ARC BENCHMARKING METHODOLOGY

VERSION 1.40

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1. TEST PROCESS

1.1 Submitting Inlays for Testing

Inlays should be submitted per the process described in the Inlay Enrollment Application. A quantity of 4000 inlays in a continuous roll is required per inlay model. The inlay samples will be archived after testing.

1.2 Inlay Selection

Each inlay received will be uniquely encoded. The encoding is sequential for the 4000 inlays in each submission. Any inlays on the roll clearly marked as "bad" or "rejected" will be removed from the sample set. Using a random number generator, random inlays are then selected from the sample for measurement.

1.3 Measurement Parameters

The inlays are measured for parameters that reflect the performance of an inlay. The parameters measured are not focused on any single use case, but rather a variety to ensure a complete profile of the inlay. The measured parameters are stored in the ARC Database in order to quickly preselect inlays that qualify for future RFID Use Case Profiles. All the parameters are measured in the ARC Chamber. For details on the test setup please see the ARC Testing Equipment document. The inlay's read sensitivity and associated backscatter signal strength as well as the write sensitivity and associated backscatter signal strength are measured during the test process. These parameters are

measured in a variety of standard and custom tests which will be detailed in the next few sections.

1.4 Test Variables

Four primary variables are altered during the testing: test platform position, measurement antenna, frequency, and power. A description with example values for each is discussed below.

Test Platform Position - The test platform is rotated from 0 to 270 degrees in increments of 30 degrees. The table positions with respect to Antenna 4 are shown in Figure 1. Please refer to the ARC Testing Equipment document for more a detailed description.

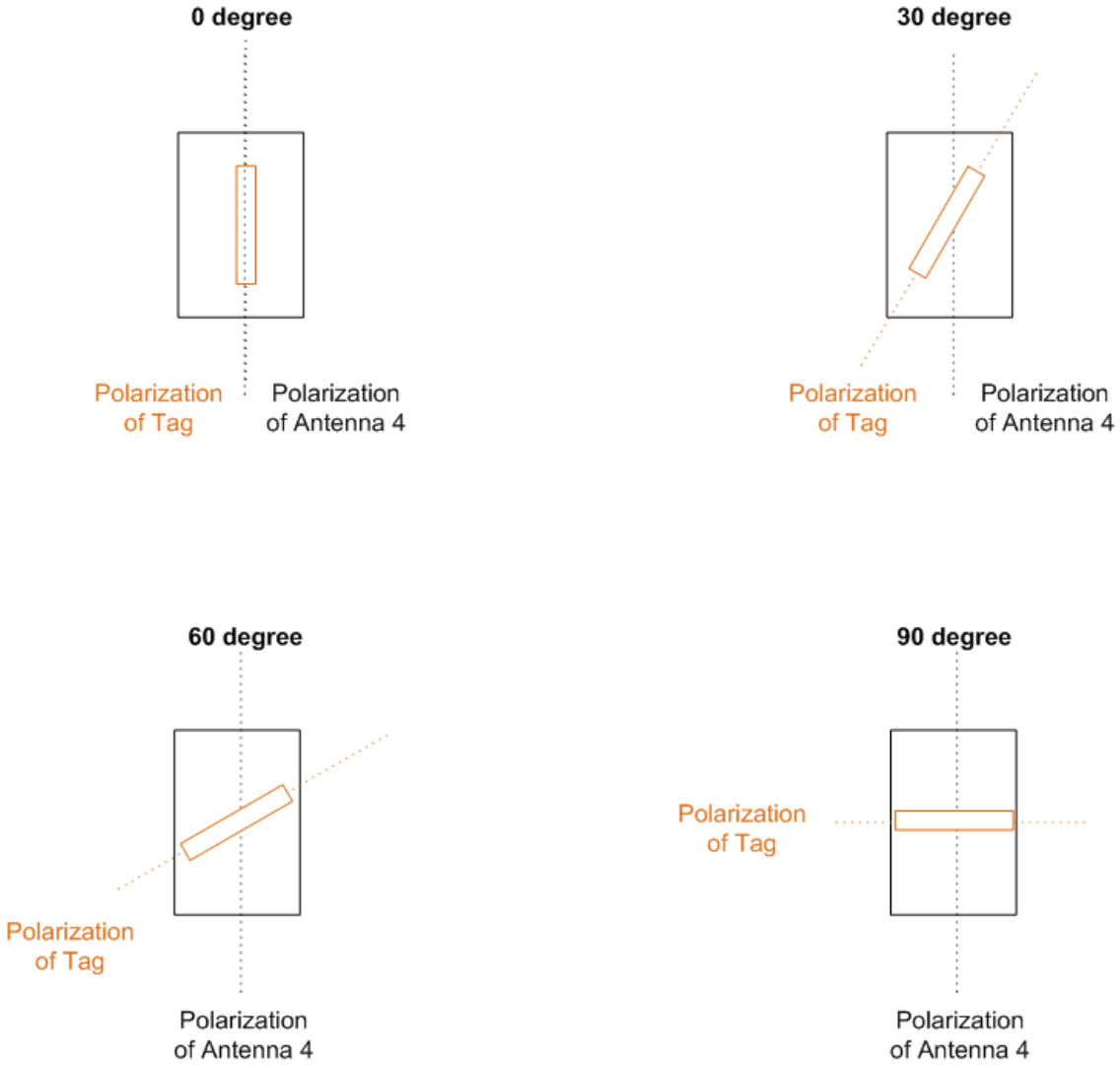

Figure 1 Test Platform Configuration as Seen From Top of Chamber

Measurement Antenna - At each test platform position, the inlay is measured with four antennas. As shown in Fig. 2, the antennas, named Antenna 1, Antenna 2, Antenna 3 and Antenna 4, are mounted at 0 degrees, 30 degrees, 60 degrees and 90 degrees with respect to the test platform. Please refer to the ARC Testing Equipment document for a more detailed description.

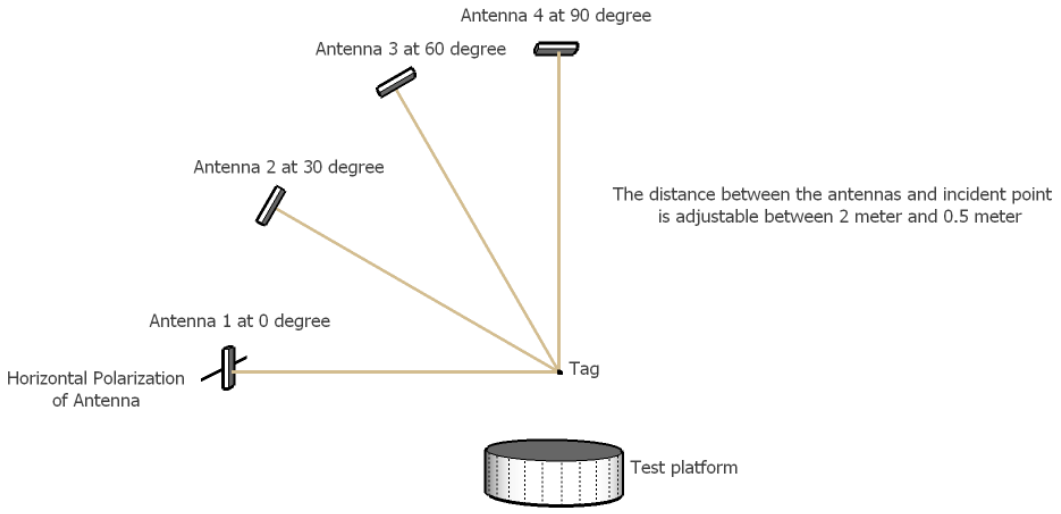

Figure 2 Antenna Configuration

Frequency Range: Each antenna measures the inlay from 800 MHz to 1000 MHz in increments of 1 MHz.

Power Range: The inlays are measured for response from 5 dBm to 40 dBm in increments of 0.1 dB at the transmitter for each of the frequencies from 800 MHz to 1000 MHz. This power range translates to -25 dBm to 10 dBm at the inlay after the path loss. The calibrated value after path loss is reported.

1.5 Inlay Tests

Inlays are measured by two types of tests: standard tests and custom tests. All inlay models received for testing will be submitted to standard tests. The standard tests create a base profile of inlay performance, and are explained in the following sections. The custom tests are additional testing required by a specific RFID Use Case Profile and

are developed for measuring properties of the inlay not covered by the standard tests. Since the custom tests are determined based on the use case, a detailed description of the custom tests required for each RFID Use Case Profile will be given in the associated Tagged Category Performance Specification.

Each test can be further divided into two types depending on the number of inlays to be tested simultaneously. There are single inlay tests and multi inlay proximity tests. The purpose of the single inlay test is to determine the effect of the medium of the tagged product on the performance of the inlay. The purpose of the multi inlay proximity tests is to determine the effect of other nearby inlays in addition to the medium of the tagged product on the performance of the inlay.

1.5.1 Standard Tests

1.5.1.1 Single Inlay Test

The inlay is measured when applied to the test material and the test material is placed on the platform such that the inlay is on top as shown in Figure 3. The face of the inlay will be parallel to the face of antenna 4. The test materials are listed in Table 1. The details of the test materials and their dimensions will be available in the inlay manufacturer profile.

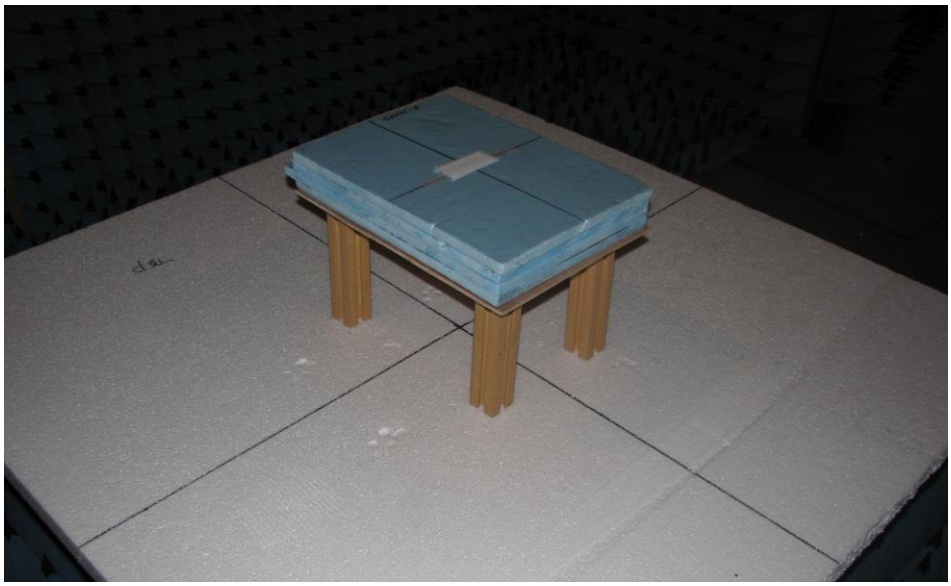

Figure 3 Single Inlay on Test Material

Styrofoam
Single walled Corrugated Cardboard
Cardstock
Plastic
Rubber
Glass
Near water (0.3 cm spacing between water container and inlay)
Near metal (0.3 cm spacing between metal and inlay)
Water in plastic container
Metal

Table -1 Test Materials Used in Standard Test Setup

1.5.1.2 Multi Inlay Proximity Test

An individual inlay is also measured in proximity to other inlays of the same model. Eleven inlays are vertically stacked and tested in two different configurations.

The inlay separations for the two vertical configurations are 2.54cm and 1.27 cm. Vertical stacks are created using Styrofoam blocks. The 2.54 cm separation Styrofoam block is shown in Figure 4. The target inlay for measurement is in the center of the stack.

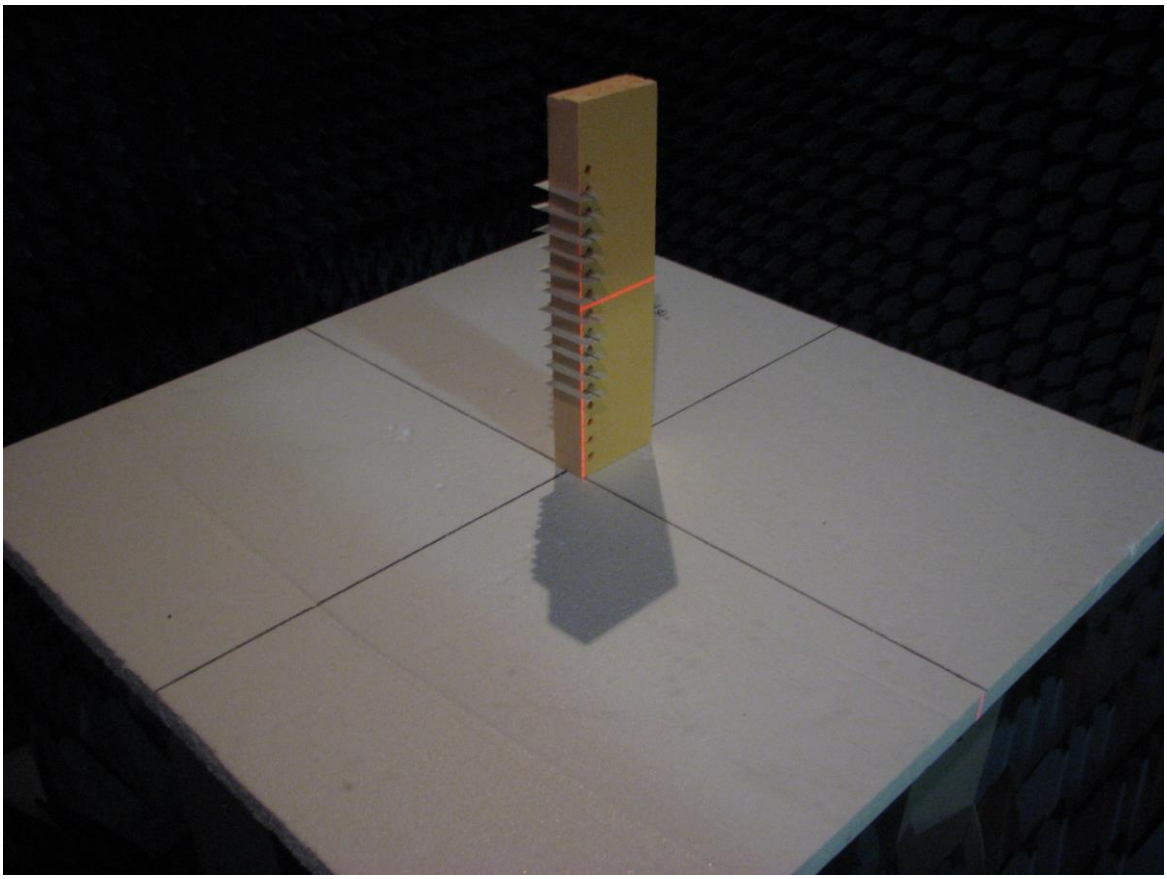

Figure 4 Inlays in Proximity

1.5.2 Custom Tests

1.5.2.1 Single Inlay Test

The inlays will also be tested in custom single inlay tests in which specific product materials will be tested to augment the standard set of materials used in the single

inlay tests. The custom test materials will be specified in the Tagged Category Performance Spec document.

1.5.2.2 Multi Inlay Proximity Test

The inlays will also be tested in custom proximity tests in which the Styrofoam spacers will be replaced by different materials depending on the use case. The custom test materials will be specified in the Tagged Category Performance Spec document.

1.6 Inlay Performance Profile

An Inlay Performance Profile will be issued to the inlay manufacturer that contains all data from the tag testing. The report will contain the minimum, maximum and average performance values for each test parameter for each combination of antenna and table position.

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APPENDIX A: DEFINITIONS

RFID Use Case Profile – (Document) - complete list of all factors in an RF use case that affect tagged product performance. These include technical factors such as the type of RF infrastructure that will be reading tagged product, as well as non-technical factors such as marketing requirements for maximum tag size or placement on the product.

Inlay –a specific combination of chipset and substrate antenna in the most finalized format that would affect tagged product performance. Multiple conversions of the same chipset and antenna combination do not constitute a unique 'inlay' unless the conversion or application of the tag affects tagged product performance.

ARC Database – database containing comprehensive technical data on the performance of market available RF tags including readability of tags on products of various composition, orientation sensitivity of the tags, performance in close proximity with other tags and interferers, and write performance.

Inlay Performance Profile – (Document) - comprehensive technical data on the performance of an RF tag including readability on products of various compositions, orientation sensitivity of the tag, performance in close proximity with other tags and interferers, and write performance.

ARC Chamber – anechoic chamber and test equipment set designed to facilitate the collection of data for the ARC Database.

Tagged Category Performance Spec – (Document) - list of minimum performance thresholds and other requirements tagged product in a retail category must meet for successful RF performance.