
**Information technology — Evaluation
methodology for environmental
influence in biometric system
performance**

*Technologies de l'information — Méthodologie de l'évaluation de
l'influence environnementale dans la performance d'un système
biométrique*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC 29197:2015](https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015)

[https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-
2540d6b461be/iso-iec-29197-2015](https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC 29197:2015](https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015)

<https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015>



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2015

All rights reserved. Unless otherwise specified, 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
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Conformance	1
3 Normative references	1
4 Terms and definitions	2
5 Overview	3
5.1 Introduction.....	3
5.2 Scenario evaluations.....	4
5.3 Operational evaluations.....	4
6 Evaluation conditions specification	5
6.1 Introduction.....	5
6.2 Definition of evaluation conditions.....	5
6.2.1 Description of the evaluation conditions.....	5
6.2.2 Types of environmental parameters.....	5
6.3 Selection of the evaluation conditions.....	6
6.3.1 General.....	6
6.3.2 Reference evaluation environment for scenario evaluations.....	6
6.3.3 Target evaluation environments.....	6
6.4 Measurement and recording of the environmental conditions.....	8
6.4.1 General.....	8
6.4.2 Instruments to measure and record environmental conditions.....	8
6.4.3 Requirements for measuring and recording environmental conditions.....	8
7 Biometric scenario evaluation	9
7.1 Introduction.....	9
7.2 Define evaluation objectives.....	9
7.3 Environment.....	9
7.3.1 Environment for enrolment.....	9
7.3.2 Generation and control of the environmental conditions.....	9
7.3.3 Biometric system placement.....	10
7.4 Test population.....	10
7.4.1 General.....	10
7.4.2 Size.....	10
7.4.3 Selection.....	11
7.4.4 Training and guidance of test subjects.....	11
7.4.5 Visits.....	12
7.5 Acclimatization.....	12
7.6 Levels of effort and decision policies.....	12
7.7 Exception handling protocols.....	12
7.8 Data to record and test results.....	13
7.8.1 General.....	13
7.8.2 Requirements for recording data.....	13
7.8.3 Requirements for calculating results.....	13
7.8.4 Requirements for reporting results.....	14
7.9 Execution sequence.....	15
7.9.1 General.....	15
7.9.2 Pre-test activities.....	15
7.9.3 Test activities.....	15
7.9.4 Post-test activities.....	16

8	Operational evaluation	17
8.1	Introduction	17
8.2	Environment	17
8.3	Test period	17
8.4	Data recording processes	17
8.5	Performance measurements	18
8.6	Impostor transactions	18
8.7	Reporting	18
	Annex A (informative) Values for environmental parameters	19
	Annex B (informative) Test equipment	21
	Bibliography	23

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC 29197:2015](https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015)

<https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015>

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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: [Foreword – Supplementary information](#).

The committee responsible for this document is ISO/IEC JTC 1, *Information technology, SC 37, Biometrics*.

<https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015>

Introduction

The performance of biometric systems can vary according to environmental conditions (see e.g. ISO/IEC 19795-1:2006, C.2.6, ISO/IEC TR 19795-3:2007, Table 4). Environmental conditions can affect subjects' ease of use and comfort in using the systems, subjects' biometric characteristics, and also the devices used for acquisition of biometric samples.

This International Standard provides a generic methodology to analyse the influence of environmental conditions on biometric system performance.

NOTE Environmental conditions can affect several elements involved in the recognition process. However, the proposed evaluation methodology does not distinguish which of them is affected. The intention of this methodology is to quantify the overall influence analysing the biometric system performance.

For this International Standard, environmental conditions has to be understood as all atmospheric parameters (e.g. temperature, humidity) and other physical and chemical phenomena (e.g. illumination, noise) that can surround the biometric system and influence in its performance. Certain environmental conditions such as vibration are not dealt with in this International Standard.

These evaluations consist of carrying out a similar “end-to-end” biometric performance evaluation in one or more predefined environments. These environments can be real (naturally occurring) or modelled (artificially controlled).

There are two possible ways to carry out an “end-to-end” biometric performance evaluation: performing scenario evaluations or operational evaluations. In scenario evaluations, biometric systems are assessed in modelled environments considering a real-world target application and population. These evaluations are specified as a special case of scenario test based on ISO/IEC 19795-2. An evaluation performed in a controlled environment can be reproducible, unlike in an operational environment which uncontrolled parameters can affect the system. In operational evaluations, biometric systems are analysed in real environments using a target population. These evaluations are specified as a special case of operational evaluations based on ISO/IEC 19795-6. Operational testing can lack the precision of scenario testing (in terms of the levels of the environmental parameters), but the testing will benefit in terms of being operationally realistic. This International Standard provides testing requirements specific to environmental testing for both kinds of evaluations.

The methodology addresses how to test several environmental factors; however, an evaluation that conforms to this International Standard can consider as few as one single environmental parameter. The test parameter or parameters to assess and control has to be previously defined by participants involved in the evaluation.

The targets of this kind of evaluations include:

- Analyse how one or a combination of environmental factors can affect the biometric system performance and quantify this influence.
- Analyse how a biometric system works in a specific controlled environment, compared to the same system working in a reference evaluation environment.
- Analyse how a biometric system behaves in a real environment compared to the same system working in a modelled environment simulating the operational environment.

The results of these evaluations can inform suppliers and users so that they can assess which environmental conditions are likely to affect the performance of a biometric system under conditions they expect to encounter. Results can also indicate whether the particular biometric modality and method of implementation is appropriate for the situation under which the system is expected to be used. Also this methodology can be used for examining environmental parameters under which biometric systems poorly.

Information technology — Evaluation methodology for environmental influence in biometric system performance

1 Scope

This International Standard addresses

- fundamental requirements for planning and execution of environmental performance evaluations for biometric systems based on scenario and operational test methodologies,
- specifications to define, establish, and measure specific conditions to assess, including requirements for equipment,
- requirements for establishing a baseline performance in order to compare the influence of environmental parameters,
- a specification of the biometric evaluation including requirements for test population, test protocols, data to record, and test results, and
- procedures for carrying out the overall evaluation.

This International Standard does not

- determine which parameters should be analysed for a specific biometric modality (This is currently covered in ISO/IEC/TR 19795-3.),
- specify requirements to perform a vulnerability analysis modifying environmental factors (This is covered by ISO/IEC 19792.),
- classify biometric systems upon performance against different environmental conditions, or
- specify requirements for determining the functional effects of environmental conditions on hardware components (such as corrosion, electrical interference, breakage, etc.) of biometric systems.

2 Conformance

Environmental tests of biometric systems shall be based on scenario evaluations or operational evaluations. Scenario evaluations shall conform with mandatory requirements of [Clause 7](#) whereas operational evaluations shall conform with mandatory requirements of [Clause 8](#).

Further, a scenario evaluation that conforms to this International Standard shall analyse at least two evaluation conditions: the reference evaluation environment and one target evaluation environment. Both shall consider at least one environmental parameter to assess such as temperature, humidity, illumination, etc. These evaluation conditions shall be selected, specified, measured, and recorded in accordance with [Clause 6](#).

3 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.

ISO/IEC 19795-1:2006, *Information technology — Biometric performance testing and reporting — Part 1: Principles and framework*

ISO/IEC 19795-2, *Information technology — Biometric performance testing and reporting — Part 2: Testing methodologies for technology and scenario evaluation*

ISO/IEC 19795-6, *Information technology — Biometric performance testing and reporting — Part 6: Testing methodologies for operational evaluation*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19795-1 and the following apply.

4.1 ambient conditions real environment

common, prevailing, and uncontrolled atmospheric and weather conditions in a room or place

Note 1 to entry: A test described as “conducted at ambient conditions” was performed at whatever conditions were prevailing at that time on that day.

4.2 baseline performance

performance of a biometric system in a reference evaluation environment

4.3 controlled conditions

climatic and physical conditions that are constrained or managed or kept within certain bounds for the testing purpose

4.4 environment generator

specialized test equipment used to establish and maintain the controlled conditions of the test

4.5 environmental conditions

all atmospheric parameters (e.g. temperature, humidity) and other physical and chemical phenomena (e.g. illumination) that can surround the biometric system and influence in its performance

Note 1 to entry: These can be controlled or ambient.

4.6 evaluation condition

environmental condition under which an evaluation is executed

4.7 evaluation configuration

physical layout of the environment in which the biometric system is going to be tested including the necessary equipment and test instruments for performing tests

4.8 evaluation environment

environment in which the biometric system is evaluated considering the environmental conditions and the evaluation configuration

4.9 extreme condition

condition that entails very high or very low values of the environmental parameters and may be hostile for systems operation or even human life

4.10**instrument**

calibrated equipment used to measure and/or record environmental parameters (such as temperature, humidity, illumination, and sound)

Note 1 to entry: In some cases, instruments have the integrated capability of both measuring and recording parameters in one piece of equipment.

4.11**measuring point**

specific value for an environmental parameter that is being assessed

4.12**operational environment**

conditions under which the biometric system is expected to operate

Note 1 to entry: This is a combination of environmental factors and operational procedures.

4.13**reference evaluation environment**

evaluation environment in which the biometric system is analysed to obtain baseline performance metrics

4.14**set point**

specific value for an environmental parameter that is being controlled

4.15**target evaluation environment**

evaluation environment in which the biometric system is analysed to obtain performance metrics for studying the influence of certain environmental conditions

<https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-2540d6b461be/iso-iec-29197-2015>

5 Overview**5.1 Introduction**

An environmental evaluation is a set of trials carried out to analyse the biometric performance of one or more biometric systems working in particular environmental conditions to determine the effect of one or more of the conditions. These may be executed as one of two types of biometric evaluations: scenario evaluations and operational evaluations. Scenario evaluations analyse “end to end” biometric system performance in a modelled environment whereas operational evaluations analyse “end to end” biometric system performance in an uncontrolled operational environment.

Once the biometric evaluation is carried out in each of the different evaluation conditions, a group of performance metrics will be calculated. These metrics are specific for these evaluation conditions.

The number of evaluation conditions to analyse will depend on the following aspects:

- if the evaluation environment is real or modelled and how many variations of environmental parameters are feasible;
- if the objective is analysing the influence of one or more environmental parameters separately and how many measuring points are going to be examined per each parameter;
- if the objective is checking how a biometric system works in a particular environment.

These aspects are not independent. A decision on conducting a scenario or operational evaluation will depend upon the objectives of the environmental evaluation, the number of parameters to assess, and whether the environment is real or modelled. The following subclauses describe both kinds of environmental evaluations and their main characteristics.

5.2 Scenario evaluations

Scenario evaluations consist of defining one or more specific evaluation conditions as well as a reference evaluation environment and carrying out a similar scenario test in each of them. In these evaluations, the biometric system and environmental parameters will be recorded at the same time in order to determine error rates and throughput rates for the specific evaluation conditions. This approach provides insights into the degree to which biometric systems are influenced by one or more environmental parameters. A schema of this evaluation methodology is shown in [Figure 1](#).

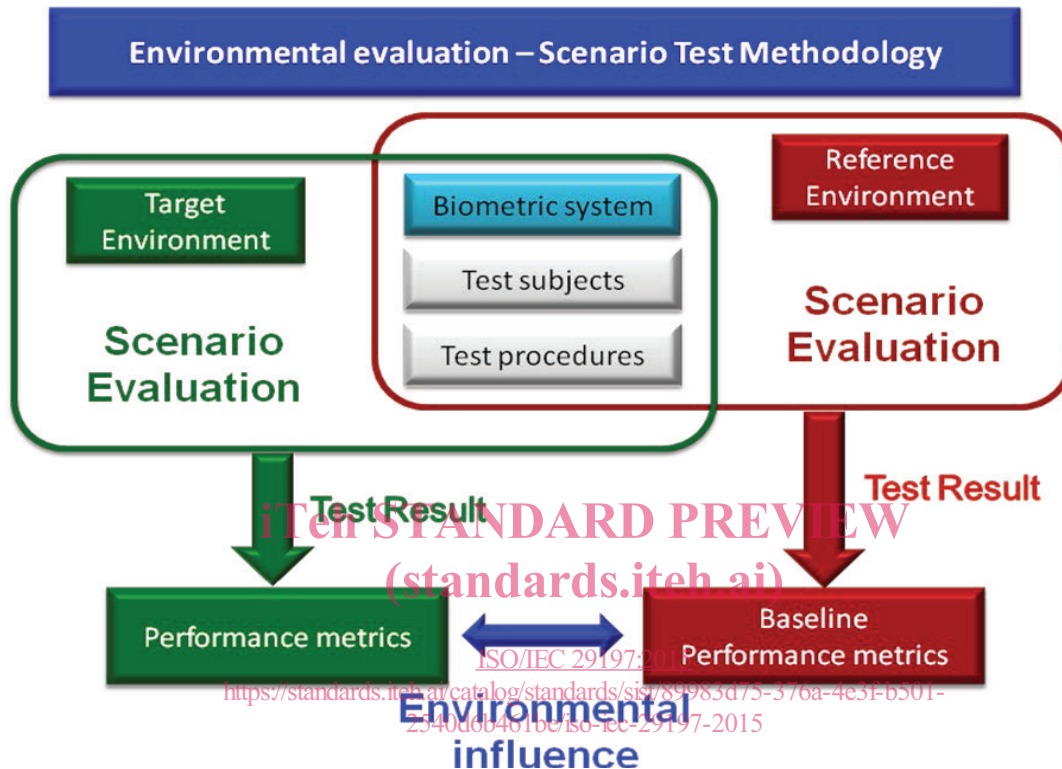


Figure 1 — Scenario Test Methodology illustration

Scenario evaluations are developed in a controlled environment usually in a test facility. These evaluations are suitable for

- measuring the influence of one or more controllable environmental parameters, or
- analysing how one or more biometric systems perform in a specific environment whose parameters are set to defined values or kept inside a particular range.

In both cases, the environmental parameters being assessed, their corresponding measuring points or ranges, and the environmental parameters being controlled shall be determined prior to the test.

5.3 Operational evaluations

Operational evaluations consist of determining a specific environment and selecting one or more environmental parameters to assess. In these evaluations, the relevant biometric system performance and the selected environmental parameters to assess will be recorded at the same time. This approach provides insights into the degree to which biometric system performance is influenced by the assessed parameters of the operational environment.

Operational evaluations are carried out in an uncontrolled environment. When performing this type of evaluation, it may be difficult to isolate the impact of environmental parameters on users, algorithms, or equipment; the impact is measured for the system as a whole.

Environmental conditions should reflect those typically encountered when the system is not under evaluation. Thus, an operational test may permit operationally viable practices such as use of a canopy for outdoor collection of facial images. Therefore, for this evaluation, the operational environment including physical layout as well as the environmental parameters that are going to be assessed shall be described.

In addition, it will be necessary that evaluators specify which evaluation conditions are of interest. It will require conducting a preliminary analysis of the operational environment for knowing the potential values of the environmental parameters.

This analysis shall be carried out before planning the operational evaluation in order to determine the following aspects:

- instruments for measuring and recording the environmental parameters to assess;
- the localization of such instruments;
- the definition of the reference evaluation environment.

6 Evaluation conditions specification

6.1 Introduction

Biometric systems can be tested in different evaluation conditions in order to analyse whether their performance is influenced by environmental conditions or not. This Clause defines requirements for defining and measuring such evaluation conditions for all potential environmental parameters that can be tested during this kind of evaluations.

6.2 Definition of evaluation conditions

[https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-](https://standards.iteh.ai/catalog/standards/sist/89983d75-376a-4e3f-b501-351016b46111/iso-29197-2015)

6.2.1 Description of the evaluation conditions

In general, the evaluation environmental conditions shall be defined considering the following two aspects:

- Environmental parameters to assess: These are the environmental conditions whose influence is going to be studied. Such conditions will be established to a specific value or narrow range denominated measuring point. It is mandatory to specify at least one parameter.
- Environmental parameters to control: These environmental conditions may influence biometric performance but they are not the target of the trial. Such conditions will be established to the same set point specified for the reference evaluation environment. It is optional to specify any control parameter.

6.2.2 Types of environmental parameters

One or more environmental parameters shall be established for the specification of the evaluation. Environmental parameters shall be described using units in the SI system whenever possible.

An environmental evaluation may consider the following types of environmental parameters:

- a) Temperature: This parameter shall be specified using Celsius degrees [°C].
- b) Humidity: This parameter shall be specified by the percentage of relative humidity using [%].
- c) Illuminance: This parameter shall be specified using lux [lx].
- d) Irradiance: This parameter shall be specified using watts per square meter [W/m²].
- e) Noise: This parameter shall be specified by the noise level using decibels [dB].

f) Atmospheric pressure: This parameter shall be specified using kilopascals [kPa].

6.3 Selection of the evaluation conditions

6.3.1 General

The selection of the evaluation conditions entails two activities. Firstly, the parameters to be assessed and/or controlled shall be defined and reported depending on the type of biometric evaluation (e.g. temperature, humidity). This decision is mainly based on the biometric modality of the system under test as well as the type of technology used by its capture sensor. These parameters shall be selected by parties involved in the evaluation.

NOTE ISO/IEC/TR 19795-3^[1] lists environmental factors that can impact performance on a modality-by-modality basis.

Then, the measuring points and set points shall be specified for the selected environmental parameters to assess and/or control respectively. This specification shall consider two aspects: the types of biometric performance evaluation (i.e. scenario or operational evaluation) and the different phases of the recognition process (i.e. enrolment and verification).

This subclause establishes requirements to select the measuring and set points for both types of environments (i.e. target evaluation environment and reference evaluation environment) considering also the aspects above mentioned.

NOTE Since it is mandatory for scenario test methodology to carry out evaluations to obtain the baseline performance apart from any other evaluation performed in the target evaluation conditions, these values can be specified for the reference evaluation environment and the target evaluation environments.

6.3.2 Reference evaluation environment for scenario evaluations

ISO/IEC 29197:2015

The reference evaluation environment defines the values or ranges for different environmental parameters under which baseline performance data will be obtained in scenario evaluation.

Evaluation conditions for this environment shall be specified for the environmental parameters to be assessed and controlled. The values shall be defined considering the values proposed for a standard environment in [Annex A](#).

If some parameters are dependent, the specification of these parameters shall be according to their dependency.

The laboratory testing environment should reach these reference values without any additional equipment. Therefore, the evaluation configuration is not disturbed by anything and it will be possible to obtain performance results considering only the influence of the environmental parameter under test, apart from the common factors that affect biometric systems.

6.3.3 Target evaluation environments

6.3.3.1 General

This Clause describes how to select the evaluation conditions for carrying out enrolment and verification functionalities depending on the type of biometric evaluation and the particular objectives to achieve in the environmental evaluation.

It is recommended that the value or range of environmental factor/factors to be assessed will be relevant to the target environment (modelled or real).