BS EN 4817:2012

BSI Standards Publication

Aerospace series — Passive UHF RFID tags intended for aircraft use

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 4817:2012.

The UK participation in its preparation was entrusted to Technical Committee ACE/1, International and European Aerospace Policy and Processes.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 77230 6

ICS 35.240.60; 49.035

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2012.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 4817

May 2012

ICS 35.240.60; 49.035

English Version

Aerospace series - Passive UHF RFID tags intended for aircraft use

Série aérospatiale - Tags passifs d'identification par radiofréquence Ultra Haute Fréquence (RFID UHF) pour usage aéronautique

Luft- und Raumfahrt - UHF Passiv RFID-Tags für Luftfahrtverwendung

This European Standard was approved by CEN on 25 February 2012.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 4817:2012) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2012, and conflicting national standards shall be withdrawn at the latest by November 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The requirements for RFID tags to be used in the aerospace industry are very different from non-aviation uses. The parts identified by the RFID tags are high value items, which are often used for ten years or more. Reading and writing across a moderate distance, and over the life-spans of these tagged-parts, is expected to improve data accuracy and cost savings. Furthermore, the aerospace industry is subject to unique considerations regarding qualification, regulations, and safety, which are enforced by aviation authorities such as the EASA, FAA, etc.

These requirements, coupled with the relatively low manufacturing volumes, will drive up the per-part cost of tags developed for the aerospace industry. This will generate the need for a set of RFID tags specifically designed for use on aircraft. Adherence to this European Standard will decrease the development cost of these low-volume, high-capability RFID tags.

1 Scope

The scope of this European Standard is to:

- Provide a requirements document for RFID Tag Manufacturers to produce passive UHF tags for the Aerospace industry.
- Identify the minimum performance requirements specific to passive UHF tags used on aircraft parts, accessed only during ground operations.
- Specify the test requirements specific to passive UHF tags for airborne use, in addition to EUROCAE ED-14 / RTCA DO-160 latest issue compliance requirements separately called out in this document.
- Identify existing standards applicable to passive UHF tags.
- Provide a qualification standard for passive UHF tags which will use permanently-affixed installation on aircraft and aircraft parts.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. All RFID applications must be compliant with local regulation in force (i.e. FCC for US, CEPT/ETSI for Europe).

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* [1)]

ISO/IEC 18046-3, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance* [1)]

ISO/IEC TR 18047-6, *Information technology — Radio frequency identification device conformance test methods — Part 6: Test methods for air interface communications at 860 MHz to 960 MHz* [1)]

DO-160 / ED-14, *Environmental Conditions and Test Procedures for Airborne Equipment* [2)]

ATA SPEC 2000, *E-Business Specification for Materials Management* [3)]

---

1) Published by: ISO International Organization for Standardization http://www.iso.ch/.

2) Published by: International Radio Technical Commission for Aeronautics http://www.rtca.com/ and by EUROCAE Regional (EU) EURopean Organisation for Civil Aviation Equipment http://www.eurocae.org/.

3) Published by: Air Transport Association Publications.

MIL-STD-810, *Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests* [4)]

FAR 14 CFR 25, *Aeronautics and Space — Part 25: Airworthiness standards: Transport Category Airplanes*

AC 20-162, *Airworthiness Approval and Operational Allowance of RFID Systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
AEROSPACE APPLICATIONS
used on products created for the aerospace industry

3.2
AIRBORNE USE
used on aircraft while in flight—as opposed to Ground Service Equipment, which is used on aircraft, but only while, the aircraft is on the ground

3.3
ATA: AIR TRANSPORT ASSOCIATION
airline trade association whose purpose is to foster a business and regulatory environment that ensures safe and secure air transportation. ATA coordinates standards-creation in support of this purpose.

3.4
BACKSCATTER
the Radio Frequency (RF) energy reflected by the tag to transmit information to the interrogator. The RFID tag's chip and antenna modulates the incident energy and reflects it back (same orientation but opposite direction). Backscatter is what the interrogator device "reads." An inert piece of aluminium will reflect RF energy, but in the absence of modulation, it is "reflection", not "backscatter."

3.5
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 interrogator Radio Frequency Beam. They backscatter like a passive UHF tag only when they are interrogated. BAP tags have greater read ranges than purely passive tags.

3.6
BAR-CODE
a standard method of identifying items based on lines of varying widths and spacing that are visually read by a scanner

3.7
BLINK RATE
the rate at which an active Chip/Tag sends out s signal to look for, this can be adjusted from hours to seconds depending on the application and desired battery life of the RFID tag

4) Published by: DoD National (US) Mil. Department of Defense http://www.defenselink.mil/.

3.8
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”.

3.9
EASA
European Aviation Safety Agency

3.10
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

3.11
EUROCAE
European Organisation for Civil Aviation Equipment

3.12
FAA
Federal Aviation Administration — the airworthiness and aviation authority in the United States of America

3.13
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.

3.14
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.

3.15
INTEGRATED CIRCUIT
(IC)
see “Chip”

3.16
INTERROGATOR (READER/WRITTER)
Radio Frequency device whose purpose is to read data from RFID tags or write data to them. There exist both hand-held versions and desk-top 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.

3.17
ISO: INTERNATIONAL ORGANIZATION for STANDARDIZATION
an international association that manages the process of setting global standards for communications and information exchange

3.18
LABEL
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.

3.19
LRU
Line Replaceable Unit — a component that can be pulled off the aircraft by “line” mechanics and replaced with an identical part, as opposed to requiring depot-level or manufacturer’s AOG (Airplane On the Ground) teams to do maintenance in situ

3.20
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.

3.21
PASSIVE
the most common RFID tags, in which an interrogator transmits an energy field that “energizes” the tag and provides the power for the tag to backscatter

3.22
RANGE
the straight line distance between two articles, e.g., an RFID tag and an RFID interrogator

3.23
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

3.24
READER/WRITTER
see “Interrogator,” above

3.25
RFID
Radio Frequency IDentification — a mechanism of applying a unique identifier to an artefact, plant, person or animal for the purpose of tracking, tracing and locating, using machine readable, non-line of sight technologies. RFID technology provides for non-line of sight creation, modification and deletion of the unique identifier. RF is defined as Radio Frequency, which describes non-line of sight transmission of data and energy between a radio transmitter/receiver known as an interrogator (reader) and the ID chip that contains the identifier (ID).

3.26
RTCA: RADIO TECHNICAL COMMISSION FOR AERONAUTICS
RTCA, Inc. is a private, not-for-profit corporation that develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues. RTCA functions as a Federal Advisory Committee.

3.27
SCD: SPECIFICATION CONTROL DOCUMENT
a requirements document used in lieu of, or in addition to, engineering drawings, and which specifies required performance, physical envelope, and interfaces with adjacent equipment and systems

3.28
SECURITY
some minimum level of encoding or password-protecting a data source in order to prevent tampering or inadvertent loss

3.29
TAG
RFID tag is comprised of primary components: a RFID inlay, an outer surface (often used for printing), a bonding surface and a specific packaging

3.30
TEMPERATURE, OPERATING
the temperature at which the RFID device will normally be interrogated or used

3.31
TEMPERATURE, SURVIVAL
the extreme temperatures to which an RFID device will be exposed. The RFID device is not expected to function at these temperatures.

3.32
UHF
Ultra-High Frequency (UHF) covers the 300 MHz to 3 GHz frequency band. Passive RFID systems operate at multiple frequencies from 860 MHz to 960 MHz.

4 General requirements

This Standard establishes the documentation required for the development of a passive-only Radio Frequency (RFID) Standard tag.

This standard does not cover:

- Interrogators (Readers),
- Active RFID devices or Battery Assisted Passive (BAP) RFID devices,
- RFID tags designed to operate outside the 860 MHz to 960 MHz frequency range.

This standard's requirements will concern RFID tags that:

- Are "passive",
- Are approved for attachment to aircraft ("airborne use"), (regulations limit operation to use only while on the ground),
- Operate in the frequency band of 860 MHz to 960 MHz (UHF), and do not produce spurious emissions that interfere with critical or essential on-board electrical equipment,
- Can be integrated into labels and tags with machine-readable and human-readable data (print and barcode),
- Are used for new airplane certification as well as retrofitting on previously-certified aircraft,
- Can be used as a part of RFID systems where the interrogator is: used in the aircraft while on the ground, installed on ground equipment; or is a handheld device,
- Use digital data for supplemental part marking and tracking, but these data are not intended to meet airworthiness requirements,
- Shall be restricted to ground interrogation only, i.e., aircraft not-in-motion, and while aircraft is clear of active taxiways or runways.

5 General configuration

RFID tag consists of a chip (integrated circuit), attached to an antenna, both of which are mounted on a dielectric substrate. The tag shall include identification markings, and shall have a cover layer that can be written on, or to which adhesive labels may be applied, in order to meet human- and machine-readable requirements of purchasers.

RFID tags shall be permanently affixed to aircraft parts using approved adhesives, methods, and processes.

Installation of RFID devices shall be compliant with the different standards published by EASA and FAA, mainly chapter 8.a. of the AC 20-162 published by the FAA.

Different tag configurations may be developed based on intended usage of the tags, to include environment, type and material of parts being labelled, memory capacity, and expected read-range performance.

6 Applicability

This document establishes the documentation required for the development of passive Radio Frequency (RFID) standard labels and tags for Airborne Use. These labels and tags are for part-marking and/or maintenance data recording for approved aviation parts that will be installed in, and flown on, aircraft.

7 Requirements

7.1 RFID Chip (Integrated Circuit) Functional Specifications/Requirements

- Passive,
- Air interface protocol as per ISO/IEC 18000-6,
- 860 MHz to 960 MHz frequency range,
- Read/write memory,
- Complies with ATA SPEC 2000 (data format).

7.2 Tag Requirements

RFID tags must:

- Have no on-tag power source and no active transmitter, i.e., operate in the passive mode only;
- Perform a ground operated, non-essential function (i.e., the absence or failure of an RFID tag will have no effect on safety or the normal operation of the aircraft);
- Not be potential sources of Radio Frequency (RF) interference.

NOTE Further requirements may be levied by purchaser.

7.3 Performance Definitions and Conformance

7.3.1 Read Range

7.3.1.1 General

Read range is the distance at which the RFID tag can return correct information to the interrogator, and can be influenced by many factors such as the tag shape, the tag orientation, the material to which it is attached, the environment it is in and the power of the interrogator. It is not the intent of this section to guarantee a read range in actual use, but rather to provide guidance on the selection of the RFID tag for a given application.

- Tag Read Range Measurement

The purpose of the test is to classify RFID tags by data read range and intended usage (on type of material). This test only needs to be performed in normal operating environments. It is understood that performance degrades with lower temperatures and the presence of moisture.

For measuring RFID tag range, the following range measurement method is to be used. The method is based on varying the output power of the RFID test equipment while keeping the distance between the tag and the antenna constant. The measurement is performed across the frequency band of 860 MHz to 960 MHz in 1 MHz steps.

The minimum power $P_{\text{min.}}$ required to communicate with the tag is recorded. The tag's read range can be determined as:

$$r = d\sqrt{\frac{\text{EIRP}.G_{\text{t}}}{P_{\text{min.}}}}$$

where

$$d = \frac{\lambda}{4.\pi}$$

EIRP = Maximum Effective Isotropic Radiated Power;

G_{t} = Gain of the antenna;

r = Read range;

λ = Wave length.

NOTE This is only applicable outside the near-field read range.

The tag to be tested shall be conformant to the base standard ISO/IEC 18000-6, and conformance testing shall be performed according to the standard ISO/IEC TR 18047-6. Performance testing shall be performed as per ISO/IEC 18046-3.

7.3.1.2 Comments and Discussion

a. Measurement equipment:

   Various options for broadband tag-testing equipment are possible. Such equipment should be able to generate query commands with desired modulation and coding formats for RFID UHF tags operating at specified frequencies with variable output RF power.

b. Frequencies:

860 MHz to 960 MHz UHF.

c. Read/write data rate:

Refer to ISO/IEC 18000-6.

To make sure that tag performance is not affected by the test equipment characteristics; broadband test equipment must have a good sensitivity and proper signal processing algorithms. This ensures tag detection/reading/writing at the minimum possible power level allowed by the tag, as soon as the tag responds.

d. Antenna:

The Antenna of the test apparatus shall be with linear polarization, with a beam width at maximum gain of 3 dBi less than ± 35°, and a Voltage Stationery Wave Ratio inferior to 1.5 (VSWR < 1.5:1); as per clauses 4.2.2.2. and 4.2.3. of Standard ISO/IEC TR 18047-6.

dBi: antenna gain referred to isotropic antenna.

e. Distance:

The distance is such that the tag is sufficiently close to the transmitting antenna, which allows lower testing power levels, but is in the far field zone. The tag and the antenna of the test apparatus are positioned on the centreline of the chamber to minimize the effect of possible reflections by maximizing the distance to the walls.

f. Mounting material:

Tag performance will change when it is mounted on different materials. The backplanes specified below simulate the two general types of parts on which RFID tags can be mounted: conductive and non-conductive.

Secure the RFID tags to the test coupons in the same manner as it will be secured in operational use.

g. Dimensions of backplanes:

The dimension of the backplane will be chosen in order to optimize the efficiency of the system.

7.3.1.3 Procedure

Range is the minimum found across the entire band from 860 MHz to 960 MHz, as opposed to the range at the optimum frequency design point within the band. (These tags will be used throughout the world on varying frequencies, and they must work throughout the entire range.)

7.3.2 Write Capability

All tags must be write-capable per ISO/IEC 18000-6.

7.3.3 Data Integrity

This test must be performed using the interrogator (reader) that is used to write data to the chip.

Procedure:

1 Fill all the available memory with random data.
2 Subject the tag to testing conditions.
3 Read memory and ensure that 100 % of data is in its original form.

7.4 RFID Tag Installation

The RFID tag installation instructions shall be defined and provided with the tags. The installation instructions shall define the acceptable materials, surface finishes and surface shapes for the parts and equipment that will host the RFID tag. Materials, including adhesives or mechanical fasteners, and processes for installing the RFID tag on the host parts and equipment shall be defined in the RFID tag installation instructions.

7.5 Environmental Performance

RFID Tags shall meet all performance requirements without physical or electrical degradation after exposure to the airplane environment. Typically the Specification Control Drawing (SCD) or source requirements will define which environment is to be selected. The following identifies three environmental classes:

- Interior - Any place inside the pressurized portion of the aircraft
- Exterior - Any place not inside the pressurized portion of the aircraft
- Powerplant - Mounted on or in the engine nacelle/strut/cowling or the APU/APU compartment

Tests methods are described in the following chapters and documents. Nonetheless, test category shall comply with individual technical specifications of end-user.

Qualification tests for RFID tags shall be performed as per ISO/IEC TR 18047-6 (conformance), ISO/IEC 18046-3 (performance).

Qualification tests for RFID tags shall also be performed as per ED-14 / DO-160. The following chapters will be especially concerned:

- 4.5.1 - Ground survival low temperature and short time operating temperature test,
- 4.5.2 - Operating low temperature test,
- 4.5.3 - Ground survival high temperature and short time operating high temperature,
- 4.5.4 - Operating high temperature test,
- 4.5.5 - In-flight loss of cooling test,
- 4.6.1 - Altitude test,
- 4.6.2 - Decompression test,
- 4.6.3 - Over pressure test,
- 6.3 - Humidity,
- 7.2 - Operational Shocks,
- 8.5 - Standard Vibration Test Procedure,
- 10 - Waterproofness,
- 11.4 - Fluid susceptibility,
- 14 - Salt Spray,
- 15.3 - Magnetic Effect.

Qualification tests for RFID tags shall also be performed as per FAR 14 CFR 25 or equivalent with regard Flammability.

As for sustaining acceleration, qualification tests for RFID tags shall be performed as per MIL-STD-810, Method 513.5, or equivalent. Concerning acoustic noise, MIL-STD-810 Method 515.5 shall be used, or equivalent.

NOTE The word “Equipment”, as referred to in DO-160 is defined as a complete RFID label or tag, consisting of an integrated circuit “chip” attached to a substrate and integrated antenna, and covered with a human-readable printed film and/or machine-readable bar-code.

The test of chapter 15.3 must be performed in the following modes, if specified:

1. Tag holds data, but is in inert environment, i.e., it is neither energized nor transmitting.

2. Tag has accepted “handshake” from interrogator, and data is being transmitted back to interrogator

7.6 Maintenance and Repair

- Any required maintenance for the RFID tag shall be specified in the tag maintenance instructions, including any required scheduled or on-condition maintenance. If no maintenance is required, this shall be stated in the tag performance specification.
- If RFID tag repairs are allowed, the repair instructions shall be defined and provided with the tags. If no tag repairs are allowed, this shall be stated in the tag specification. If the RFID tag has a service life limit, this service life limit shall be stated in the tag specification

7.7 Military activities

- Exportation Restrictions
    - ITAR: The system must be non ITAR covered;
    - EAR: The system must be non EAR covered.
- Dual Use
    - The system should not be considered as military technology.

Bibliography

[1] ISO/IEC 15961, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: application management*

[2] ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

[3] ISO/IEC FCD 18046-1, *Information technology — Radio frequency identification device performance test methods — Part 1: Test methods for system performance*

[4] ISO/IEC 18046-2, *Information technology — Radio frequency identification device performance test methods — Part 2: Test methods for interrogator performance*

[5] EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defence Organizations*

[6] AS 9100, *Quality Management Systems — Requirements for Aviation, Space and Defense Organizations*

[7] EN 4818, *Aerospace series — Passive HF RFID tags intended for aircraft use*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™