



# Best Practices in RFID Tag Quality Assurance and Testing



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## INTRODUCTION: THE MYTH OF THE METAL TAG

Radio frequency identification (RFID) technology is playing an increasingly important role in a number of business-critical applications—everything from supply chain management and asset management to fleet tracking, work-in-process monitoring, and access control.

Key to the success of the technology across these applications and multiple vertical markets has been the development of robust, reliable RFID transponders (tags) that can be mounted on a variety of surfaces and support long-term, business-critical use cases. To provide this type of reliability, RFID tag manufacturers must develop robust designs, repeatable manufacturing processes, and dedicate themselves to following rigorous quality assurance testing. Only by providing tags that end users can confidently deploy in large numbers throughout an enterprise can manufacturers help to build a solid foundation for successful deployments.

Omni-ID®, a leading supplier of passive, durable UHF RFID tags, has developed a rigorous quality assurance testing program for its line of RFID products that isolates potential failure issues during the design phase, checks for imperfections in manufacturing, and guarantees high performance during the life of the tag.

This white paper will outline Omni-ID pre- and post-production quality assurance testing programs.

## RIGOROUS QUALITY ASSURANCE

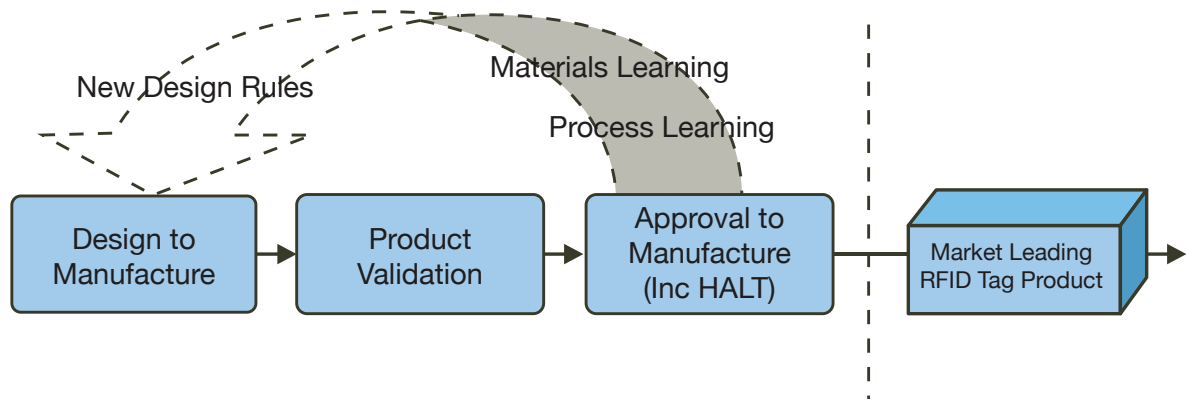
Omni-ID develops and markets RFID tags that are specially designed to function near liquid and metal, materials that traditionally interfere with RF signals. Since 2007, the company has implemented RFID systems worldwide using its patented plasmonic technology first developed by QinetiQ. In 2009, Omni-ID launched its second generation of RFID tags, including a completely revised Prox, Flex and Max range, in addition to the MaxSQ, MaxHD, and Ultra—all products boast enhanced durability and survivability.

In order to completely control and drive market-leading quality, Omni-ID made the strategic decision in 2008 to invest in its own dedicated manufacturing facilities, rather than outsourcing production. From the beginning, the company planned to include a robust testing facility within the manufacturing plant. By doing so, Omni-ID could significantly enhance product quality control and take an entirely new approach to controlling the product evolution within the company.

Omni-ID aggressively tests, validates and characterizes processes and procedures that demonstrate conformance to each product's stated performance standards during the design process, and then tests and validates the performance of 100% of tags during production.

The new quality assurance program has not only helped verify the quality of the RFID tags being shipped to customers, it has also greatly accelerated the design-for-manufacture and development stages by allowing engineers to build on the data gleaned from the testing processes.

The company puts each new tag design through two phases of pre-production quality testing. The Product Validation testing program determines each tag's performance parameters and how they may be affected by exposure to heat, impact and other conditions. The Highly Accelerated Life Testing (HALT) suite, on the other hand, provides data on how the tags will perform over long periods in very challenging conditions. These tests allow Omni-ID scientists and engineers to validate the long-term use of the product in the field.



Latter stages of Product development process featuring rigorous Product Validation and HALT testing.

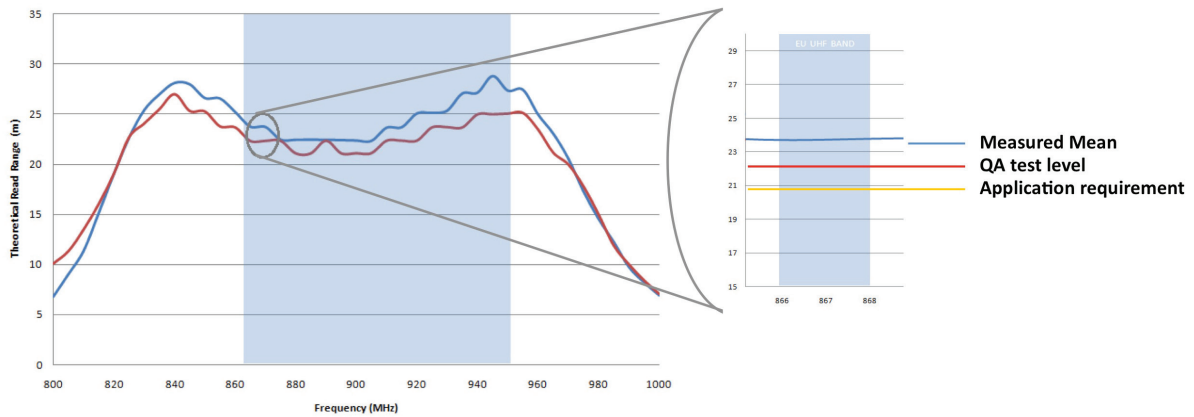
If a product does not pass the extensive quality assurance testing program, members of Omni-ID senior management team and engineers reject the product design.

This essential product characterization and validation system ensures that each tag performs as promised, and can be used as a reliable and stable RFID solution in the field.

## DESIGN FOR MANUFACTURE AND PRODUCT VALIDATION

Omni-ID's unique and rigorous quality assurance process begins during the design phase of each tag. Understanding the acceptable performance for the target application and design-for-manufacture is the first step to ensuring quality in mass production. Choosing the correct tag sensitivity, selecting suitable materials and appropriate processes are all considered in the Design-to-Manufacture phase. After design and prototyping, the next step is pre-production (often using multiple thousands of parts) to first validate RF performance parameters, and then to ensure that any changes during a rigorous product validation testing regime are measured and understood.

The RF performance is characterized by the sensitivity and operating frequency of the tag on a suitable range of substrates. A statistically representative sample is tested to benchmark the average and standard deviation of the product performance. This is used to define the Quality Assurance levels.



Typical RF Performance Characterization with Mean and QA Level Highlighted for EU Band.

In order to accurately assess RF performance characteristics, Omni-ID designed and manufactured bespoke anechoic test cells, allowing Omni-ID to test its tags in a reliable and repeatable environment.

During the Product Validation phase, products undergo the following tests:

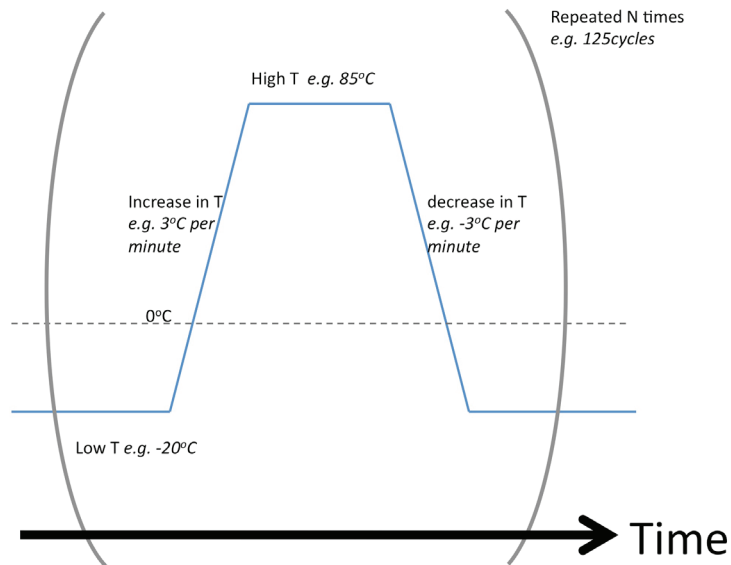
### Sustained Thermal Exposure at Maximum Operating Temperature

During the thermal testing process, tags are loaded into a thermal oven for up to 700 hours at the tag's specified maximum operating temperature. A selection of tags are removed at key stages, and then undergo extensive characterization and evaluation testing. This stage gate is a pass/fail gate with signatory acceptance/rejection reviews.

Note that the thermal exposure is sustained. Some manufacturers simply conduct this test for short durations, and will pass the tags if they are still operational. For tags to pass similar thermal testing at Omni-ID, the tags must meet the pre-defined application requirements; often this means that to pass the test the product must not change by more than a few percent in performance.

### Sustained Thermal Cycle Between Maximum and Minimum Operating Temperature

During this test, the tags endure up to 500 cycles of exposure as the temperature continues ramping from maximum to minimum operating temperatures. The temperature is held both at the maximum and minimum temperatures for a defined period during each cycle, and this process is repeated for the test duration.



Typical thermal cycle test profile

### Impact Testing

Products either have a 1kg, 5kg, 10kg, and 25kg loads dropped onto them from a defined distance, or are dropped from a defined distance in stacks of 20 to 100 labels. Again, the products undergo characterization and evaluation testing. This stage gate is a pass/fail gate with signatory acceptance/rejection reviews.

### IP Protection Testing

Each tag that Omni-ID produces is rated for protection against water as defined in the IEC Standard for ingress protection (IP) ratings during all stages of design, product validation and manufacturing. There are set pass/fail criteria for these tests, and tags undergo extensive characterization and evaluation testing. This stage gate is a pass/fail gate with signatory acceptance.

### Application Testing

**Static:** Omni-ID performs both static and dynamic load testing to determine adhesion strength for each tag and substrate. For static load testing, a load is applied (at defined environments) and held until failure, and the elapsed time to failure is recorded.

**Dynamic:** For dynamic load testing, the load is progressively increased until adhesion failure in laboratory or simulated real environments.

**Mechanical Attachment:** For tags that may be riveted on to an item, the company performs a rivet test to ensure that the tag casing won't crack or shatter during the riveting process.

After each of these tests is completed, the tags are measured and tested to determine if they have maintained their fit, form and function characteristics, and to determine if they still meet their design specifications.

## APPROVAL TO MANUFACTURE (HALT TESTING)

The Highly Accelerated Life Testing (HALT) program simulates performance over the typical life of a tag. The HALT program is based on defined periods of elevated thermal exposure, thermal cycling and impact testing to determine if the tags will still meet their performance criteria after being utilized in typical operating conditions over time. This sustained testing cycle is designed to mimic an operating lifecycle of between three to five years.

By testing the tags at these elevated temperatures, Omni-ID has been able to provide data on how the tags would perform over multiple years. By conducting these two stages of rigorous testing, material and design potential weaknesses can be identified and corrected prior to product release, making the Omni-ID tags “mature” at launch.

## CONCLUSION

By performing extensive and controlled testing of its RFID tags to defined standards, and validating that the tags can meet and exceed their stated performance specifications in a variety of specified and enhanced conditions, Omni-ID is able to guarantee the quality of its products both at delivery and over the course of their utilization in real-world applications.

The quality assurance testing program developed at Omni-ID has allowed the company to improve and maintain the quality of its current tag portfolio, while enabling ongoing performance and material improvements in the future. With these stringent testing strategies in place, customers can be assured that the tags they deploy will perform reliably over the life of their applications.

## ABOUT OMNI-ID

Omni-ID is the leading supplier of passive, low profile UHF RFID solutions. Omni-ID's patent-pending technology enables a broad range of new applications to improve asset tracking, supply chain management and work-in-process. Omni-ID's family of versatile RFID tags works reliably in the harshest environments including on, off, and near metal and liquids and excels in solving tracking and identification challenges with unprecedented accuracy. For more information visit [www.omni-id.com](http://www.omni-id.com).

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Visit [www.omni-id.com](http://www.omni-id.com) to learn more about Omni-ID's products and solutions.

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