

## RFID Performance Testing

Beyond Compliance:  
The Importance of Pre-Deployment,  
Customer-Specific Performance &  
Integration Testing to RFID Success

**Sensormatic**<sup>®</sup>  
EAS & RFID Solutions

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## Performance Testing: The Key To RFID Success

Precise simulations have long been a critical step in the execution of all successful endeavors. Architects, for example, use scale models to validate design decisions before construction starts. And just about every manufactured object is modeled before production, from a tiny nano-device to a towering Boeing 777 jet. Even in the abstract, whether splicing genes or pricing financial derivatives, models are vital to success.

*Performance testing can help ensure the rapid ROI of an RFID investment.*

And so it is with RFID implementations. Although RFID is conceptually simple to understand, doing it right depends on engineering the control of a wide range of interdependent material, component and environmental variables.

That's why, before initial site deployments begin, the modeling and performance testing of Electronic Product Code (EPC) label placement, label application and RFID system operation in lab and field environments is imperative. Otherwise, companies deploying RFID potentially can incur time-consuming, trial-and-error system tunings as well as opportunity costs, both of which could put them at risk of delaying and possibly diminishing the ROI of their RFID investments.

By first simulating supply-chain scenarios relevant to their businesses and processes, companies like yours can ascertain the

performance levels of their RFID system designs for themselves and for their retail channel partners who may require it.

As a key industry driver of RFID adoption, Wal\*Mart is requiring its top 100 vendors to establish effective RFID use in their supply chains by January 1, 2005, and expects the same of all its other suppliers by the end of 2006. Target Stores, Albertson's, Tesco and Metro have issued similar requests, indicating that RFID will soon become a ubiquitous, global requirement for the retail supply chain.

While the expectations of Wal\*Mart and other key retailers are driving supply chain adoption of RFID, Tyco Fire & Security cautions against taking a head-long rush into its implementation because of the many variables RFID requires you to control – or at least understand – and optimize their trade-offs.

Given our pioneering RFID experience that goes back 15 years and includes large-scale, field deployments, we're very realistic about its critical success factors. That's why we believe that testing the performance of your RFID system before you deploy it is not only sensible but a key step and a worthwhile investment in your company's ultimate RFID success and payoff.

This white paper will give you insights into the value of RFID performance testing in your implementation of the technology as

well as what to expect in a comprehensive RFID performance testing program every step of the way.

However, this paper does not intend to replace a visit to our global RFID Performance Testing Center in Boca Raton, Florida, where you can see our facilities for yourself and meet our RFID staff who can serve as an extension of your team. For that, I wish to extend you a personal invitation to contact me directly or speak with your ADT account representative. Thank you.



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## RFID Performance Testing: What To Expect

RFID performance testing processes should follow logical steps to identify those variables that would most affect a particular client's simulated RFID model; to understand the interplay of these variables; and to ensure that label placement is optimized to (a) account for as many of the variables as possible, and (b) comply with the requirements set forth by either the client, the client's customer or both.

Among the many variables that can affect positive RFID outcomes are:

- RF-absorbing water/liquid content in food stuffs and manufactured goods;
- RF-absorbing water content in corrugated cardboard packaging, with added variability due to changing relative humidities of indoor/outdoor climates;
- RF-reflecting and/or RF-shielding metal content in both goods and packaging, even foils and metallic inks;
- The individual scenario, which defines single or multiple reads and static or dynamic characteristics;
- Label types, specifically with regards to communication protocols and performance;
- Label substrates, including electrical and mechanical properties;

- Label placement and orientation, at pallet-, case- or item-levels;
- Label application, which is expected to become increasingly automated over time, so that the type and speed of the applicator mechanism as well as the efficacy in hitting prescribed target pallet-, case- or item-level placements will become critical;
- Antenna distance and the inverse correlation of distance to the number of correct reads;
- Antenna configuration, which can overcome other system or environmental limitations when creatively applied;
- Reader frequencies: Low-frequency (125/134KHz); high-frequency (13.56 MHz); ultra high-frequency (850-950 MHz); and super high-frequency or microwave (2.4 GHz);
- Reader protocols, depending on the manufacturer;
- Tolerances between readers and labels and their performance specifications;
- Through-put speeds of pallets, cartons or items on fork-lifts, pallet jacks or conveyors;
- Environmental issues, such as so-called “noise pollution” – signal interference from other RF devices – or the reflective and/or shielding characteristics of a scenario surroundings.
- Software device and data management architectures, efficiencies and robustness.

The preceding list is hardly exhaustive but clearly representative of the engineering challenges posed by deploying RFID effectively in any supply chain scenario. That's why the value of years of accumulated knowledge and experience among an RFID performance testing team can become key factors in accurately modeling a client's RFID scenarios.

### RFID Performance Testing: Process Steps & Scope Of Work

Obviously the time and cost considerations of RFID scenario simulations and testing depend on a client's requirements including the number of products to be tested, the amount of metallic and/or liquid content in the goods and/or its packaging, the degree of desired RFID performance, the number of scenarios to be simulated and so on.

In every case, an RFID testing and scenario modeling effort should operate according to a detailed test plan as a matter of good project management. To illustrate what that effort might look like, the following provides an outline and general descriptions of the steps involved in a typical RFID scenario simulation and testing project done by Tyco Fire & Security's RFID Group.

**Assigning the team.** To determine an initial scope of work, an interdisciplinary team from Tyco Fire & Security and ADT will meet with a client to learn as much as possible about its business

drivers for deploying RFID and both the physical and process contexts for its use. Team members typically include:

- Senior technicians from the Tyco Fire & Security RFID Performance Center and Integration Services teams who will oversee the scenario models and tests;
- Staff and partner specialists in RFID EPC label design, manufacture and application;
- Specialists in RFID reader and antenna technologies as well as system design and engineering;
- Field application engineers, skilled in actual onsite deployments;
- Members of our RFID product and program management groups;
- An experienced senior manager who serves as overall project leader and as a single point of contact for the client to ensure clear communications and accountability.

**Surveying the client site.** A survey of a client site is important to extend the team's learning and understanding of the client's RFID requirements, especially in relation to where the technology will ultimately be deployed. It's more than a matter of compliance with an external customer's requirements; it's helping to ensure that an RFID implementation is fully integrated with a client's environment, workflow and business processes.

A site survey also is key to developing a comprehensive performance test plan that is relevant to the client's particular supply chain conditions and even predictive of the performance of the RFID solutions to those requirements.

From an RF perspective, every environment within which RFID is to be installed will differ. Wireless networks, short-range radios, cordless phones, and so forth – whether behind walls, around corners, or otherwise hidden – all can generate RF interference that can impede RFID system performance.

Identifying those sources of interference is one thing but knowing the nuances of how these devices “behave” RF-wise can be used to optimize an RFID implementation given their existence in the target environment. Tyco Fire & Security's RFID Development team has built an extensive database on their various makes and models, including their finer points of compliance with the FCC's “Part 15” section and the evolving ETSI standards on RF interference.

**Qualifying the label.** At the heart of any performance testing process should be a series of tests described below that qualify the use of RFID EPC labels, also known as tags, on actual client product samples and according to a client's RFID configuration model. To ensure the validity of these label tests, our lab technicians calibrate the test readers' RF output each day according to a rigorous, multi-step performance verification.

The label qualification tests are:

- **Label Performance Qualification** – This procedure puts labels on a client's case-level carton packaging and verifies the read distance of the labels.
- **Label Write Test** – This EPC Class 1 test is done using a single label on a single carton of a client's products and determines the programming performance of a selected label on the client's carton. The assessment verifies the label's ability to write at a specific distance and considers all known variances.
- **Label Placement Qualification** – This is a critical exercise that determines the optimum location on the client's cartons for the EPC label's placement. Among other variables, it accounts for package moisture and how pallets are built.

These tests are conducted using our growing knowledge base of optimal label positioning for a wide variety of products and product categories. This includes label positioning know-how from the group's extensive heritage of Sensormatic® Electronic Article Surveillance (EAS) source tagging programs. These programs have processed more than 47,000 products, all certified for tag design, automated placement and performance.

**Qualifying the system.** Next in the series of our RFID performance-testing procedures illustrates how we qualify various fundamental RFID application configurations that would typically make up a working RFID system. These procedures are:

- **Conveyor Tests** – This set of tests determine the EPC labels' readability on a customer's product(s) as they pass over a conveyor system at various speeds, product concentrations and label orientations.
- **Portal Test** – This procedure moves a pallet of EPC-labeled cartons of a client's goods (built to the client's specifications) through a portal that is set up according to either Wal\*Mart's or other retailer's portal dimensions or the dimensions of the client's own portal scenarios. It measures the readability of each labeled carton as well as the pallet tags as it moves at variable speeds through center, left and right lanes of the portal width.
- **Dock Door Test** – Similar to the Portal Test, this procedure moves a pallet of EPC-labeled cartons (also built to client specifications) through a dock door (or dock doors) that reflect either Wal\*Mart's or other retailer's dock door dimensions, or the client's own dock door scenarios. It measures the readability of each labeled carton as well as the pallet tags as it moves at variable speeds through center, left and right lanes of the dock door's width.
- **Continuous Inventory Test** – This test determines how an EPC-labeled pallet performs in static warehouse shelf conditions with cartons labeled according to placements recommended by the Label Placement Qualification Test.

**Benchmarking the results.** At this point in the RFID industry, Wal\*Mart's RFID requirements are baseline performance criteria for Tyco Fire & Security's RFID Group's performance testing program. Some RFID performance testing clients, however, are already insisting on meeting alternative or even higher levels of operating criteria.

For the reader's information, the following summarizes Wal\*Mart's compliance expectations based on Tyco Fire & Security's current understanding:

1. RFID EPC tags are required on all pallets and cases, with cases defined as reusable plastic containers, totes or corrugated boxes.
  - Tags are required to be EPC Global Class 0 or 1 where both tags are UHF.
2. Application Performance Requirements
  - Conveyors: 100% detection of labeled product regardless of orientations on multiple cases moving at speeds of up to 600 feet per minute;
  - Portals/Dock Doors: 100% read of pallet tags and multiple case reads at speeds up to 8 miles per hour.

The table below summarizes an example of a Tyco Fire & Security RFID performance testing procedure.

**Table 1. Examples of Test Parameters Against Known Wal\*Mart Requirements**  
(As of February, 2004)

Test Area and Conditions	Test Parameters
Write (Programming)	12 to 24 inches
Conveyor Speed	200 feet per minute and faster, all orientations, multiple cases, 100% detection
Portal	4 to 8 miles per hour: 100% of pallet tags; maximum number of carton tags
Dock Door	120 to 360 feet per minute: 100% of pallet tags; maximum number of carton tags

*All performance-testing scenarios are accurately and extensively documented for our clients.*

**Delivering the results.** Based on the results of the preceding procedures, Tyco Fire & Security’s RFID group delivers to its clients a final report with performance details and recommendations where appropriate on how to optimize label and system performance given the client’s scenario models. With pre-deployment scenario modeling and performance testing, the client and its retailers – including Wal\*Mart – will have much higher levels of confidence that its products and supply chain will meet their respective RFID expectations.

## Tyco Fire & Security RFID Scenario Modeling and Performance Testing Services

Tyco Fire & Security, a recognized RFID pioneer and market, aims to help product manufacturers and retailers optimize the return on their RFID investments by providing scenario modeling and performance testing services.

*A Tyco Fire & Security RFID performance test has the respect of leading retailers who know our exacting standards.*

To support our commitment to this market need, we have established a facility in Boca Raton, Fla., our global center of competency for these RFID services.

In addition, we have focused a skilled and growing RFID team whose collective knowledge is seasoned with years of real-world experience in early RFID implementations.

### Known & Respected By Retailers & Packaged Good Makers

Our EAS certifications have long been recognized by the world's top retailers and consumer package goods companies.

Why are these relationships important? While RFID and EAS are different technologies serving different needs, Tyco Fire & Security has years of experience in negotiating and collaborating with these retailers and manufacturers to develop best practices for label placements. Simply put, a performance test from Tyco Fire & Security carries the respect of these industry leaders

because they recognize the know-how, field-tested experience and exacting requirements behind our testing process and procedures.

In fact, our database of EAS certified products includes the records of performance tests done on more than 47,000 products. In 2003, we estimate that nearly three billion items were source-tagged and sold at 25,000 retail outlets worldwide – all based on recommendations by Tyco Fire & Security's EAS performance labs.

### Tyco RFID Performance Center: Complete Facilities For RFID Scenario Modeling & Performance Testing

At our RFID Performance Center, we simulate as many supply chain scenarios as possible, we have forklifts, pallet jacks, stretch wrappers, multiple dock doors of various sizes, portals, conveyors and long lengths of multi-story stock shelving for continuous inventory simulations.

Also part of our setup is an RF semi-anechoic testing chamber to evaluate the capabilities of various RF labels and readers. For testing label application performance, our RFID certification facility features a high-speed label application lab equipped with the principal applicator styles from all the major applicator manufacturers. In it, we can test applications of up to 400 labels per minute.

## RFID Scenario Modeling & Performance Testing: Taking The Next Step

Much has been written about the promise of RFID technologies to provide perfect supply chain visibility from source to shelf, but realizing this promise depends on RFID's successful execution. And successful execution begins with accurate scenario models as well as product and process performance testing.

If you are looking into how RFID technologies could benefit your supply chain or if an RFID implementation has already become a channel imperative for your company, we invite you to consider how the Tyco Fire & Security RFID Performance Center can help you ensure a successful RFID deployment.

### About Tyco Fire & Security

As a leader in electronic security for more than 30 years, Tyco Fire & Security and its Sensormatic SensorID™ solutions group has helped to pioneer RFID in retail supply chains. We strongly support the development of open industry standards and protocols to accelerate RFID's deployment across the entire retail supply industry, so its benefits of resource optimization and cost reduction can be realized sooner.

In addition, Tyco Fire & Security, via its Sensormatic solutions portfolio, designs, manufactures, services and markets the

world's most advanced lines of fully integrated electronic article surveillance (EAS) systems. Our EAS systems are used by all types of retailers to deter shoplifting and internal theft. We lead the security industry in integrated source tagging – helping consumer and fast-moving goods manufacturers apply some 10 million anti-theft tags every day in their packaging or manufacturing plants around the globe.

With more than 445,000 EAS installations worldwide, our customers include a majority of the top 100 retailers worldwide, and our installation history includes more than 80,000 systems at UHF frequencies.

ADT Security Services sells and services Sensormatic solutions in the U.S. and in Europe. Sensormatic products are offered worldwide in over 100 countries through an extensive network of Tyco, ADT and Sensormatic branded subsidiaries and other distribution channels.

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