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ACCREDITED STANDARDS COMMITTEE*
X3 – INFORMATION TECHNOLOGY

Non-Contact Information Systems Interface Test Plan

***Operating under the procedures of the American National Standards Institute**
X3 Secretariat, Information Technologies Industries Council
1250 Eye Street NW Suite 200 Washington DC 20005-3922
Telephone 202-737-8888 (Press 1 twice) FAX: 202-638-4922 or 202-628-2829

TEST PLAN
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Attachment 1 — Logical Model
Attachment 2 — Test Grid
Attachment 3 — Terms and Conditions
Attachment 4 — Safe Separation Distance Graphs
Attachment 5 — Radio Frequency Identification Application Requirements

SECTION 1. GENERAL

1.1 Purpose. The Test Plan is designed to aid the members of the X3T6 Committee to analyze equipment offered by participating vendors and intended for international use. It is the intent of the X3T6 Committee to select a single vendor's communication protocol, between a transponder and interrogator, that best meets the requirements of the Committee. The selected protocol will then become the basis of a draft proposed American National Standard. Those basic physical elements, such as operating frequencies, transmit power levels, and receiver sensitivities, that are associated with the protocol and are necessary to assure basic communication compatibility among manufacturers will also be included in the draft proposed standard. Due to the nature of the American National Standards Institute (ANSI) process for standardization, the content of the final standard may differ from the proposed standard.

The radio frequency identification application requirements, Attachment 5, provides the basis for establishing specific tests for category 1 requirements.

The Test Plan for the Non-Contact Information Systems Interface (NCISI) is written to fulfill the following objectives:

1. To provide specific instructions and procedures such that each participating vendor's product receives an equitable review.

2. To specify tests that will produce quantified and repeatable data describing the ability of each product to meet the performance requirements.

3. To provide consistent and detailed records of each product tested such that there is a public record of the results which support the selection of a certain protocol.

1.2 References.

X3T6/93-008 ANSI X3T6 RFID Applications Ranking 1991 (rev).

Federal Communication Commission Regulation Part 15.

American National Standards Institute document C95. 1-1532.

Underwriters Laboratory document UL 913-1988.

Accredited Standards Committee X3/SD-2, Organization, Rules and Procedures of X3 dated January 1993.

1.3 Terms and Definitions.

Radio Frequency (RF): For the purposes of this test plan, RF is defined as the electromagnetic frequencies from 10 kilohertz to 300 gigahertz.

Transponder: A small self contained device, also called a "tag," which communicates information through an RF interface to and from an interrogator. (See Attachment 1 for diagrammed description.)

Interrogator: A device which communicates information to and from a transponder. The interrogator is generally the intermediary or relay communications device between the host system and the transponder.

Communication Session: The passing of information between an interrogator and a transponder.

Range: The distance the transponder can be located from the interrogator and maintain data reliability.

Data Reliability: The accuracy of the interrogator to correctly communicate information between a transponder and an interrogator, within the interrogator's range, per communications session.

Sensor: An external/internal device used to measure a desired external or internal event.

Protocol: A set of semantic and syntactics rules that determines the behavior of functional units in achieving communication.

Test Conductor: The lead representative of the third-party entity responsible for administering the tests according to the Test Plan.

Basic Physical Elements: For the purposes of this Test Plan, this phase refers to physical attributes of the transponder and interrogator communication link, such as operating frequencies, transmit power levels, and receiver sensitivity, that are associated with the protocol and are necessary to ensure basic communication compatibility among manufacturers.

SECTION 2. TEST PLAN

2.1 System Description. Each manufacturer shall supply, at its own cost, a complete system for the duration of the test period. Each system shall include the transponders, interrogators, systems software, and all other items necessary to set up a complete working system. In addition, each manufacturer shall supply a description of the protocol used.

2.2 Testing Schedule. Testing schedules will be based on an agreed upon schedule between the X3T6 Technical Committee and each manufacturer. Sufficient time, subject to the X3T6 Technical Committee approval, will be allowed for each manufacturer to set up, test, and certify for release to the Test Conductor its equipment prior to the actual test. Each manufacturer will be allowed a single test period.

2.3 Required Equipment and Services.

2.3.2 Regulatory Requirements. Safe power levels as defined in 2.3.2.2 and / or 2.3.2.3 shall be used throughout the tests.

2.3.2.1 Radio Regulatory Compliance. The system shall support non-licensed communications in compliance with the Federal Communications Commission Part 15 and the manufacturer shall so state prior to testing.

2.3.2.2 Health and Safety Standards Regulatory Compliance. Each manufacturer shall supply proof of compliance with standards for exposure to radiated energy. This proof shall be provided through testing and documentation compiled by an acceptable third party organization. Manufacturers will be required to provide measurements from a certified standards laboratory to confirm that all equipment meets guidelines and power density limits specified in American National Standards Institute (ANSI) C95.1-1532 and ANSI / UL 913-1988.

2.3.2.3 Ordnance Safety Requirements. Prior to conducting the tests, each manufacturer shall supply proof of compliance with standards for ordnance safety. Manufacturers will be required to document that their transponders are safe to use as close as one inch away from unshielded munitions that contain 10 ma no-fire current electro explosive detonators. Attachment 4, titled "Safe Separation Distance Graphs" shall be used to determine the allowable power level at one inch separation. Following completion of the tests, the Test Conductor will conduct testing to verify that the winner is in compliance with the standards for ordnance safety.

2.3.3 Personnel Requirements. Each manufacturer will supply, at its own cost, the personnel needed to set up and operate their equipment.

2.3.4 Supplied Materials.

2.3.4.1 Hardware. Each manufacturer will, at its own cost, supply in advance, marked for the appropriate test, all hardware needed to set up and make functional the equipment it wishes to be tested. Two non-functional transponders shall also be provided to the Test Conductor for use at his / her discretion in ensuring test integrity. Manufacturers may use different models of equipment for the tests under the condition that they all use the same RF communication protocol and basic physical elements. For any given test, unless otherwise specified, only a single interrogator shall be used. If a manufacturer wishes to use a different model of equipment for a specific test, then sufficient documentation justifying the change of equipment shall be provided to the Test Conductor prior to the beginning of the testing phase. Based on the supplied documentation, the Test Conductor will recommend approval or disapproval of the equipment being used for the test to the X3T6 Test and Evaluation Committee.

2.3.4.2 Software. Each manufacturer will supply, at its own cost, all software needed to make its system functional.

2.3.4.3 Site Materials. The X3T6 Technical Committee and the Test Conductor will supply mounting fixtures, facilities, and test equipment needed to test each manufacturer's transponders and interrogators.

2.3.5 Security. The Test Conductor will be responsible for material security.

2.3.6 Guidelines for Presentations. All tests that require a presentation (written explanation) in lieu of a demonstration shall be in writing (summary format) with sufficient detail to provide a reasonable understanding of the techniques proposed.

SECTION 3. TEST SPECIFICATION AND EVALUATION

3.1 Test Specification. In a series of tests, transponders and interrogators are tested for compliance with functional requirements. Each test is designed to measure functionality in a scientific manner and produce a quantitative measurement. The tests shall be conducted on an outdoor field. All transponders shall be positioned on wood stands 3 feet (1 meter) above the ground, except where otherwise indicated. The interrogator will be tested at an elevation of 10 feet (3 meters) unless otherwise specified. Each manufacturer shall be permitted set up time for system adjustments. Once each series of tests begin, there shall be no changes (except replacement for catastrophic failures), repositioning or reorientation.

Tests of the system range shall be conducted using concentric rings around a pole (see Attachment 2). Each ring shall increase by 10 feet (3 meters) increments with various sector increments. The number of successful interrogations within a given ring shall be totaled and calculated in percentage terms.

3.1.1 Performance Requirements. The tests are divided into four categories: static, slow-speed, high-speed communication sessions and noise.

3.1.1.1 Static Communication Session.

3.1.1.1.1 Single Transponder, Omnidirectional Performance Test. This test shall be conducted at 20 foot increments with the interrogator at an elevation of 10 feet (3 meters) and 3 feet (1 meter) and the transponder at an elevation of 1 foot (0.3 meter). The communication sessions shall be conducted with a single transponder, as it is positioned facing North (to ensure consistency of orientation) at each of the 45 degree increments on a given ring. The test shall start with the innermost ring and progress to more distant rings until the communication session performance falls below 95 percent at any 45 degree increment on a ring, for two successive rings. A communication session is considered successful when the interrogator writes and stores a 128 byte ASCII character string to the transponder, and then reads this same string from the transponder. Eighty communication sessions shall be attempted at each test position. Testing will stop at a maximum 330 foot radius even if communication sessions are successful at the 330 foot radius.

3.1.1.1.1a Three Dimensional Antenna Radiation Test. This test shall be conducted to determine the three dimensional antenna radiation pattern of each manufacturer's omnidirectional transponder tested in 3.1.1.1.1. Testing shall be performed in a suitable environment, such as an anechoic chamber. In the event of an overall tie, the transponder with the most uniform omnidirectionality would be deemed the winner.

3.1.1.1.2 Single Transponder, Directional Test. This test shall confirm that the system can provide directional communication. To pass this test, the transponder must communicate at

the 0 axis, but fail to communicate 100 percent of the time at the 45 and 315 axis. A communication session shall be conducted with a single transponder, initially placed at the 0 axis on the 50 foot ring. The directional antenna is pointed along the 0 axis. After the initial communication attempt, the transponder is moved to the 45 and 315 axis along the ring. An interrogation communication session is considered successful when the interrogator writes and stores 128 bytes full ASCII character string to the transponder and then reads this same string. Eighty communication sessions shall be attempted at each of the three test positions.

3.1.1.1.3 Multiple Transponder Test.

a. In the first test, twenty-six transponders shall be uniformly distributed around the 50' ring. Each of the transponders shall receive and send back to the interrogator a 128 byte string. This procedure shall be repeated 10 times.

b. The next test, is designed to test the ability of the protocol to uniquely address 500 transponders. 500 transponders shall be randomly placed by the Test Conductor between the 20' and 60' rings. A 128 byte string shall be written to each tag then read from each tag to verify successful operation.

c. The manufacturer shall submit a report which clearly shows how its protocol can uniquely address up to 10,000 transponders within the field of view of a single interrogator. (written only)

d. In the last test, ten transponders shall be co-located within a circle two feet in diameter at the 0 axis on the 50' ring; transponder orientation shall be chosen by the manufacturer. An 8k byte full-ASCII character string of data, using at least one extended ASCII value (a value greater than 127) shall be written to all transponders then read from each to verify successful operation. The time required for this write/read operation to be conducted on all tags shall be recorded. This test shall be repeated 10 times.

3.1.1.1.4 Transponder Discrimination Test. Ten transponders shall be co-located within a circle two feet in diameter at the O axis on the 50' ring. One transponder shall be randomly selected by the Test Conductor to receive an 8k byte full-ASCII character string of data, using at least one extended ASCII value (a value greater than 127.) All ten transponders shall be interrogated to verify that only the selected transponder responded. The test shall be repeated 10 times.

3.1.1.1.5 Mutual Interference Test. Twenty transponders shall be co-located within a one foot square at zero degrees on the 50' ring (a cardboard box may be used for this test). The orientation of the transponders shall be randomly arranged by the Test Conductor. A 128 byte string shall be written to each transponder, then read from each tag to verify successful operation.

3.1.1.1.6 Unannounced Automatic Recognition Test. This test shall verify that an unannounced randomly placed transponder can be recognized automatically. Three transponders shall be placed at the zero degree axis on the 50' ring. The Test Conductor shall verify that all tags are operational. A randomly selected "unannounced" transponder shall be placed with the other transponders. The new transponder shall be automatically identified at this time.

3.1.1.1.7 Transponder Interrupt Test. The Test Conductor will consistently place three transponders with sensors at the 50' ring. The Test Conductor shall randomly select a transponder and activate its sensor. This action shall be automatically recorded by the interrogator. This test shall be repeated twice.

3.1.1.1.8 Metal Obstruction Test. Three transponders shall be placed on the cab floor of a large truck (the same type of truck and transponder position or orientation will be used in all tests) that is facing away from the center of the rings. Initially, the front wheels of the truck shall be centered over the zero degree axis of the 50 foot ring. A 128 byte string shall be written to each tag, then read from each tag to verify successful operation.

3.1.1.1.9 Transponder Position Location Test.

a. Homing

The manufacturer shall document features of its products that will allow a person with a portable interrogator to find a specific transponder. This search operation must be capable of communicating with a transponder at least 50 feet from the interrogator. The search capability must be suitable for use in typical industrial and military environments, which may include high noise, poor visibility, and obstructions between the transponder and interrogator. (written only)

b. 3d Location Accuracy

The manufacturer shall demonstrate the ability to remotely locate a transponder in a population of five. This process shall use fixed interrogator(s) to remotely determine the location of the transponder. This process shall not use non-radio emissions or observer input to assist in the determination of location. Five transponders shall be randomly placed along the circle defined by the 50' circle. The test shall be conducted 10 times. The sum of the x, y, and z differences measured in inches between the actual coordinates and coordinates measured by the manufacturer's equipment shall be averaged. The precision to which the transponder and interrogator(s) positions will be surveyed before testing will be plus or minus three inches.

3.1.1.1.10 Transponder Orientation Test. This test shall consist of rotating the transponder at 45 degree increments in three axes. The test shall be conducted at the 0 axis of the 50 foot ring. At each position, a 128 byte string shall be written to tag, then read from the tag to verify successful operation.

3.1.1.1.11 Memory Security (Presentation). The manufacturer shall submit documentation describing the method of protecting secure transponder memory from inadvertent modification. At a minimum, this method must employ the use of controlled access to a secure portion of transponder memory. (written only)

3.1.1.1.12 Analog to Digital (Presentation). The manufacturer shall present the transponder's capability to record analog information. (written only)

3.1.1.1.13 Diagnostics (Presentation). The manufacturer shall document that the transponder and interrogator have diagnostics. (written only)

3.1.1.1.14 Multiple Interrogator (Presentation). The manufacturer shall show, by way of a written summary, that its protocol can properly process communication sessions initiated by at least two interrogators on the same transponder. The manufacturer shall discuss the different types of sessions (read / write, write / read) that may be initiated simultaneously by each interrogator and how data collisions and other such errors are eliminated when attempting to simultaneously communicate with the single transponder (i.e., TDMA, CDMA or other such communication technique).

3.1.1.1.15 Maximum Transponder Dimension. The transponder shall have as small a dimension as possible (displacement volume). The transponder used for this test will be the largest used in testing.

3.1.1.1.16 Memory Test. The maximum amount of data that the transponder can accept shall be written to a single transponder located 50 feet from the interrogator, then read from the transponder. The manufacturer may choose the transponder location.

3.1.1.1.1.17 Battery Life Status (Presentation). The manufacturer shall show by way of written summary that the transponders have the ability to provide battery life status when interrogated.

3.1.1.2 Slow-speed Transponder Communication Sessions. (Simulates a warehouse environment)

3.1.1.2.1 Single Transponder in Slow-speed Motion. One transponder shall be moved at 10 mph (16 kph) in a direction perpendicular to the 0 axis, such that the transponder passes over the 0 axis at the point where it intersects the 20-foot ring. At the point in time when the transponder passes over the 0 axis, the transponder shall transfer 128 bytes of data to the interrogator. Upon completion of the move, the 128 bytes of data shall be read and confirmed. The test shall be repeated 10 times. Additional tests shall be conducted to find the maximum amount of data that the transponder can transfer to the interrogator in a single pass. This maximum result must be successfully transferred in three consecutive passes.

3.1.1.2.2 Multiple Transponders in Slow-speed Motion. Five transponders shall be simultaneously, and in a group which is confined by a 2-foot circle, moved at 10 mph (16 kph). The transponders shall be moved in a direction perpendicular to the 0 axis, such that the tags pass over the 0 axis at the point where it intersects the 20-foot ring. At the point in time when the tags pass over the 0 axis, the interrogator shall initiate the transfer of 128 bytes of data to all tags. Upon completion of the move, the 128 bytes of data shall be read and confirmed. The test shall be repeated 10 times.

3.1.1.3 Open Highway Transponder Communication Session.

3.1.1.3.1 One Transponder in High-speed Motion. A single transponder shall be moved at 55 mph (88 kph) past an antenna that is mounted on an overhead mast at a height of no more than 21 feet (6.4 meters). The transponder shall transmit 32 bytes to the interrogator upon entering the range of the interrogator. The interrogator shall, after successfully receiving the 32 bytes, transmit at a minimum, 16 bytes, to be written back to the transponder. The transponder shall verify that the 16 bytes have been received correctly and only then shall it store the information in the memory of the transponder. The interrogator shall receive a

positive or negative confirmation indicating the success or failure of the write operation. The test shall be repeated 10 times. The speed shall increase by 10 mph (16 kph) and the test shall be repeated until there are two successive failures of the test or until 85 mph (136 kph) is reached.

3.1.1.3.2 Three Transponders in High-speed Motion. Three passenger vehicles shall be equipped with transponders as stated in section 3.1.1.3.1 above. The vehicles shall then be driven with a separation of three feet (0.9144 meters), maintained by means of tow bars, past the interrogator repeating the tests in section 3.1.1.3.1 above, only at a speed of 55 mph (88 kph).

3.1.1.3.3 Obstructed Collection from a Transponder in High-speed. A vehicle equipped with a transponder as detailed in section 3.1.1.3.1 above shall be towed behind a step van. The tests as stated in section 3.1.1.3.1 above shall be repeated, only at a speed of 65 mph (104 kph).

3.1.1.4 Interference Tests.

3.1.1.4.1 Jamming on Center Frequency of Operation. An omnidirectional CW signal generator will be set 12 feet from the interrogator to inject noise on the center frequency into the surrounding environment around the interrogator. The initial power level shall be specified by the manufacturer. A transponder under the jamming antenna shall be activated and shall transmit 32 bytes of data to the interrogator. After successfully receiving the 32 bytes of data, the interrogator shall transmit 16 bytes of data back to the transponder. The transponder shall verify that the 16 bytes of data have been received correctly, and only then shall it store the information in the memory of the transponder. The interrogator shall receive a negative or positive confirmation indicating the failure or success of the operation. This process shall be repeated 10 times. The jamming signal strength shall be increased to find, with +/- 1db accuracy, the point where two of the 10 successive readings fail at a given power level.

3.1.1.4.2 Jamming on First Harmonic of Operating Frequency. An omnidirectional CW signal generator will be set up 12-feet from the interrogator to inject noise on first harmonic of the center frequency into the surrounding environment around the interrogator. The initial power level shall be specified by the manufacturer. A transponder under the jamming antenna shall be activated and shall transmit 32 bytes of data to the interrogator. After successfully receiving the 32 bytes of data, the interrogator shall transmit 16 bytes of data back to the transponder. The transponder shall verify that the 16 bytes of data have been received correctly, and only then shall it store the information in the memory of the transponder. The interrogator shall receive a negative or positive confirmation indicating the failure or success of the operation. This process shall be repeated 10 times. The jamming signal strength shall be increased to find, with +/- 1db accuracy, the point where two of the ten successive readings fail at a given power level.

3.1.1.4.3 White Noise Test. An omnidirectional white noise signal generator will be set 12 feet from the interrogator to inject noise on the entire band used by the interrogator and transponder. The initial power level shall be specified by the manufacturer. A transponder under the jamming antenna shall be activated and shall transmit 32 bytes of data to the interrogator. After successfully receiving the 32 bytes of data, the interrogator shall transmit 16 bytes of data back to the transponder. The transponder shall verify that the 16 bytes of data have been received correctly, and only then shall it store the information in the memory of the transponder.

The interrogator shall receive a negative or positive confirmation indicating the failure or success of the operation. This process shall be repeated 10 times. The test shall be repeated at different jamming strengths to find, with +/- 1db accuracy, the point where two of the ten successive readings fail at a given power level.

3.1.1.4.4 Industrial Electromagnetic Interference Test. The test shall be conducted to determine the susceptibility of each omnidirectional system(s) (tested in 3.1.1.1.1) to electrostatic discharge, magnetic waves, and electromagnetic radiation. Failure would be the inability to perform 10 out of 10 successful read and write cycles with 128 bytes of data under the following standard commercial testing conditions.

a. Electrostatic Discharge: IEC 801-2

b. Magnetic Field (Impulsive): MIL461D, RS101

c. Electromagnetic Susceptibility (50 KHz-18GHz): MIL461D, RS103

3.2 Test Methods and Constraints.

3.2.1 Scoring. Pass/fail criteria and optional point scoring were derived from the performance requirements listed in Attachment 5. A listing of the correlation between the performance requirements and each test is presented in Table 1. If there is no winner, X3T6 will determine a winner based on test scores. Those not selected will have the right of appeal. See Section 5.

TABLE 1. Cross Reference Between the Performance Requirements (X3T6 93-008, Category 1) and The Test Plan

ITEM #	LISTED REQUIREMENT	RELATED TEST NUMBER	COMMENTS
1	Communications	3.1.1.4, 3.1.1.1.8	Test for a robust technology. (tag = transponder)
2	Identification Only	Not To Be Tested	A read-only tag is not required.
3	ID and Data Exchange	3.1.1.1.2	Test for read and write capability.
4	Tag Generated Communications	3.1.1.1. 6/7	
5	International Operation Use	Attachment 4	Manufacturer will be required to show compliance if selected as the winner.
6	International Standards Used	Not To Be Tested	This line item is informational and is not a requirement.
7	Range, Read	3.1.1.1.1	
8	Range, Write	3.1.1.1.1	
9	Tag at Rest	3.1.1.1.1	

ITEM #	LISTED REQUIREMENT	RELATED TEST NUMBER	COMMENTS
10	Tag with Slight Motion	3.1.1.2.1/2	
11	Tag with High Speed	3.1.1.3.1/2/3	
12	Frequency - Manufacturer Defined	Not To Be Tested	Manufacturer will be required to show compliance with international operation, at the selected frequency(ies), if selected as the winner.
13	Frequency - Part 15	Attachment 4	Manufacturer will be required to show compliance if selected as the winner.
14	Frequency - Multiple	Not To Be Tested	Not a requirement.
15	Memory - Bytes	3.1.1.1.16	
16	Memory - Features	3.1.1.1.11	
17	Memory - Full 256 ASCII	3.1.1.1.4	
18	Encryption	Not To Be Tested	Not a requirement.
19	Localization	3.1.1.1.9	
20	Transmission Speed	3.1.1.1.3 d	
21	Safety	2.3.2.3/ Attachment 4	Manufacturer must certify compliance with ANSI C95 and munitions safety criteria if selected as the winner.
22	Diagnostics	3.1.1.1.13	
23	Serviceability	Not To Be Tested	Listed as a requirement, although not considered within the scope of the test.
24	Transponder - Active	Not To Be Tested	Not a requirement.
25	Transponder - Passive	Not To Be Tested	Not a requirement.
26	Omnidirectional	3.1.1.1.1/10	
27	Size - Maximum Dimension	3.1.1.1.15	Manufacturer's transponder will be measured to show compliance with the requirement.
28	Minimum Tag Life	Not To Be Tested	Not considered within the scope of the testing, but is considered a procurement issue.
29	Durability - Ambient Weather	Not To Be Tested	Not considered within the scope of testing, but is considered a procurement issue.

ITEM #	LISTED REQUIREMENT	RELATED TEST NUMBER	COMMENTS
30	Multiple Tag Read	3.1.1.1 4/14, 3.1.1.2.2, 3.1.1.3.2, 3.1.1.1.3 b/c/d	
31	Analog to Digital	3.1.1.1.12	
32	On-Board CPU	Not To Be Tested	Not a requirement.
33	Cell Communication	3.1.1.1.14	
34	Triangulation	Not To Be Tested	Not a requirement.
35	Pass Word Memory	3.1.1.1.11	
36	Interchangability - Reader	Not To Be Tested	Definition: Readers from various manufacturers are interchangeable. This is not within the scope of testing but is considered a procurement issue.
37	Interchangability	Not To Be Tested	Definition: Tags from various manufacturers are interchangeable. This is not within the scope of testing but is considered a procurement issue.
38	RFID Standard Compatibility	Not To Be Tested	Definition: Users require compatibility with existing or future standards.
39	Retail Cost	Not To Be Tested	

Successful completion of each test is measured in two ways: pass/fail criteria and optional points. The pass/fail criteria indicates the minimum acceptable performance. Some tests will also determine a product's maximum performance, and award optional points based on how well the product performed against competitive products.

Manufacturers will be required to successfully meet or exceed all pass/fail criteria in order to be considered for selection as the test winner. From those manufacturers that meet or exceed all pass/fail criteria, the single manufacturer with the highest optional point score will be selected as the winner. If two or more manufactures have passed all pass or fail tests and have the same number of optional bonus points, X3T6 will endeavor to select the winner based on a review of all test data and scores. If no manufacturer passes all of the pass or fail tests, X3T6 will conduct a review of all test performance data. Based on this review, if it is found that a manufacturer has demonstrated a very strong overall level of performance, X3T6 may recommend that the manufacturer be selected as a test winner. Those not selected will have the right of appeal. A summary of the pass or fail criteria and optional points is presented in Table 2.

TABLE 2. Summary of Scoring Criteria

ANSI TEST	DESCRIPTION	USER REQUIREMENT	PASS/FAIL CRITERIA	OPTIONAL POINTS
1.1	International Use	Yes	Y	
2.3.2.1	Radio Regulation (P-15)	Yes	Y	
2.3.2.2	Health Regulation	Yes	Y	
2.3.2.3	Ordinance Safety	Yes	Y	
3.1.1.1.1	R/W Range Omni	100M	Y – 16m	Up to 1.0*
3.1.1.1.1a	Three Dimensional Antenna Radiation	–	–	
3.1.1.1.2	R/W Range Directional	–	Y	
3.1.1.1.3a	Multiple Tag (Uniform)	Y	Y	
3.1.1.1.3b	Multiple Tag (500)	500 Tags	Y	
3.1.1.1.3c	Multiple Tag (10,000)	Y	Y	
3.1.1.1.3d	Multiple Tag (Response)	Response Time	–	Up to 1.0*
3.1.1.1.4	Discrimination (Select 1)		Y-Transfer 8k Bytes	
3.1.1.1.5	Mutual Interference	Yes	Y	
0.6	Unannounced	Yes	Y	
0.7	Tag Interrupt	Yes	Y	
0.8	Metal Obstruction	Yes	Y	
0.9	a. Homing	Yes	Y	
	b. 3d Location Accuracy	Location	–	Up to 1.0*
0.1	Tag Orientation	Omni & Beam	Y	
0.11	Password Scheme	Yes	Y	
0.12	A to D Demo	Yes	Y	
0.13	Diagnostics	Yes	Y	
0.14	Multiple Interrogators	Yes	Y	
0.15	Transponder Size	No	–	Up to 1.0*
0.16	Tag Memory	8k=Minimum 128k=Maximum	8k Bytes	Up to 1.0*
0.17	Battery Life Status	–	Y	
3.1.1.2.1	Slow Speed (1 Tag)	Yes	Y	Up to 1.0*
3.1.1.2.2	Slow Speed (5 Tags)	Yes	Y	

ANSI TEST	DESCRIPTION	USER REQUIREMENT	PASS/FAIL CRITERIA	OPTIONAL POINTS
3.1.1.3.1	High-Speed (1 Tag)	Yes	Y – 55mph	Up to 1.0*
3.1.1.3.2	High-Speed (3 Tags)	Yes	Y	
3.1.1.3.3	High-Speed (Obstructed)	Yes	Y	
3.1.1.4.1	Jam Center Frequency	Yes	–	Up to 0.33*
3.1.1.4.2	Jam Harmonic	Yes	–	Up to 0.33*
3.1.1.4.3	Jam White Noise	Yes	–	Up to 0.33*
3.1.1.4.4	Industrial Electromagnetic Interference	–	Y	

Note: * Indicates that this test will determine the vendor with the best performance. Points will be awarded by setting the overall best performance equal to one point and other vendors will get a fraction of a point proportional to the difference between the vendor who's best performance was least desirable (or the minimum user requirement, if specified) and the overall best performance.

Table 3 describes the scoring criteria for each test. Manufacturers must successfully meet, or do better than, the criteria marked as "Pass/Fail Criteria." Points awarded for performance above the minimum requirements are allocated according to the description entitled "Optional Points Criteria."

TABLE 3. Scoring Criteria For Each Test

ANSI TEST	DESCRIPTION	SCORING CRITERIA
1.1	International use	Pass/Fail Criteria: The manufacturer must meet the terms and conditions of Attachment 3. The manufacturer must also sign the agreement of Attachment 3 and return the executed agreement to the Committee prior to testing.
2.3.2.1	Radio Regulation (P-15)	Pass/Fail Criteria: This manufacturer must meet the terms and conditions of Attachment 3. The manufacturer must also sign the agreement of Attachment 3 and return the executed agreement to the Committee prior to testing.
2.3.2.2	Health Regulation	Pass/Fail Criteria: This manufacturer must meet the terms and conditions of Attachment 3. The manufacturer must also sign the agreement of Attachment 3 and return the executed agreement to the Committee prior to testing.
2.3.2.3	Ordinance Safety	Pass/Fail Criteria: Thismanufacturer must meet the terms and conditions of Attachment 3. The manufacturer must also sign the agreement of Attachment 3 and return the executed agreement to the Committee prior to testing.

ANSI TEST	DESCRIPTION	SCORING CRITERIA
3.1.1.1.1	R/W Range Omni	Pass/Fail Criteria: The minimum transmission distance for 128 bytes of data is 50 feet (16m). If the 128 bytes of data is not accurately stored in the tag then the test is considered a failure. The test must be successful 100% of the time at each point on the test ring. Optional Points Criteria: The company testing with the greatest distance will receive 1 point. All others will receive a fraction of a point based on their greatest successful ring distance as compared to the most successful company.
3.1.1.1.1a	Three Dimentional Antenna Radiation	Optional Points Criteria: In the event of an overall tie, the transponder with the most uniform omnidirectionality would be deemed winner.
3.1.1.1.2	R/W Range Directional	Pass/Fail Criteria: A successful manufacturer shall execute 80 communication sessions at the O degree axis, all of which must accurately transfer the indicated information. In addition, at the 45 degree and 315 degree axis, the manufacturer shall execute 80 communication sessions (at each axis), all of which must fail to transfer the indicated information.
3.1.1.1.3a	Multiple Tag (Uniform)	Pass/Fail Criteria: To pass this test the manufacturer must successfully send and receive 128 bytes to 26 transponders paced uniformly on the 50'(16m) ring. This must be repeated 10 times. 100% success must be achieved.
3.1.1.1.3b	Multiple Tag (500)	Pass/Fail Criteria: All 500 tags must be accurately written to and read on the first attempt to pass this test.
3.1.1.1.3c	Multiple Tag (10,000)	Pass/Fail Criteria: The report must be submitted and have a reasonable explanation of how this requirement is met.
3.1.1.1.3d	Multiple Tag (Response)	Optional Points Criteria: The times of the ten tests will be added together. The lowest total will be the winner and receive one point. All others will receive a fraction of a point equal to the winning time divided by their time.
3.1.1.1.4	Discrimination (Select 1)	Only one transponder shall receive data. In order to pass the test, no other transponders can receive the indicated data.
3.1.1.1.5	Mutual Interference	Pass/Fail Criteria: To pass this test, the system must write and read a 128 byte string, in one communication session, to each of the twenty tags, one at a time, each with a different string.
3.1.1.1.6	Unannounced	Pass/Fail Criteria: To pass this test the system must automatically identify the introduction of a single tag to a group of 3 tags.
3.1.1.1.7	Tag Interrupt	Pass/Fail Criteria: To pass this test, the interrogator must indicate the parameter of interest has changed as a result of the second condition on the tag (e.g., change in temperature) on each of the ten tests.
3.1.1.1.8	Metal Obstruction	Pass/Fail Criteria: To pass this test, each of the three tags will be written and read successfully on the first attempt each with a different 128 byte string.

ANSI TEST	DESCRIPTION	SCORING CRITERIA
3.1.1.1.9	a. Homing	Pass/Fail Criteria: The report must be submitted and have a reasonable explanation of how this requirement is met.
	b. 3d Location Accuracy	The X, Y, and Z coordinates of the tag indicated by the vendors equipment shall be used to calculate a separation distance between the actual tag location and the indicated location. After all 5 trails are performed the average mismatch shall be determined for each vendor. The vendor with the smallest mismatch shall be awarded one bonus point. Other vendors shall receive a fraction of a point determined as follows: winner's separation distance divided by other vendor's separation distance. For example, if Vendor A = 10 inch avg. mismatch, Vender B = 20 inch avg. mismatch, Vendor C = 30 inch avg. mismatch: Vendor A gets 1 point. Vendor C gets 10/20 = .50 point, Vendor C gets 10/30 = .333 point. In the event that two or more vendors average mismatch is within the 3 inch measurement accuracy of each other, they shall be deemed to have the same separation distance.
3.1.1.1.10	Tag Orientation	Pass/Fail Criteria: To pass this test, the tag shall have a 128 byte string written to and read from it successfully on the first attempt at each orientation. Perform for both beam and omni configurations.
3.1.1.1.11	Password Scheme	Pass/Fail Criteria: The report must be submitted and have a reasonable explanation of how this requirement is met.
3.1.1.1.12	A to D Demo	Pass/Fail Criteria: The reports must be submitted and have a reasonable explanation of how this requirements is met.
3.1.1.1.13	Diagnostics	Pass/Fail Criteria: The report must be submitted and have a reasonable explanation of how this requirement is met.
3.1.1.1.14	Multiple Interrogators	Pass/Fail Criteria: The report must be submitted and have a reasonable explanation of how this requirement is met.
3.1.1.1.15	Tag Size	The tag used in bonus point calculations will be the vendor's largest tag used for any test plan. The vendor with the smallest tag (smallest total displacement volume) shall be awarded one point. Each other vendor will get a fraction of a point determined as follows: smallest ("winning" tag) displacement volume divided by other vendors tag displacement volume. For example, for three vendors with tags of 10, 20, and 30 cubic inch displacement volumes, one vendor gets 1 point, another gets 10/20 (.50 point) and the third gets 10/30 .333 point).
3.1.1.1.16	Tag Memory	Pass/Fail Criteria: To pass this test, the transponder must be able to accept and store at least 8k bytes of data. Optional Points Criteria: Optional points will be awarded to those manufacturers whose transponders will accept more than 8k bytes of data. The maximum amount of storage considered in this test is 128k bytes. Points will be assigned according to the following formula: Optional Points = (Maximum Measured Memory Capacity (up to 128k bytes) - 8k bytes) /120k bytes.
3.1.1.1.17	Battery Life Status	Pass/Fail Criteria: The report must be submitted and have a reasonable explaination of how this requirement is met.

ANSI TEST	DESCRIPTION	SCORING CRITERIA
3.1.1.2.1	Slow Speed (1 Tag)	Pass/Fail Criteria: To pass this test, the system shall successfully transfer the 128 bytes of data for each of the 10 passes. Optional Points Criteria: Extra points will be awarded for successfully transferring, on three consecutive passes, more than 128 bytes, up to a maximum of 128 K bytes. $\text{Optional Points} = \frac{\text{maximum measured memory transfer (up to 128 K bytes) - 128 bytes}}{130{,}944}$
3.1.1.2.2	Slow Speed (5 Tags)	Pass/Fail Criteria: To pass this test, the system shall successfully transfer 128 bytes of data to all 5 tags for each of the 10 passes.
3.1.1.3-1	High-Speed (1 Tag)	Pass/Fail Criteria: Manufacturers must successfully complete the indicated data transfer operation for each of the 10 passes at 55mph. Optional Points Criteria: Extra points will be awarded for operation above 55mph, up to a maximum of 85mph. Those systems successfully operating at 85mph will be awarded 1 point. Systems with a maximum successful operating speed above 55mph, but less than 85mph will be awarded a fraction of a point according to the following formula: $\text{Optional Points} = \frac{\text{Maximum Speed-55}}{30}$
3.1.1.3.2	High-Speed (3 Tags)	Pass/Fail Criteria: Manufacturers must successfully complete the indicated data transfer operation for the single pass at 55mph.
3.1.1.3.3	High-Speed (Obstructed)	Pass/Fail Criteria: Manufactures must successfully complete the indicated data transfer operation for the single pass at 65mph.
3.1.1.4.1	Jam Center Frequency	Pass/Fail Criteria: None. Optional Points Criteria: To graduate to the next power level, the system must successfully transfer the indicated data for at least 8 of the 10 attempts at the current power setting. Desirable points will be awarded according to the following formula: $\text{Desirable Points} = \frac{\text{VMPL - MPP}}{\text{MBP - MPP}} \times 0.33$ VMPL = Current vendor's maximum power level MPP = Maximum power level for vendor with poorest performance MBP = Maximum power level of vendor with best performance.

ANSI TEST	DESCRIPTION	SCORING CRITERIA
3.1.1.4.2	Jam Harmonic	Pass/Fail Criteria: None. Optional Points Criteria: To graduate to the next power level, the system must successfully transfer the indicated data for at least 8 of the 10 attempts at each power setting. Desirable points will be awarded according to the following formula: Desirable Points = $\frac{VMPL - MPP}{MBP - MPP} \times 0.33$ VMPL = Current vendor's maximum power level MPP = Maximum power level for vendor with poorest performance MBP = Maximum power level of vendor with best performance.
3.1.1.4.3	Jam White Noise	Pass/Fail Criteria: None. Optional Points Criteria: To graduate to the next power level, the system must successfully transfer the indicated data for at least 8 of the 10 attempts at each power setting. Desirable points will be awarded according to the following formula: Desirable Points = $\frac{VMPL - MPP}{MBP - MPP} \times 0.33$ VMPL = Current vendor's maximum power level MPP = Maximum power level for vendor with poorest performance MBP = Maximum power level of vendor with best performance.
3.1.1.4.4	Industrial Electromagnetic Interference	Pass/Fail Criteria: The transponder must successfully complete the electrostatic discharge, magnetic waves, and electromagnetic radiation test.

3.2.2 Extent of Test. This document describes the entire test, although the Test Conductor may require additional measurements and procedures to properly record a product's performance and assure its compliance with the requirements of this Test Plan.

3.2.3 Data Recording. All test results shall be recorded by the Test Conductor and documented in a Test Analysis Report.

3.3 Test Evaluation.

3.3.1 Test Data Criteria. Data presented by the manufacturer's system shall be in units consistent with the units used in this Test Plan. All data relevant to the completion of each test must be immediately available in printed form (hard copy).

3.3.2 Test Data Reduction. Data presented by the manufacturer's system shall clearly indicate the system's performance, and shall be in sufficient detail for the Test Conductor to verify performance.

SECTION 4. TEST (IDENTIFY) DESCRIPTION

4.2 Test Control.

4.2.1 Means Of Control. The Test Conductor shall control all test activities, with a primary goal of conducting and documenting repeatable tests per this Test Plan and conducting the tests such that each manufacturer is equitably tested.

4.2.2 Test Data. Hard copies of all test data and commands executed during a test shall be provided by the manufacturers' system, and submitted immediately to the Test Conductor upon demand (normally at the beginning and ending of each test).

4.2.2.1 Input Data. The manufacturer's system shall display all data to be transferred to and from the transponder during a test, and have a provision to allow the Test Conductor to modify a few values prior to the execution of a particular test.

4.2.2.2 Input Commands. The manufacturer's system shall produce a sequential record (hardcopy) of the commands executed during each test.

4.2.2.3 Output Data. The manufacturer's system shall provide a sequential record (hardcopy) of all data relevant to a test. The system shall also time-tag all blocks of data, to a least a 10th of a second, for those tests that measure response time.

4.3 Test Procedures.

4.3.1 Test Setup. The manufacturer shall be responsible for setting up equipment for each test. The manufacturer shall be given reasonable time to set up its equipment and check operation. The Test Conductor must approve the set-up before each test begins, to maintain testing consistency from one manufacturer to the next. The Test Conductor shall record the equipment configuration (position, model numbers, serial numbers, interconnections).

4.3.2 Test Initialization. The manufacturer shall be responsible for initializing its system for each test, including the loading of any necessary data to be transferred. The Test Conductor shall approve the initialization.

4.3.3 Test Steps. The Test Conductor shall determine the sequence of each test and the individual steps to execute each test, in order to best expedite the overall test execution. The Test Conductor shall record the sequence of tests and test steps, and shall strive to maintain a consistent sequence from one manufacturer to the next.

The manufacturer will be responsible for executing each step in a manner acceptable to the Test Conductor.

4.3.4 Test Environment. Tests will be conducted during day light hours and during periods of average weather conditions for that test site.

4.3.5 Test Termination. A manufacturer shall complete all tests, even if it fails one or more of the pass-fail tests.

At the discretion of the Test Conductor, a test may be terminated prior to completion if there is a clear indication that the test can not be completed in timely and reasonable manner, due to a manufacturer's inadequate equipment or services.

At the discretion of the Test Conductor, a test may also be temporarily suspended due to conditions of convenience such as weather, meal times, or end of the business day. When a test has been temporarily suspended, the Test Conductor will determine if it is possible to have equitable and repeatable results by continuing the disrupted test. If there is some doubt that equitable and repeatable results will come from the continued test, then the Test Conductor may require the test to be started over.

The Test Conductor shall record any anomalies in a manufacturer's results. The X3T6 Committee reserves the right to reject a manufacturer for falsifying data or misrepresentation.

SECTION 5. APPEALS PROCEDURE

Test participants have the right to appeal decisions that directly and materially affect their interest. The appeals procedure is defined in Accredited Standards Committee X3/SD-2, Organization, Rules and Procedures of X3.

5.1 Introduction. The provision for appeals is important for the protection of directly and materially affected interests and of the standards developers. An appeals mechanism is required as a part of due process by ANSI.

5.2 Right of Appeal. Directly and materially affected interests who believe they have been or will be adversely affected by a standard or any action or inaction relative thereto within the X3 Secretariat's jurisdiction have the right to appeal such actions or inaction's of X3 including any of X3's Subgroups or the X3 Secretariat in accordance with the following procedures.

ANSI will not normally hear an appeal of an action or inaction by X3 or its Secretariat until the procedures provided by X3 have been completed as prescribed below. Such appeals shall be directed to ANSI in accordance with the procedures of the appropriate ANSI entity (e.g., Board of Standards Review, Executive Standards Council, standards boards).

5.3 Criteria for Appeals Mechanism. It is the intention of the X3 secretariat that the following general criteria are encompassed in these appeals procedures:

1. Appeals shall be addressed promptly and a decision made expeditiously.

2. The right of the involved parties to present their cases shall not be denied.

3. These procedures shall provide for participation by all parties concerned without imposing an undue burden on them.

4. Consideration of appeals shall be fair and unbiased and shall fully address the concerns expressed.

5. Records of appeals shall be kept and made available upon request. The X3 Secretariat may levy a nominal charge to cover the cost of reproduction, handling and distribution for requests received from other than the involved parties.

5.4 Appeals. The appellant shall file a written complaint with the X3 Secretariat within thirty calendar days after the date of notification of the action being appealed or at any time with respect to inaction. The complaint shall state the nature of the objection(s) including any direct and material adverse effects, the section(s) of these procedures or the standard that are at issue, actions or inaction's that are at issue, and the specific remedial action(s) that would satisfy the appellant's concerns. Previous efforts to resolve the objection(s) and the outcome of each shall be noted.

Within thirty calendar days after receipt of the complaint, the X3 secretariat shall respond in writing to the appellant, specifically addressing each allegation of fact in the complaint to the extent of the respondent's knowledge.

If the appellant and the X3 Secretariat are unable to resolve the written complaint informally in a manner consistent with these procedures within fifteen calendar days, the X3 Secretariat shall schedule a hearing with an appeals panel on a date agreeable to all participants but within forty-five calendar days, giving at least ten calendar days notice.

The appeals panel shall consist of three individuals who have not been directly involved in the matter in dispute. At least two members shall be acceptable to the appellant and at least two shall be acceptable to the X3 Secretariat. The appeals panel members shall be selected as follows:

1. The appellant selects one.

2. The X3 Secretariat selects one.

In the event the appellant does not wish to select a panelist or a third panelist cannot be agreed upon, the X3 Secretariat shall appoint these individuals to the panel in order to hold a hearing.

The appeals panel shall convene at CBEMA Headquarters unless another mutually agreed site is selected.

The appellant has the burden of demonstrating adverse effects, improper actions or inaction's, and the efficacy of the requested remedial action. The X3 Secretariat has the burden of demonstrating that X3 and the X3 Secretariat took all actions in compliance with these procedures and that the requested remedial action would be ineffective or detrimental. Each party may adduce other pertinent arguments, and members of the appeals panel may address questions to individuals.

The appeals panel shall render its decision in writing within thirty calendar days, stating findings of fact and conclusions, with reasons therefor, based on a preponderance of the evidence. Consideration may be given to the following positions, among others, in formulating the decision:

1. Finding for the appellant, remanding the action to X3 or the X3 Secretariat with a specific statement of the issues and facts in regard to which fair and equitable action was not taken.

2. Finding for the X3 Secretariat with a specific statement of the facts that demonstrate fair and suitable treatment of the appellant and the appellant's objection.

3. Finding that new, substantive evidence has been introduced, and remanding the entire action to X3 or the X3 Secretariat for appropriate reconsideration.

If, for whatever reason(s), the appellant chooses to forego the process detailed above, the X3 Secretariat shall forward the appeal action to ANSI in accordance with the provisions of 5.2. Included in the materials forwarded to ANSI will be all documents pertaining to the X3 Secretariat's attempts to resolve the matter at hand.

5.5 Further Appeal. If the appellant gives notice to the X3 Secretariat that further appeal to ANSI is intended, a full record of the complaint, response, hearing and decision shall be submitted by the X3 Secretariat to ANSI.