



International
Standard

ISO/IEC 18046-5

**Information technology — Radio
frequency identification device
performance test methods —**

Part 5:

**Test methods for the environmental
characteristics of RFID tags used in
sporting goods**

*Technologies de l'information — Méthodes d'essai des
performances du dispositif d'identification par radiofréquence —*

*Partie 5: Méthodes de test des performances des RFID utilisées
dans les articles de sport*

**First edition
2025-01**

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO/IEC 18046-5:2025](https://standards.iteh.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025)

<https://standards.iteh.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025>



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Abbreviated terms and symbols	3
4.1 Abbreviated terms.....	3
4.2 Symbols.....	3
5 Requirements	3
5.1 Mechanical and electrical characteristics	3
5.2 Testing item form.....	4
6 Test method	4
6.1 Sampling method.....	4
6.2 Standard atmospheric conditions	4
6.3 Environmental characteristic test.....	4
6.3.1 Performance test.....	5
6.3.2 Environmental test.....	6
6.3.3 Calculation.....	13
Annex A (informative) Test design manual	14
Annex B (informative) PCR use case	22
Bibliography	23

iTech Standards
 (https://standards.itih.ai)
 Document Preview

[ISO/IEC 18046-5:2025](https://standards.itih.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025)

<https://standards.itih.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025>

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

ISO and IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO and IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO and IEC had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents and <https://patents.iec.ch>. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

A list of all parts in the ISO/IEC 18046 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

The global market for sporting goods is expanding rapidly each year, and as a result, RFID tags are becoming increasingly popular in the industry. These small electronic devices transmit information using radio waves and are particularly advantageous in efficiently tracking and managing individual products. While RFID technology has primarily been used by manufacturers and distributors for inventory management, it is gradually developing and being utilized by consumers for various purposes, such as monitoring an athlete's performance or facilitating the payment and maintenance of sports equipment.

It is crucial to ensure the reliability of RFID tags in sporting goods, as errors or malfunctions can have serious consequences. For instance, inaccurate inventory counts due to improperly registered RFID tags can lead to under stocking or overstocking. Similarly, malfunctioning tags can result in inaccurate data, potentially harming athlete training and leading to injury.

Various approaches can be taken to ensure the reliability of RFID tags. Performance and environmental factors play a significant role, as the environment to which the tags are exposed can consist of physical, chemical and biological conditions that can deteriorate the tag's performance or cause it to fail. This document proposes a method to identify the main use environment and related environmental characteristics of sporting goods, along with a way to measure and evaluate tag performance changes after testing the environmental conditions. It recommends environmental tests that can demonstrate the product's ability to operate or survive under the climatic and dynamic conditions typically encountered during the use of sporting goods utilizing RFID tags.

While it is not always possible to make recommendations for all types of products, locations and applications, this document offers a suitable test for the majority, increasing safety and success for businesses and users alike. It is important to note that issues such as safety margins and acceleration factors are left to the judgment of the designer, the manufacturer, the test consultant or the end user.

(<https://standards.iteh.ai>)
Document Preview

[ISO/IEC 18046-5:2025](https://standards.iteh.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025)

<https://standards.iteh.ai/catalog/standards/iso/8c7478b1-7b40-4069-a99d-17e130eaffee/iso-iec-18046-5-2025>

Information technology — Radio frequency identification device performance test methods —

Part 5: Test methods for the environmental characteristics of RFID tags used in sporting goods

1 Scope

This document specifies the methods for testing the environmental characteristics of RFID-enabled sporting goods.

This document suggest methods for identifying the main use environments and related testing of environmental characteristics of sporting goods for indoor and outdoor sports with RFID and optionally additional advanced electronic devices like sensors.

The environmental characteristics addressed in this document are applicable to manufacturers, including distribution and inventory management, as well as the aspects of consumer use of the actual RFID-enabled sports items. This document establishes methods to measure and evaluate the performance change of tags after environmental characteristic testing.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-E04, *Textiles — Tests for colour fastness — Part E04: Colour fastness to perspiration*

ISO/IEC 18000-2, *Information technology — Radio frequency identification for item management — Part 2: Parameters for air interface communications below 135 kHz*

ISO/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 18000-61, *Information technology — Radio frequency identification for item management — Part 61: Parameters for air interface communications at 860 MHz to 960 MHz Type A*

ISO/IEC 18000-62, *Information technology — Radio frequency identification for item management — Part 62: Parameters for air interface communications at 860 MHz to 960 MHz Type B*

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*

ISO/IEC 18000-64, *Information technology — Radio frequency identification for item management — Part 64: Parameters for air interface communications at 860 MHz to 960 MHz Type D*

ISO/IEC 18046-3:2020, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance*

ISO/IEC 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO/IEC 18046-5:2025(en)

IEC 60068-1, *Environmental Testing— Part 1: General and Guidance*

IEC 60068-2-1, *Environmental Testing— Part 2-1: Tests - Test A: Cold*

IEC 60068-2-2, *Environmental Testing— Part 2-2: Tests - Test B: Dry Heat*

IEC 60068-2-11, *Environmental Testing— Part 2-11: Tests - Test Ka: Salt Mist*

IEC 60068-2-78, *Environmental Testing Method (Electric/ Electronic) Damp Heat, Steady State Testing Method*

IEC 60068-2-27, *Environmental Testing— Part 2: Tests - Test Ea and Guidance: Shock*

IEC 60068-2-6, *Environmental Testing— Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

sporting good

category of equipment, apparel, accessories, footwear and gear used in sports and recreational activities

Note 1 to entry: Further details regarding this classification are given by the Sports and Fitness Industry Association (SFIA).

3.2

sports equipment

collection of gear, tools and accessories used by athletes and individuals participating in a diverse range of sporting activities

EXAMPLE Ball, rackets, sticks, protective gear, goal and field equipment, training tools.

3.3

athletic footwear

type of footwear that is specifically designed and manufactured for sports and other physical activities primarily to enhance performance and improve safety

EXAMPLE Athletic shoes, hiking and outdoor footwear, water and snow sports footwear.

3.4

sports apparel

clothing items specifically designed and engineered to offer comfort, support and performance enhancement during sports and physical activities

EXAMPLE Tops, bottoms, compression wear, outerwear, swimwear.

3.5

sports accessory

supplementary item used in conjunction with sports equipment and apparel to enhance performance, comfort and safety during sports and physical activities

EXAMPLE Bags, caps, water bottles, heart rate monitors.

4 Abbreviated terms and symbols

4.1 Abbreviated terms

DUT	device under test
PCR	performance change rate
LTPD	lot tolerance percent defective
PDP	performance degradation percentage
RFID	radio frequency identification
RH	relative humidity

4.2 Symbols

c	number of allowable defects
D	distance between the tag and the antenna
l_{conf}	confidence level
$H_{\text{THR identification}}$	identification magnetic field threshold
n	number of samples
p	maximum allowable defect rate
P_{DP}	performance degradation percentage
$P_{\text{DPaverage}}$	average performance degradation percentage
$P_{\text{DP}i}$	percentage change in performance degradation percentage from the initial value, i
P_{min}	minimum power operation threshold (i.e. the minimum power received by the isotropic antenna from the E-field required to turn on the tag)
R_{PC}	performance change rate
$R_{\text{PCaverage}}$	percentage change in performance change rate from the initial value, i
R_{X}	receiver tag sensitivity
T_{X}	transmitter tag sensitivity
x_0	performance measurement result before the environmental test
x_1	performance measurement result after the environmental test
χ	value of the degrees of freedom of the inverse chi-square function

5 Requirements

5.1 Mechanical and electrical characteristics

A manufacturer shall provide mechanical and electrical characteristics necessary to evaluate RFID tags in sporting goods (hereinafter referred to as “RFID tags”), including the allowable limit of error.

5.2 Testing item form

The manufacturer shall prepare the DUT in two forms: with the tag attached to the sporting good and with the tag alone.

In principle, tests should be performed with the inlay tag. However, at the request of the manufacturer, the tests may also be performed with the tag attached to the sporting goods.

Some environmental tests, such as shock and drop, shall be performed with the tag attached to the sporting good.

6 Test method

6.1 Sampling method

For RFID tags to be used in the test, 10 tags shall be sampled in principle from the passed/qualifying products manufactured under the same conditions during the most recent days using a process of conducting a total inspection before a final shipment.

Furthermore, three additional testing items are sampled to replace a defective tag in case of defects caused by an accident that is not the fault of the manufacturer.

For sampling, the manufacturer shall provide five RFID tags attached to sporting goods and five RFID tags without sporting goods.

6.2 Standard atmospheric conditions

Unless testing environments are specified for individual testing items, testing and measurements shall be conducted under the standard atmospheric conditions stipulated in IEC 60068-1 and [Table 1](#).

Table 1 — Standard atmospheric conditions

Temperature °C	Humidity %RH	Pressure kPa
15 to 35	25 to 75	86 to 106

6.3 Environmental characteristic test

The environmental characteristic test is composed of performance and environmental tests. Only the passed/qualifying products from the performance test are used in the environmental test.

The stages in the test procedure for interference rejection performance measurement are as follows:

- a) pre-test: measure R_X sensitivity of the tag before performing environmental testing;
- b) environmental test: perform the exposure test to environmental stresses that can affect the performance of DUTs throughout the life cycle of sporting goods from storage, transportation, installation, operation and disposal;
- c) post-test: measure the R_X sensitivity power of the tag after environmental test;
- d) calculation: calculate the PCR, the amount of change in performance values from pre-test to post-test due to the effects of environmental testing.

6.3.1 Performance test

6.3.1.1 Overview

The test items and conditions in the performance test conform with the $H_{\text{THR identification}}$ and P_{min} measurement method required by ISO/IEC 18046-3, which is the international test standards of RFID tags. The test setup described in ISO/IEC 18046-3 may be used.

The performance test shall use a form of RFID tags only without sporting goods.

Performance testing is done twice: before and after the environment test.

The performance test shall satisfy all the test items in [Table 2](#).

Table 2 — Performance test items and decision criteria

Category	Testing method	Test procedure	Tag type	Decision criteria	Allowable number of failures
Performance test	ISO/IEC 18046-3:2020, 7.1	6.3.1.2	ISO/IEC 18000-2 ISO/IEC 18000-3	Manufacturer's specifications	0
	ISO/IEC 18046-3:2020, 8.1	6.3.1.3	ISO/IEC 18000-61 ISO/IEC 18000-62 ISO/IEC 18000-63 ISO/IEC 18000-64		

6.3.1.2 Identification magnetic field threshold

The identification magnetic field threshold ($H_{\text{THR identification}}$) of a tag is measured at the conditions specified in ISO/IEC 18046-3:2020, 7.1.

6.3.1.3 Minimum power threshold

The minimum power threshold (P_{min}) of tag is measured at the conditions specified in ISO/IEC 18046-3:2020, 8.1.

The equipment and antenna layout for the identification minimum power threshold measurements used shall be as described in ISO/IEC 18046-3:2020, Clause 6. The test equipment consists of an emulator (signal generation and analysis) unit that plays the role of the reader, antenna, distance control unit (optional) and driving software as shown in [Figure 1](#).