

TECHNICAL REPORT

ISO/IEC TR 29119-13:2022(E)

Date: 2022-07-2209-19

ISO/IEC TR 29119-13:2022(E)

ISO/IEC ~~TC JTC 1~~ JTC 1/SC ~~SC 7~~ 7/WG26

Secretariat: BIS

Software and systems engineering — Software testing — Part 13: **Guidelines**
~~for~~Using the ~~use of~~ ISO/IEC/IEEE 29119 **series** in the testing of biometric systems

iTeh STANDARD PREVIEW
(standards.itech.ai)

ISO/IEC PRF TR 29119-13

<https://standards.itech.ai/catalog/standards/sist/8c9ed595-2e6e-4c76-a529-de8bca9587f6/iso-iec-prf-tr-29119-13>

© ISO/IEC 2022

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

Fax: +41 22 749 09 47

Email: copyright@iso.org

Website: www.iso.org

Published in Switzerland

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO/IEC PRF TR 29119-13

<https://standards.iteh.ai/catalog/standards/sist/8c9ed595-2e6e-4c76-a529-de8bca9587f6/iso-iec-prf-tr-29119-13>

Contents

Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	8
4 Introduction to biometrics	11
4.1 Biometrics overview	11
4.2 Standardization and biometrics	11
4.2.1 Introduction to standardization of biometrics	11
4.2.2 ISO/IEC JTC 1/SC 37 (biometrics)	12
4.2.3 ISO/IEC JTC 1/SC 37/WG5 (biometrics and testing)	12
5 Introduction to software testing	12
5.1 Software testing in context	12
5.2 Static and dynamic testing	12
5.3 Systematic software testing	12
5.4 Purpose of testing	13
5.5 Standardization and software testing	13
5.5.1 Testing standards prior to the ISO/IEC/IEEE 29119 series	13
5.5.2 The ISO/IEC/IEEE 29119 series	13
5.5.3 ISO/IEC JTC 1/SC 7/WG 26 (software testing)	16
5.6 Risk-based testing	16
5.6.1 Risk-based testing at the core of software testing	16
5.6.2 Risk categories	16

6	Software testing of biometric systems and subsystems	16
6.1	Traditional evaluation of biometric systems	16
6.1.1	General	16
6.1.2	Evaluation levels for biometric systems	17
6.1.3	Performance measures for biometric systems	22
6.2	Scope of testing for biometric systems.....	23
6.2.1	General.....	23
6.2.2	Biometric enrolment and recognition	24
6.2.3	Biometric components and supporting components.....	24
6.2.4	Biometric subsystem as part of a larger system	24
6.2.5	Static and dynamic testing of the biometric system	24
6.2.6	Testing all quality characteristics or limited to biometric performance	24
6.3	Documentation for testing biometric systems	25
6.4	Standards for testing biometric systems	25
Annex A (informative)	Brief introduction to biometric systems.....	26
Annex B (informative)	Standards related to the testing of biometric systems	35
Annex C (informative)	Generic risks in biometric systems	41
Annex D (informative)	Test documentation mappings for biometric systems	90
Annex E (informative)	Mapping from ISO/IEC 19795-1 to the ISO/IEC/IEEE 29119 series	115
Annex F (informative)	Mapping from ISO/IEC 19795-2 to the ISO/IEC/IEEE 29119 series	164
Annex G (informative)	Mapping from ISO/IEC 19795-4 to the ISO/IEC/IEEE 29119 series.....	212
Annex H (informative)	Mapping from ISO/IEC 19795-6 to the ISO/IEC/IEEE 29119 series.....	244
Annex I (informative)	Mapping from ISO/IEC 19795-7 to the ISO/IEC/IEEE 29119 series	255
Annex J (informative)	Mapping from ISO/IEC TS 19795-9 to the ISO/IEC/IEEE 29119 series	267
Annex K (informative)	Mapping from ISO/IEC 29109-1 to the ISO/IEC/IEEE 29119 series	282
Bibliography.....		295

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO/IEC PRF TR 29119-13

<https://standards.iteh.ai/catalog/standards/sist/8c9ed595-2e6e-4c76-a529-de8bca9587f6/iso-iec-prf-tr-29119-13>

Foreword

ISO (the International Organization for Standardization) ~~is a~~ and IEC (the International Electrotechnical Commission) ~~form the specialized system for worldwide federation of national standards standardization. National bodies (that are members of ISO member bodies). The work of IEC participate in the development of preparing~~ International Standards ~~is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.~~

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 ~~ISO documents~~ 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).

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) or the IEC list of patent declarations received (see <https://patents.iec.ch>).

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 JTC1 JTC 1, Information technology, Subcommittee SC 7, Software and ~~Systems Engineering~~ systems engineering.

A list of all parts in the ISO/IEC/IEEE 29119 series can be found on the ISO ~~website~~ 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

This document provides an overview of the topics of biometric systems and software testing and their standardization. It describes how to apply the ISO/IEC/IEEE 29119 series of software testing standards to the testing of both pure biometric systems and more extensive systems that include biometric subsystems.

It includes information on the creation of a risk-based test strategy that addresses the full range of quality characteristics for a system (i.e. not restricted or focused solely on those quality characteristics covered by biometric technical performance testing).

This document includes ~~informative~~ mappings between the documentation requirements of:

— ISO/IEC 19795-1

— ISO/IEC 19795-2

— ISO/IEC 19795-6

and the software test documentation defined by ISO/IEC/IEEE 29119-3.

It provides ~~informative~~ mappings between the ISO/IEC/IEEE 29119 series and the following standards defining the testing of biometric systems:

— ISO/IEC 19795-1

— ISO/IEC 19795-2

— ISO/IEC 19795-4

— ISO/IEC 19795-6

— ISO/IEC 19795-7

— ISO/IEC TS 19795-9

— ISO/IEC 29109-1

The standards covering the evaluation and testing of biometric systems (e.g. the ISO/IEC 19795 series) are written from the perspective of an expert in biometric systems, are focused on technical biometric performance testing (i.e. error rates and throughput rates) based on dynamic testing and do not explicitly use a risk-based approach to the testing, as required by the ISO/IEC/IEEE 29119 series of software testing standards.

This document has been created to provide support to software testers who are inexperienced in testing biometric systems. It lists the most relevant biometric standards for software testers of biometric systems. It provides information on performing systematic software testing (static and dynamic) of biometric systems using a risk-based approach in conformance with the ISO/IEC/IEEE 29119 series of software testing standards. The ~~informative~~ mappings also show how conformance with the most popular biometric testing standards maps to the requirements of the ISO/IEC/IEEE 29119 series. This document also provides useful information for biometrics experts, who want to test a complete biometric system using a risk-based approach in conformance with the ISO/IEC/IEEE 29119 series of software testing standards.

As a ~~technical report~~ **Technical Report**, this document contains data of a different kind from that normally published as an International Standard or Technical Specification, such as data on the “state of the art”.

Software and Systems Engineering — Software Testing — Part 13: Guidelines for the use of ISO/IEC/IEEE 29119 series in the testing of biometric systems

1 Scope

This document:

- gives information for software testers for the systematic, risk-based testing of biometric systems and larger systems which include biometric subsystems;
- establishes the importance of both biometric standards and software testing standards and provides overviews of both areas and their standardization;
- specifies the most important biometric standards for software testers of biometric systems;
- provides information for ~~those~~ software testers who wish to conform to both the relevant biometrics standards and the ISO/IEC/IEEE 29119 series of software testing standards by providing ~~informative~~ mappings between the two sets of standards;
- is not limited to the testing of the technical performance of biometric systems in terms of error rates and throughput rates, but instead covers the testing of the full range of relevant quality characteristics, such as reliability, availability, maintainability, security, conformance, usability, human factors, and privacy regulation compliance;
- gives information on applying a risk-based testing approach to the testing of biometric systems that covers the full range of product and project risks;
- provides testers with an example set of product and project risks associated with biometric systems along with suggestions on how these risks can be treated as part of a risk-based approach to the testing;
- includes mappings between the documentation requirements of ISO/IEC 19795-1, ISO/IEC 19795-2 and ISO/IEC 19795-6 and the software test documentation defined by ISO/IEC/IEEE 29119-3.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions ~~given in ISO/IEC 2382-37 and the following~~ apply.

ISO and IEC maintain ~~terminological~~ 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/>

3.1.1

biometric characteristic

biological and behavioural characteristic of an individual from which distinguishing, repeatable *biometric features* (3.1.3) can be extracted for the purpose of *biometric recognition* (3.1.6)

EXAMPLE Galton ridge structure, face topography, facial skin texture, hand topography, finger topography, iris structure, vein structure of the hand, ridge structure of the palm, retinal pattern, handwritten signature dynamics, etc.

[SOURCE: ISO/IEC 2382-37:2047, 3.1.2]2022, 37.01.02, modified — The deprecated term has been removed.]

3.1.2

biometric data

biometric sample (3.1.9) or aggregation of biometric samples at any stage of processing, ~~e.g. *biometric reference* (3.1.7), *biometric probe* (3.1.5), *biometric feature* (3.1.3) or *biometric property*~~

EXAMPLE *Biometric reference* (3.1.7), *biometric probe* (3.1.5), *biometric feature* (3.1.3) or *biometric property*.

Note 1 to entry: Biometric data need not be attributable to a specific individual, e.g. Universal Background Models.

[SOURCE: ISO/IEC 2382-37:2047, 3.3.6]2022, 37.03.06]

3.1.3

biometric feature

~~numbers~~*number* or ~~labels~~*label* extracted from *biometric samples* (3.1.9) and used for *comparison* (3.1.14)

<https://standards.iteh.ai/catalog/standards/sist/8c9ed595-2e6e-4c76-a529-de8bca9587f6/iso->

[SOURCE: ISO/IEC 2382-37:2047, 3.2022, 37.03.11, modified — Notes to entry have been removed.]

3.44]1.4

biometric identification

process of searching against a biometric enrolment database to find and return the *biometric reference* (3.1.7) identifier(s) attributable to a single individual

[SOURCE: ISO/IEC 2382-37:2047, 2022, 37.08.02, modified — Note 1 to entry has been removed.]

3.3.42]1.5

biometric probe

biometric query

biometric sample (3.1.9) or *biometric feature* (3.1.3) set input to an algorithm for biometric *comparison* (3.1.14) to a *biometric reference(s)* (3.1.7)

Note 1 to entry: In some comparisons, a biometric reference ~~might~~*can* be used as the subject of the comparison with other biometric references or incoming biometric samples used as the objects of the comparisons. For example, in a duplicate enrolment check, a biometric reference will be used as the subject for comparisons against all other biometric references in the database.

Note 2 to entry: Typically in a biometric comparison process, incoming biometric samples serve as the subject of comparisons against objects stored as biometric references in a database.

[SOURCE: ISO/IEC 2382-37:2017, 3.3.14]2022, 37.03.14, modified — "biometric query" has been changed from a preferred term to an admitted term.]

3.1.6

biometric recognition

biometrics

automated recognition of individuals based on their biological and behavioural characteristics

Note 1 to entry: Biometric recognition encompasses *biometric verification* (3.1.12) and *biometric identification* (3.1.4).

Note 2 to entry: Automated recognition implies that a machine-based system is used for the recognition either for the full process or assisted by a human being.

[SOURCE: ISO/IEC 2382-37:2017, 2022, 37.01.03, modified — The original notes 1, 2, 5 and 6 to entry have been removed; notes 3, 4, and 4 to entry have been renumbered as notes 1 and 2 to entry.]

3.1.7

biometric reference

one or more stored *biometric samples* (3.1.9), *biometric templates* (3.1.11) or biometric models attributed to a *biometric data* (3.1.2) subject and used as the object of biometric *comparison* (3.1.14)

EXAMPLE Face image stored digitally on a passport, fingerprint minutiae template on a National ID card or Gaussian Mixture Model for speaker recognition, in a database.

Note 1 to entry: A biometric reference may be created with implicit or explicit use of auxiliary data, such as Universal Background Models.

Note 2 to entry: The subject/object labelling in a comparison ~~might~~ be arbitrary. In some comparisons, a biometric reference ~~might~~ potentially be used as the subject of the comparison with other biometric references or incoming samples and input to an *biometric* algorithm for ~~biometric~~ comparison. For example, in a duplicate enrolment check a biometric reference will be used as the subject for comparison against all other biometric references in the database.

[SOURCE: ISO/IEC 2382-37:2017, 3.32022, 37.03.16]

3.1.8

biometric reference adaptation

automatic incremental updating of a *biometric reference* (3.1.7)

Note 1 to entry: Biometric reference adaptation ~~may~~ be used to improve performance (e.g. adapting the reference to take account of variability of an individual's *biometric characteristics* (3.1.1) and to mitigate performance degradation (e.g. due to changes in biometric characteristics over time).

[SOURCE: ISO/IEC 2382-37:2017, 3.552022, 37.05.05]

3.1.9

biometric sample

~~analog~~ analogue or digital representation of *biometric characteristics* (3.1.1) prior to *biometric feature* (3.1.3) extraction

EXAMPLE A record containing the image of a finger is a biometric sample.

ISO/IEC TR 29119-13:2022(E)

[SOURCE: ISO/IEC 2382-37:2017, 3.3.2022, 37.03.21]

3.1.10

biometric system

system for the purpose of the *biometric recognition* (3.1.6) of individuals based on their behavioural and biological characteristics

[SOURCE: ISO/IEC 2382-37:2017, 3.2.32022, 37.02.03, modified — Note 1 to entry has been removed.]

3.1.11

biometric template

reference biometric feature set

set of stored *biometric features* (3.1.3) comparable directly to ~~probe~~ *biometric features* *probe* (3.1.5)

EXAMPLE A record containing a set of finger minutiae is a biometric template.

Note 1 to entry: A *biometric reference* (3.1.7) consisting of an image, or other *captured biometric sample* (3.1.13), in its original, enhanced or compressed form, is not a biometric template.

Note 2 to entry: The biometric features are not considered to be a biometric template unless they are stored for reference.

[SOURCE: ISO/IEC 2382-37:2017, 3.3.222022, 37.03.22, modified — "reference biometric feature set" has been changed from a preferred term to an admitted term.]

3.1.12

biometric verification

DEPRECATED: authentication

process of confirming a biometric claim through ~~biometric comparison~~ (3.1.14)

[SOURCE: ISO/IEC 2382-37:2017, 3.8.2022, 37.08.03, modified — Notes to entry have been removed: the deprecated term has been added.]

3.1.13

captured biometric sample

DEPRECATED: raw biometric sample

biometric sample (3.1.9) resulting from a biometric capture process

[SOURCE: ISO/IEC 2382-37:2017, 3.3.2022, 37.03.25]

3.1.14

comparison

DEPRECATED: match ~~(noun) (deprecated as a synonym for comparison)~~

DEPRECATED: matching ~~(noun) (deprecated as a synonym for comparison)~~

estimation, calculation or measurement of similarity or dissimilarity between *biometric probe(s)* (3.1.5) and *biometric reference(s)* (3.1.7)

[SOURCE: ISO/IEC 2382-37:2017, 3.5.72022, 37.05.07]

3.1.15

decision policy

one or more rules used to determine whether a biometric *comparison* (3.1.14) results in a positive or negative match

Note 1 to entry: The decision policy often includes a threshold above which a comparison score is considered a match.

3.1.16

detection error trade-off

DET

relationship between false-negative and false-positive errors of a binary classification system as the discrimination threshold varies

Note 1 to entry: The DET may be represented as a DET table or a DET plot.

Note 2 to entry: The receiver operating characteristic (ROC) curve was used in the previous edition of this document. The ROC is unified with the DET.

[SOURCE: ISO/IEC 19795-1:2021, 3.28]

3.1.17

failure to acquire

FTA

failure to accept for subsequent *comparison* (3.1.14) the ~~output of a biometric capture process, a biometric sample~~ (3.1.9) of the *biometric characteristic* (3.1.1) of interest ~~output from the biometric capture process~~

Note 1 to entry: Acceptance of the output of a biometric capture process for subsequent comparison will depend on policy. ~~Failure to acquire includes failure to capture (3.1.19).~~

Note 2 to entry: ~~Other possible~~Possible causes of failure to acquire include *failure to capture* (3.1.19), ~~failure to extract~~, poor biometric sample quality, algorithmic deficiencies and biometric characteristics outside the range of the system.

[SOURCE: ISO/IEC 2382-37:2017, 3.9.32022, 37.09.03]

3.1.18

failure-to-acquire rate

FTAR

proportion of a specified set of biometric acquisition processes that were *failures to acquire* (3.1.17)

Note 1 to entry: The results of the biometric acquisition processes may be *biometric probes* (3.1.5) or *biometric references* (3.1.7).

Note 2 to entry: The experimenter specifies which biometric probe (or biometric reference) acquisitions are in the set, as well as the criteria for deeming a biometric acquisition process has failed.

Note 3 to entry: The proportion is the number of processes that failed divided by the total number of biometric acquisition processes within the specified set.

[SOURCE: ISO/IEC 2382-37:2017, 3.9.42022, 37.09.04]

3.1.19

failure to capture

FTC

failure of the biometric capture process to produce a *captured biometric sample* (3.1.913) of the *biometric characteristic* (3.1.1) of interest

ISO/IEC TR 29119-13:2022(E)

Note 1 to entry: The decision as to whether or not a biometric sample has been captured depends on system policy, ~~for~~ For example, one system ~~may~~can use a low-quality fingerprint whereas another ~~might~~can declare it a failure to capture.

[SOURCE: ISO/IEC 2382-37:2017, 2022, 37.09.05]

3.9.5)1.20

failure to enrol

FTE

failure to create and store a biometric enrolment data record for an eligible biometric capture subject, in accordance with a biometric enrolment policy

Note 1 to entry: Not enrolling someone ineligible to enrol is not a failure to enrol.

[SOURCE: ISO/IEC 2382-37:2017, 3.9.6)2022, 37.09.06]

3.1.21

failure-to-enrol rate

FTER

proportion of a specified set of biometric enrolment transactions that resulted in a *failure to enrol* (3.1.20)

Note 1 to entry: Basing the denominator on the number of biometric enrolment transactions ~~may~~can result in a higher value than basing it on the number of biometric capture subjects.

Note 2 to entry: If the FTER is to measure solely transactions that fail to complete due to quality of the submitted *biometric data* (3.1.2), the denominator should not include transactions that fail due to non-biometric reasons (i.e. lack of eligibility due to age or citizenship).

[SOURCE: ISO/IEC 2382-37:2017, 3.9.7)2022, 37.09.07]

3.1.22

false accept rate

FAR

proportion of verification transactions with false biometric claims erroneously accepted

[SOURCE: ISO/IEC 19795-1:2021, 3.21]

3.1.23

false match

comparison (3.1.14) decision of a match for a *biometric probe* (3.1.5) and a *biometric reference* (3.1.7) that are from different biometric capture subjects

Note 1 to entry: It is recognized that this definition considers the false match at the subject level only, and not at the *biometric characteristic* (3.1.1) level. Sometimes a comparison ~~may~~can be made between a biometric probe and a biometric reference from different biometric characteristics of a single biometric capture subject. In some of these cases ~~—~~, for example, when comparing Galton ridges of different fingers of the same *biometric data* (3.1.2) subject ~~—~~, a comparison decision of match ~~might~~can be considered to be an error, ~~while in~~ In other cases ~~—~~, for example, when comparing a mispronounced pass-phrase in text-dependent speaker recognition ~~—~~, a comparison decision of match ~~might~~can be considered to be correct.

[SOURCE: ISO/IEC 2382-37:2017, 2022, 37.09.08]

3.1.24**false match rate****FMR**

proportion of the completed biometric non-mated *comparison* (3.1.14) trials that result in a *false match* (3.1.23)

Note 1 to entry: The value computed for the false match rate ~~will depend~~*depends* on thresholds, and other parameters of the comparison (3.1.14) process, and the protocol defining the biometric non-mated comparison trials.

Note 2 to entry: Comparisons between: the following require proper consideration (see ISO/IEC 19795-1):

- identical twins;
- different, but related *biometric characteristics* (3.1.1) from the same individual, such as left and right-hand topography ~~will need proper consideration (see ISO/IEC 19795-1).~~

Note 3 to entry: "Completed" refers to the computational processes required to make a comparison decision, i.e. failures to decide are excluded.

[SOURCE: ISO/IEC 2382-37:2017, 3.9.9 ~~2022~~, 37.09.09]

3.1.25**false-negative identification rate****FNIR**

$FNIR(N, R, T)$

proportion of a specified set of *identification transactions* (3.1.30) by capture subjects enrolled in the system for which the subject's correct reference identifier is not among those returned

Note 1 to entry: The false-negative identification rate can be expressed as a function of N , the number of enrollees, and of parameters of the identification process where only candidates up to rank R , and with a candidate score greater than threshold T are returned to the candidate list.

[SOURCE: ISO/IEC 19795-1:2021, 3.22], modified — "FNIR(N, R, T)" has been changed from a preferred term to an admitted term.

3.1.26**false non-match**

comparison (3.1.14) decision of "non-match" for a *biometric probe* (3.1.5) and a *biometric reference* (3.1.7) that are from the same biometric capture subject and of the same *biometric characteristic* (3.1.1)

Note 1 to entry: There ~~may~~*can* need to be consideration on how much non-conformance to system policy on the part of the biometric capture subject is tolerated before the ~~probe~~-biometric ~~sample~~*probe* and the biometric reference are deemed to be of different biometric characteristics.

[SOURCE: ISO/IEC 2382-37:2017, 3.9.9 ~~2022~~, 37.09.10]

3.1.27**false non-match rate****FNMR**

proportion of the completed biometric mated *comparison* (3.1.14) trials that result in a *false non-match* (3.1.26)