



AEROSPACE STANDARD

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(R) Passive RFID Tags Intended for Airborne Equipment Use

RATIONALE

Increased use of Radio Frequency Identification (RFID) in the aerospace industry in the area of maintenance, supply chain, and logistics has led to increasing demand for, and subsequent development of, flyable UHF Passive, RFID tags. Aerospace industry adoption of RFID technology will be enhanced significantly by standardization of these RFID tags.

The requirements for RFID tags to be used in the aerospace industry are different from many non-aviation uses. The aerospace industry requires a combination of reading and writing across both moderate and long distances, and which range from low cost, disposable, low memory tags, to extremely durable, higher memory tags that are expected to last the life of the product to which they attach. It is expected that these RFID tags will fulfill the promise of data automation for accuracy and cost savings. Furthermore, the aerospace industry is subject to unique considerations regarding qualification, regulations, and safety, which are enforced by national authorities such as the FAA, EASA, FCC, etc.

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1. SCOPE

The scope of this document is to:

1. Provide a requirements document for RFID tag manufacturers to produce passive-only UHF RFID tags for the aerospace industry.
2. Identify the minimum performance requirements specific to the Passive UHF RFID Tag to be used on airborne equipment, to be accessed only during ground operations.
3. Specify the test requirements specific to Passive UHF RFID tags for airborne equipment use, in addition to EUROCAE ED-14 / RTCA DO-160 compliance requirements separately called out in this document.
4. Identify existing standards applicable to Passive UHF RFID Tag.
5. Provide a certification standard for RFID tags which will use permanently-affixed installation on airborne equipment.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS9100 Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations

2.1.2 ISO/IEC Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO/IEC 18000-6 Information technology - Radio frequency identification for item management - Part 6: Parameters for air interface communications at 860 MHz to 960 MHz General

ISO/IEC 18000-63 Information technology - Radio frequency identification for item management - Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C

2.1.3 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

2.1.4 EUROCAE Publications

Available from EUROCAE Secretariat, 102 rue Etienne Dolet, 92240 Malakoff, France, Tel: +33 1 40 92 79 30, www.eurocae.net.

EUROCAE ED-14 Environmental Conditions and Test Procedures for Airborne Equipment

2.1.5 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

Title 14, CFR part 25, app. F, Part 1 Test Criteria and Procedures for Showing Compliance with §25.853 (a) (14 CFR part 25, Appendix F)

2.1.6 Airlines for America (A4A) Publications

Available from Airlines for America (A4A), 1301 Pennsylvania Avenue, NW, Suite 1100, Washington, DC 20004, Tel: 202-626-4000, www.airlines.org.

ATA Spec 2000, Chapter 9 Automated Identification and Data Capture

2.1.7 GS1 EPC™ Publications

Available from GS1 EPC™ website: <https://www.gs1.org/standards/epc-rfid>

EPC™ Radio-Frequency Identity Protocols Generation-2 UHF RFID Standard, Specification for RFID Air Interface Protocol for Communications at 860 MHz – 960 MHz

EPC TAG Data Standard, defines the Electronic Product Code™ and specifies the memory contents of Gen 2 RFID Tags.

3. DEFINITIONS

14 CFR: Title 14 of the Code of Federal Regulations.

A4A: AIRLINES FOR AMERICA (formerly AIR TRANSPORT ASSOCIATION/ATA): Airline trade association that advocates on behalf of its members to shape crucial policies and measures that promote safety, security and a healthy U.S. airline industry. A4A through the ATA e-Business Program coordinates standards creation within Engineering, Maintenance, and Material.

ANCILLARY PART MARK: An RFID-based part mark. The data elements, as defined by ATA Spec 2000, are the same as those in a primary part mark, but embedded in digital format to an RF carrier to facilitate the collecting of part data using scanners. An ancillary part mark shall be accompanied by a primary part mark.

ACTIVE: An Active tag is an RFID tag that has an active radio transmitter (versus a passive tag that reflects a received radio signal from an interrogator).

AEROSPACE APPLICATIONS: Used on products created for the aerospace industry.

AIRBORNE USE: Used on airborne vehicle while in flight - as opposed to Ground Service Equipment, which is used on airborne vehicle, but only while the vehicle is on the ground.

AIR INTERFACE PROTOCOL: The process by which RFID tags and readers communicate.

BACKSCATTER: The reflected radio frequency (RF) energy that has been modulated by the RFID tag's chip and antenna. Backscatter is what the interrogator device "reads." An inert piece of aluminum will reflect RF energy, but in the absence of modulation, it is "reflection," not "backscatter."

BARCODE: A code consisting of a group of printed and variously patterned bars and spaces and sometimes numerals that is designed to be scanned and read into computer memory and that contains information (such as identification) about the object it labels.

BAP: Battery Assisted Passive - RFID tags that have an on-board battery to power the electronics in the tag, minimizing the power required from the reader RF Beam. They backscatter like a Passive UHF tag only when they are interrogated. BAP tags have greater read ranges than purely passive tags.

CHIP: “Chip,” or “microchip,” refers to integrated circuits, or ICs. This is the “brain” of the RFID tag. RFID chips modulate reflected RF power to transmit data back to an RFID reader, or “interrogator.”

dBil: Decibel units for antenna gain. The gain relative to an isotropic radiator as measured by a linearly polarized measuring antenna. The more standard unit for antenna gain, dBi, does not convey the polarity of the measuring antenna. For instance, the gain of a perfect circularly polarized antenna may be 9 dBi when measured by a matched circularly polarized measuring antenna and 6 dBil as measured by a linearly polarized measurement antenna.

dBm: Decibel milliwatts

EASA: European Union Aviation Safety Agency - Successor to the pan-European Joint Aviation Authorities (JAA), which was cooperatively formed by several European national aviation agencies.

EIRP: Equivalent Isotropically Radiated Power - the amount of power that would have to be emitted by an [isotropic antenna](#) (that evenly distributes power in all directions and is a theoretical construct) to produce the peak power density observed in the direction of maximum antenna [gain](#).

Electronic Product Code (EPC): Unique identifier for an RFID tag under the EPC scheme.

EPCglobal®: EPCglobal® was a GS1 initiative to develop industry-driven standards for the Electronic Product Code™ (EPC) to support the use of Radio Frequency Identification (RFID) in today's fast-moving, information rich, trading networks. Standards were developed in two areas: EPC/RFID tags and EPC Information Services (EPCIS).

EPCglobal® Class 1 Gen 2 UHF Tag: Also known as GS1 EPC™ Gen 2 UHF Tag, a passive-backscatter, Interrogator-talks-first (ITF), RFID tag operating in the 860 to 960 MHz frequency range as defined in the GS1 EPC™ Gen 2 publication above.

ERP: Effective Radiated Power - Total power radiated by an actual antenna relative to a half-wave dipole rather than a theoretical isotropic antenna. A half-wave dipole has a gain of 2.15 dB compared to an isotropic antenna.

ETSI: European Telecommunications Standards Institute - produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast, and internet technologies.

FAA: Federal Aviation Administration - The airworthiness and aviation authority in the United States of America.

FAR FIELD: Region sufficiently distant from a radio antenna for angular field distribution to be independent of distance.

FCC: Federal Communications Commission - The regulator of radio-magnetic spectrum uses in the United States of America.

GRADE: Read range performance level of the RFID tag.

HF: High Frequency (HF) RFID systems operate at 13.56 MHz with a typical maximum read range of ~3 feet (~1 m).

HUMAN-READABLE: Human-readable refers to a representation of information that can be naturally read by humans. In most contexts, the alternative representation is data primarily designed for reading by a machine, e.g., scanner/computer/etc.

ID: Identification.

IEC: International Electrotechnical Commission - Quasi-governmental organization which develops International Standards and operates conformity assessment systems in the fields of electrotechnology.

INLAY: The RFID inlay is comprised of four primary components: chip, attachment harness, antenna, and substrate. An antenna is either laid or printed on a substrate material (typically a polymer). Designers create antenna patterns to satisfy specific performance requirements. The “chip” is harnessed to the antenna pattern so that the contacts on the chip make contact with the appropriate legs of the antenna.

INTEGRATED CIRCUIT: (IC) See “Chip.”

INTEGRATED NAMEPLATE: An Integrated Nameplate is an identification and/or marking that contains and/or is enabled with an embedded RFID chip or device that may be utilized in the same manner as other identification and markings as shown in 14 CFR Parts 21.182 and 45. The RFID enabled segment of the Integrated Nameplate shall have the same part identification information, i.e., part Birth Record elements as defined in ATA Spec 2000 encoded in digital and printed in text formats. Barcode representation of the same data is typically included. For Integrated Nameplates the human readable segment will act as primary part marking and the RFID enabled segment is considered ancillary part marking. Integrated Nameplate, as used in this standard only, is only interchangeable with an identical Integrated Nameplate.

INTERROGATOR (READER/WRITER): Radio Frequency device whose purpose is to read data from RFID tags or write data to them. There exist both fixed and mobile versions. Hand-held interrogators have battery power and on-board modulator/demodulators to allow reading permanently-affixed tags while moving past them, and are usually limited in power output.

ISO: INTERNATIONAL ORGANIZATION FOR STANDARDIZATION: An international association that manages the process of setting global standards for communications and information exchange.

ISO/IEC 18000-63 (formerly known as ISO/IEC 180000-6C) RFID Tag: A passive-backscatter, Interrogator-talks-first (ITF), RFID tag operating in the 860 to 960 MHz frequency range as defined in the ISO/IEC 18000-63.

LABEL: RFID label is comprised of three primary components: an RFID inlay, an outer surface (often used for printing), and a bonding surface. Other layers and components are often added to provide addition features and performance to the label.

LRU: Line Replaceable Unit - A component that can be pulled off the airborne vehicle by mechanics and replaced with an identical part, as opposed to requiring depot-level or manufacturer's AOG (Aircraft on the Ground) teams to do maintenance on location.

MACHINE-READABLE: The term machine-readable (or computer-readable) refers to information encoded in a form which can be read (i.e., scanned/sensed) by a machine/computer and interpreted by the machine's hardware and/or software. Machine-readable technologies include optical character recognition (OCR) and barcodes.

PASSIVE-BACKSCATTER, INTERROGATOR-TALK-FIRST (ITF) System: As defined in the ISO/IEC 18000-63 and GS1's EPC Gen 2 publications above, the system consists of interrogators, also known as readers, and tags. *“An Interrogator receives information from a tag by transmitting a continuous-wave (CW) RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the Interrogator. The system is ITF, meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an Interrogator.”*

PASSIVE UHF RFID Tag: Tag which can be uniquely identified by a receiver which decodes an Ultra High Frequency radio signal that the tag transmits. Passive RFID tags are not directly powered, but absorb energy radiated by the reader. The energy is stored until there is sufficient to enable the tag Integrated Circuit to passively modulate its antenna, resulting in backscattering or reflecting back encoded information including the unique ID of the tag. Also known as: GS1 EPC™ Gen Tag, EPCglobal® Class 1 Gen 2 UHF Tag, ISO/IEC 18000-6C Tag, or ISO/IEC 18000-63 Tag.

RANGE: The straight line distance between two articles, e.g., an RFID tag and an RFID interrogator.

RANGE, MINIMUM REQUIRED: The minimum distance between the RFID chip and the interrogator's antenna that satisfies a requirement for a customer's specifications or the performance grades included in this specification.

READER/WRITER: See “Interrogator.”