fodnews.com/documents/ProcaccioGRPEffectivenessofFODControlMeasuresFinal_000.pdf) Felice Anthony Procaccio  
EFFECTIVENESS OF FOD CONTROL MEASURES Embry-Riddle  
Aeronautical University Worldwide Campus October 2008



specially designed RFID tags that can be easily read on metal objects.

The students focused on more accurately tracking tools during foreign material exclusion (FME) activities, which include the cleaning and maintenance of PG&E's reactors. All tools going into the FME area need to be closely monitored. If even one tool is left behind after reactor maintenance, the whole facility can shut down resulting in a significant loss of revenue for the company.



### **XERAFY PICO<sup>X</sup> TAG HEAT-SHRUNK TO WRENCH**

Both the tool room and FME activities currently rely on assigned monitors manually writing tool and employee information into paper forms during check-in and check-out. If employees fail to log the tools they check out of the tool room, PG&E can lose track of these items,





which are expensive to replace. The students were tasked with replacing this manual process with an automated database and RFID system.

The primary obstacle was finding a tag that would work on all of the tools, many of which contained a significant amount of metal. Most RFID tags do not work on metal objects, or require a bulky buffer in between the item and the tag. In addition, PG&E's tools are used in harsh conditions where sweat or impact with other tools and equipment could easily damage the tag.

After testing a number of sample tags, the students found that XERAFY's Pico<sup>x</sup> was the most durable and provided the most consistent performance in the PG&E applications. The Pico<sup>x</sup>, at 12 mm by 7 mm, is currently the smallest UHF read-on-metal tag, and is encased



**DR. FREED, DIRECTOR OF POLYGAIT LAB**

in a rugged capsule that is able to withstand the harsh conditions in the tool room and FME areas. By securing the tags with heavy-duty sealing tape, the students were able to tag all of PG&E's tools, regardless of shape or size.

"I believe that the Xerafy tags are unique, and provide a particularly good tagging solution for metal objects, as well as non-metallic tools and equipment. Said Dr. Tali Freed, Associate Professor of Industrial and Manufacturing Engineering and PolyGAIT Director.

## Conclusion

Combined with the current FOD and FME methods, the ability to “see” what cannot be seen with the human eye, gives an extra level of security to detect a stray tool in a nuclear reactor or aircraft engine that wouldn’t have been located otherwise. The RFID solution is already being implemented by the US Military, Lockheed Martin, Boeing, Airbus, GE and more.

The potential benefits to save up to \$4 Billion for the aviation industry in un-needed repair/equipment replacement costs sounds appealing but the true benefit is to reduce risks that may save many lives. As with any change in the manufacturing process, the employees that have to use it need to accept the technology. The companies that have implemented the technology have found that the workers like the more efficient automation that reduces the paperwork hassles and wait times for products.

The solutions come from partnerships in the industry and expertise in software, tool cribs, services, and innovative RFID technology.

## About XERAFY

XERAFY provides the world's smallest and most durable, EPC Gen2 RFID read-on-metal (ROM) tags, which are qualified and tested to meet extreme conditions over the lifetime of the asset. Our innovative, patented RF technology offers customers, from aerospace to manufacturing, affordable high-performing tags attached to or embedded in metals. XERAFY is headquartered in Hong Kong, and maintains sales and support offices in Dallas, Texas and Shanghai, China. The name XERAFY, {sur-uf-fahy}, was invented to represent how our customers can utilize our tags to qualify, verify and quantify their assets. We want you to *xerafy* your assets.

Learn more about XERAFY by visiting us at: [www.xerafy.com](http://www.xerafy.com).

## About WinWare

WinWare Inc. was established in 1992 in Marietta, GA., just outside Atlanta. Its knowledgeable and experienced staff is dedicated to creating enterprise-wide systems that manage tools and inventory in productive environments. WinWare has a long-term reputation for providing outstanding customer service and technical support for each of its customers, no matter how large or small. The company is committed to providing expert software and hardware solutions. Visit WinWare’s Web site at [www.CribMaster.com](http://www.CribMaster.com).