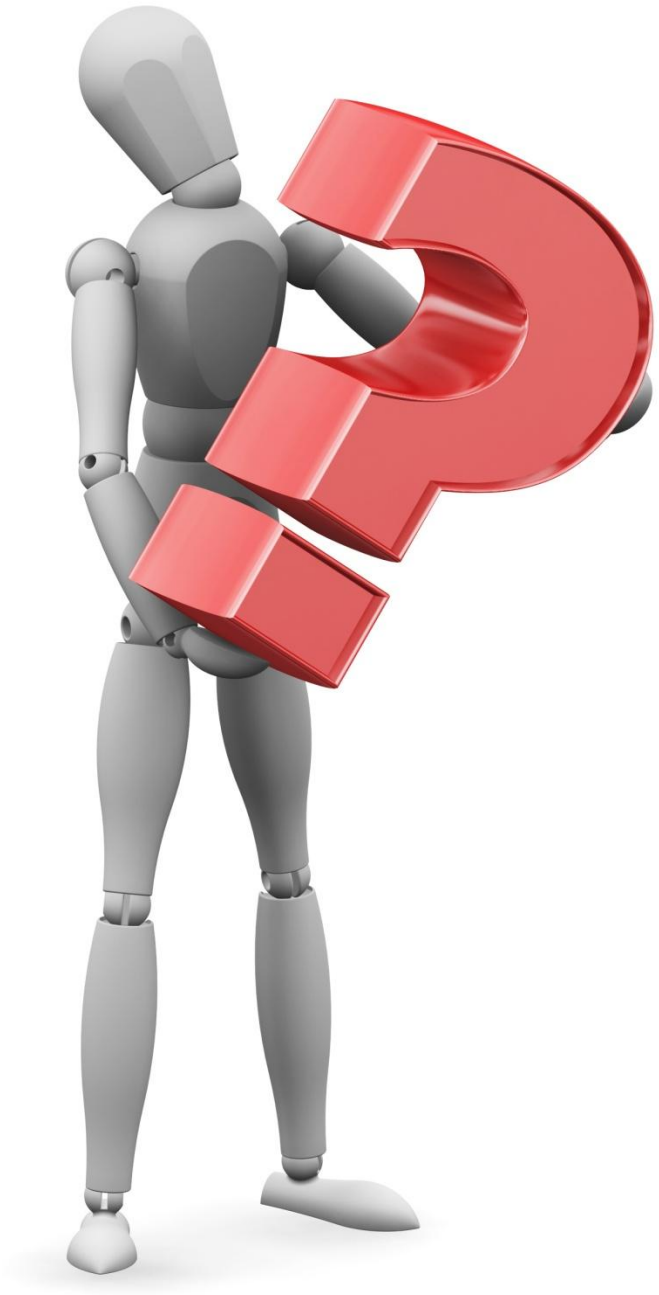

Durable Asset Tag Product Evaluation & Benchmarking

November 26, 2008

Written by Louis Sirico with enormous contributions from the entire Wizard's Team

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During the past several years, I have heard many people say, "RFID does not work with metal and liquids" in the context of passive UHF technology, more specifically with EPCglobal Class 1 Gen 2 or ISO 18000-6C. This unfortunate misconception has been perpetuated by misinformation from vendors with competitive offerings in other frequencies. In reality, anyone can achieve tag reads on metal from 39 feet away and 2½ feet away submerged in water if the proper tag, reader, and antenna is used. This report should definitively prove that passive UHF tags can work on metal and in/near water as well as give you the knowledge you need to do it yourself.

In November 2008, we evaluated twelve commercially available Durable Asset Tags (Metal Mount and Submersible tags). We define **Durable Asset Tags** as RFID tags that are specifically designed to withstand a variety of challenging environmental operating conditions. In order for a tag to be included in this category **it must have an IP Rating** which provides a standardized measure for durability. This category includes both **metal mount tags** and **submersible tags**.

All of the tags were tested for average and maximum read rates while on metal; on plastic near metal; on water; and in water. In addition, each test was conducted in both controlled orientations, as might be found in an assembly line; and uncontrolled orientations, as are typical in the use of hand-carried assets in a data center.

The results varied by manufacturer and by tag. The overall best performing tags are from Omni-ID, with strong performances from Intermec and SimplyRFiD. Tags should be selected carefully to suit a given application (e.g., all-metal; plastic-on-metal; on water or submerged).

Passive RFID Durable Asset Tags Evaluated

Small	Medium	Large
• Confidex Halo™ • Omni-ID Prox™ • SimplyRFID Nox TM4	• Confidex Ironside™ • Intermec IT65 Small Rigid Tag • Omni-ID Flex™	• Avery Dennison Metal Track AD-900™ • Avery Dennison AD-902™ • Avery Dennison AD-908™ • Confidex Survivor™ • Intermec IT65 Large Rigid • Omni-ID Max™

RFID Reader Equipment Used

Two ISO 18000-6C compliant stationary readers are used for these performance tests: an Impinj Speedway® (reader firmware v3.0.2) and an Alien 9900 (reader firmware v07.10.30.00).

The far field tests use linear and circular polarized antennas from Cushcraft. All antennas used the standard cables connected directly to the reader.

The near field tests use a Convergence Systems Limited CS777 Brickyard™ Near Field Antenna. The antennas used the standard cables connected directly to the reader.

Software Used

For the Impinj Speedway, we used the RFID demo application built-in to the reader. For the Alien 9900, our team used Alien Gateway Version 2.17.00.

To obtain results using a third party application, we choose epcHOTSPOT version 02.06.00. epcHOTSPOT was also used to determine the most suitable tag placement

location for some tests. For more information information on tag placement, please read our in-depth articles:

- **In-Depth: Tag Placement - Tag It Right!**
  An in-depth article that helps you choose the right RFID tag and explains the importance of tag placement.

- **Hands-on: Tag Placement Using epcHOTSPOT**

Software Performance Differences

In one test case we used the Readometer feature of the Alien Gateway and then ran the exact same test with the Tag Grid feature. The Tag Grid was able to show tags persisting up to two feet further than the Readometer. As a result, we opted to disregard all Readometer results and only keep the Tag Grid results.

Although it is a third party application, the test results using epcHOTSPOT were extremely close to the vendor specific applications.

Our Passive RFID Durable Asset Tag Performance Benchmark Tests

All tests are designed based on real-world scenarios that a product will encounter. Three trials of every test is performed. When possible, a different tag was used for each test in order to account for production variances. This also eliminates having a really good tag or a really bad tag that skews the results. Although tags may read briefly at further distances, each tag must maintain a 5 second read before the distance results are recorded. In some cases a tag would be read very briefly at a much greater distance than the recorded result demonstrates. Our team selected 5 seconds because it helps to eliminate tags reads resulting from stray reflections. The result of each test is captured and the average of all tests is calculated and published to the web site.

The tags were tested in a variety of scenarios; all tests are grouped into one of four categories:

1. On metal
2. On plastic, near metal
3. On water
4. In water

On Metal Benchmark Tests

Rack Mounted Server Evaluation

As many of the tags are marketed for IT asset management, our first set of tests on metal used a generic rack-mounted server. The server case is made entirely of metal. Our team placed each RFID tag on the front of the server (as pictured) because it is the least likely place the tag will come off when the server is moved or be obstructed by metal from the rack or another server. Tags often have human readable information and the front is a very common tag placement location for IT assets. On our particular model server, there are air vents in the front with a fan for cooling.that blows air on the adhesive which one of the reasons our team prefers screw or bolt mounting on metal.

Steel Asset Tracking Evaluation

The second set of metal mount tests used a section of steel that is similar to a durable goods part or a carrier. The tag is mounted in the center and slightly inset. Again, this placement helps prevent the tag from being damaged or ripped off as the item moves.

Although we did not bolt the tags in place, this is a another example of when it is appropriate to do so.

On Plastic, Near Metal Benchmark Tests

IT Asset Tracking Evaluation
Nearly all of the tags evaluated are marketed specifically for tracking IT assets, we elected to use two common IT products:

1) a portable hard drive (pictured left) and 2) a wireless router

Both of these assets have a plastic case with metal components inside.

After some consideration, our team decided to only test the average distances using the far field antennas. Most small IT assets are hand-carried or placed in random locations on a push cart and travel through a RFID-enabled doorway. This kind of configuration is typically used for asset tracking applications. It is very rare that orientation is controlled.

The Water Tests

Our team decided to use ordinary tap water for our liquid tests simply because there are so many different types of liquids, it would be difficult to decide what chemical combinations to use.

Our water tests are used to simulate work-in-progress applications of pharmaceuticals such as shown in the picture - right. The tag is either mounted directly to a bottle or submerged in the liquid.

All tests with water were performed using near field antennas as described above.

On Water Benchmark Tests

Given that some of the tags are marketed as being appropriate for pharmaceutical tracking, our team used plastic bottles that can be found in many households, such as those pictured below left. The tags were affixed using adhesive.

In Water Benchmark Tests

In order to test some of the tags in water, it required larger bottles such as those pictured below right. The tag was simply placed inside the water filled bottle and tested.

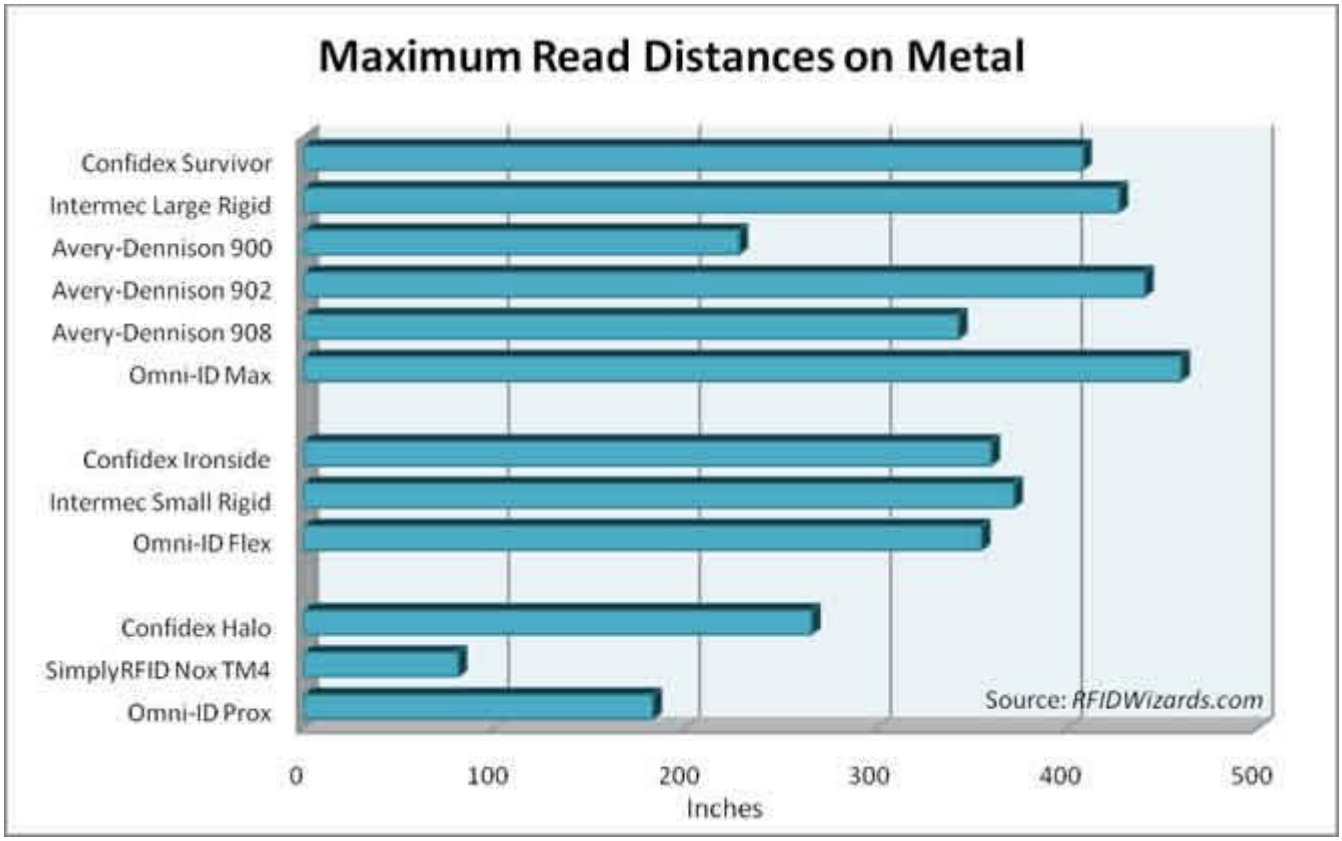
Tag Performance Results - Far Field Antennas

Maximum Read Distance on Metal

These tests are designed to show how the tag will perform when orientation is controlled. A linear polarized antenna is used and the tag is remains in the proper orientation to the antenna. This results in the maximum read distance achievable with the tag, reader, antenna combination.

Real World Use Case
This kind of configuration is used for work-in-progress applications such as shown in the picture

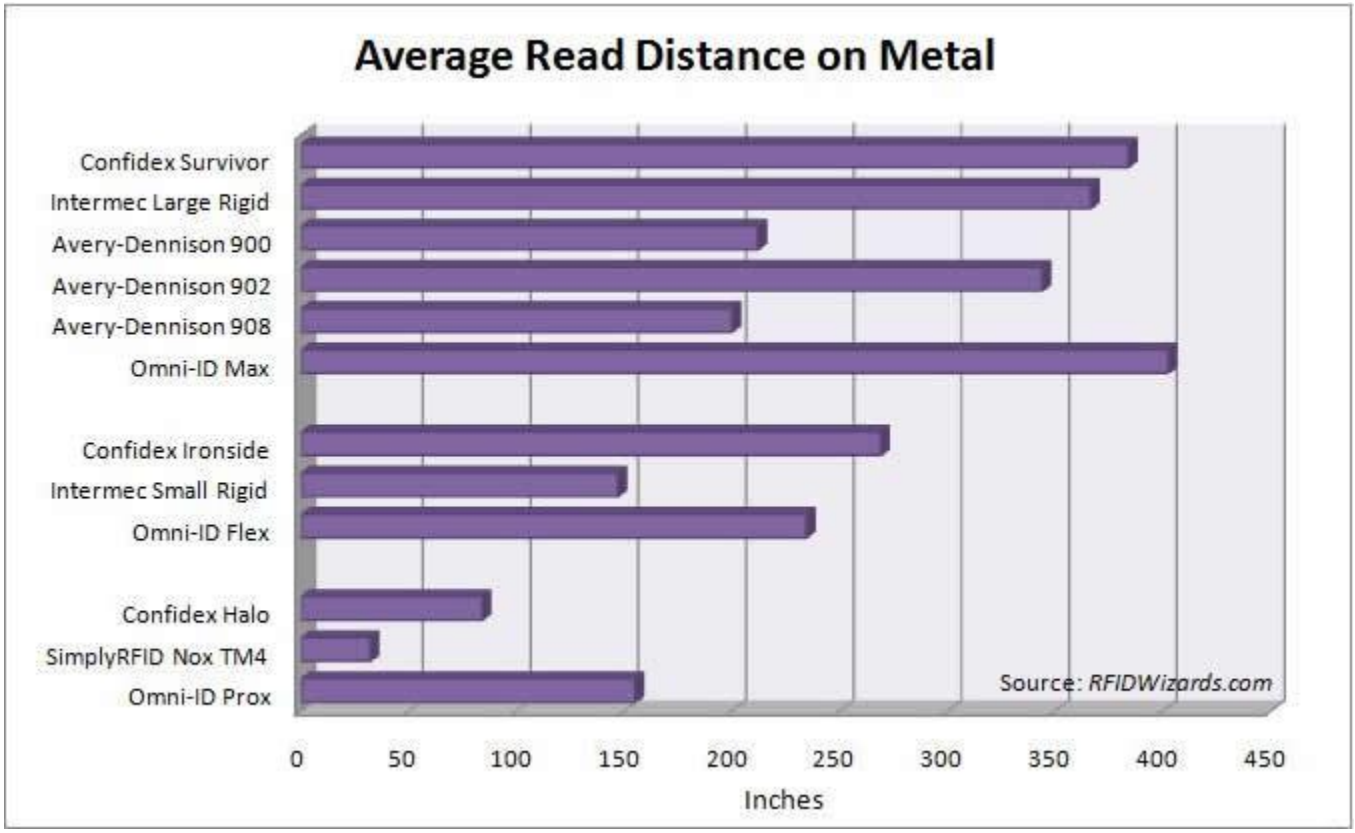
- right. The durable asset tag is mounted directly to a metal carrier. For more details about this application, read Using RFID for Work-In-Progress (WIP) Management



Average Read Distance on Metal

These tests are designed to show how the tag will perform when orientation is not controlled. Circular polarized antennas are used and the tag is tested in all possible orientations to the antennas. This results in the average read distance achievable with the tag, reader, antenna combination.

Real World Use Case
This kind of configuration is used for asset racking applications. Assets are hand-carried or placed in random locations on a push cart and travel through a RFID-enabled doorway.

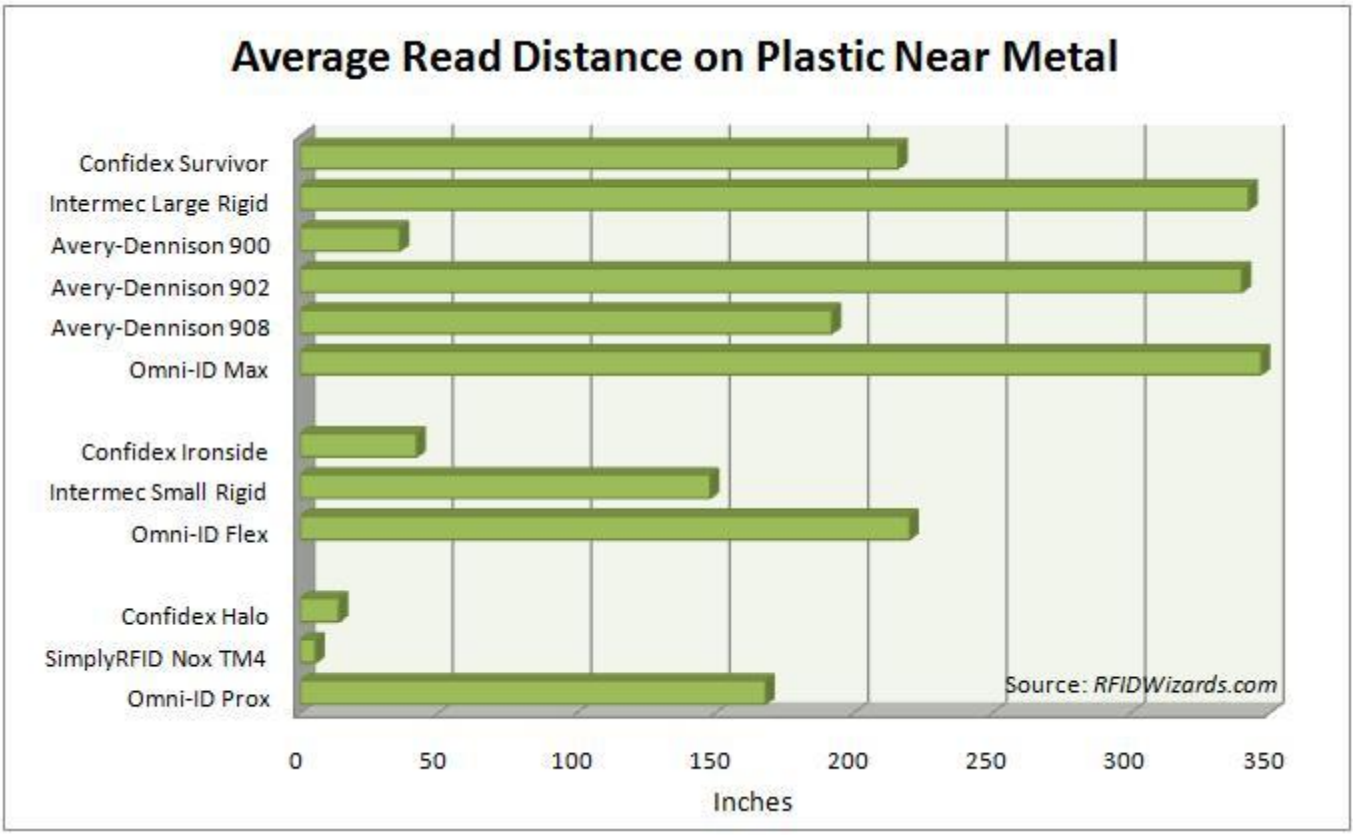


Average Read Distances on Plastic, Near Metal

These tests are designed to show how the tag will perform when orientation is not controlled. Circular polarized antennas are used and the tag is tested in all possible orientations to the antennas. This results in the average read distance achievable with the tag, reader, antenna combination.

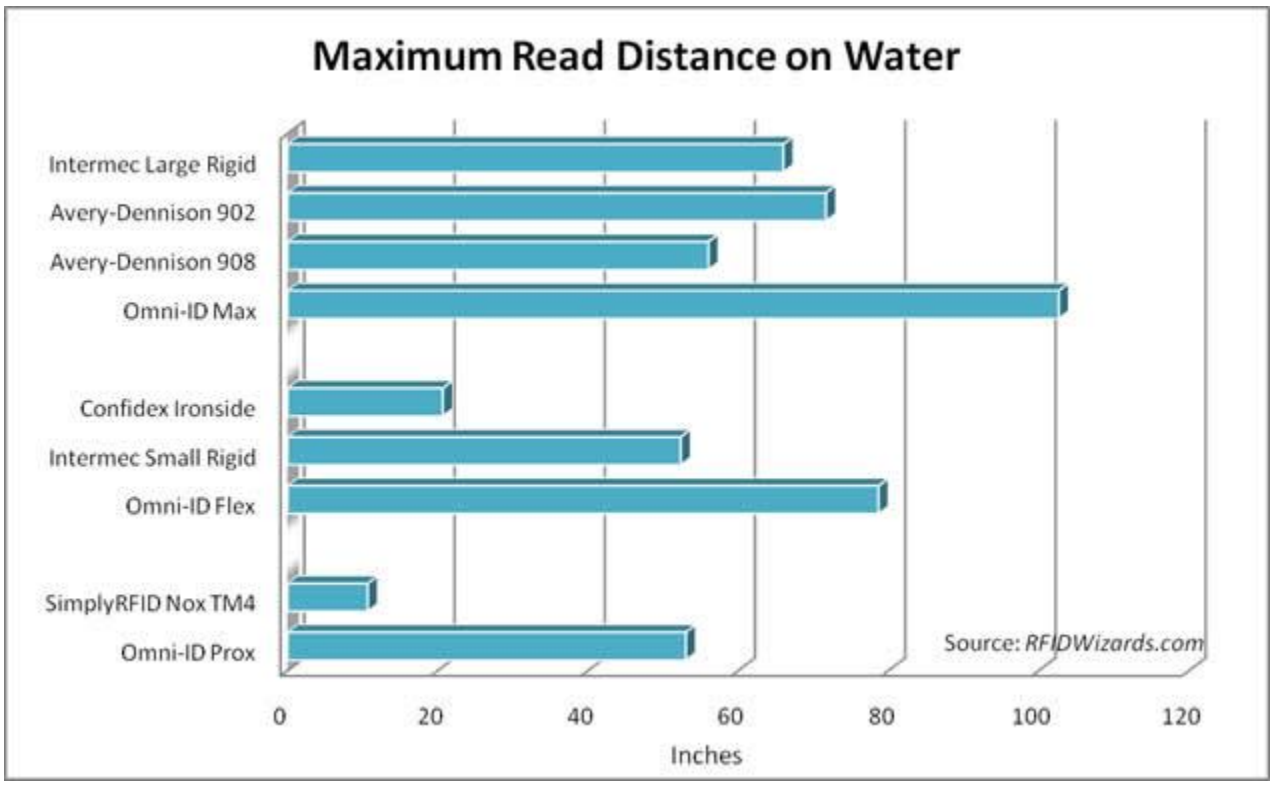
Real World Use Case

This kind of configuration is used for asset racking applications. Assets are hand-carried or placed in random locations on a push cart and travel through a RFID-enabled doorway.

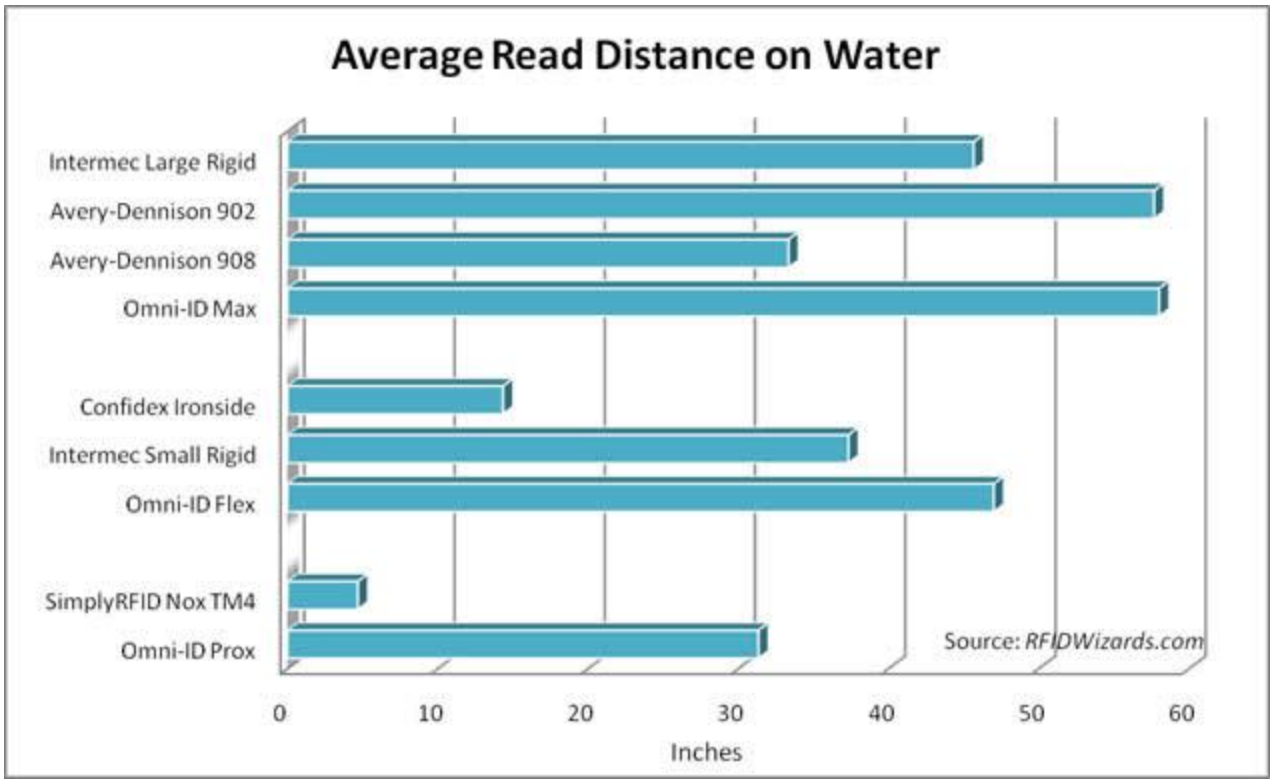


Tag Performance Results - Near Field Antennas

Maximum Read Distance on Water



Average Read Distance on Water



Maximum Read Distance in Water