

AS ISO/IEC 19795.1:2022
ISO/IEC 19795-1:2021



STANDARDS
Australia



Information technology — Biometric performance testing and reporting

Part 1: Principles and framework



currently in preview, click buy full version

AS ISO/IEC 19795.1:2022

This Australian Standard® was prepared by IT-032, Biometrics and Identification. It was approved on behalf of the Council of Standards Australia on 30 August 2022.

This Standard was published on 9 September 2022.

The following are represented on Committee IT-032:

- Australian Information Industry Association
- Australian Retailers Association
- Centrelink
- Defence Science & Technology Group
- Department of Foreign Affairs and Trade (DFAT)
- Department of Home Affairs — Digital and Technology Policy Division
- NSW Business Chamber
- Photo Marketing Association

This Standard was issued in draft form for comment as DR AS ISO/IEC 19795.1:2022.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

ISBN 978 1 76113 917 8

Information technology — Biometric performance testing and reporting

Part 1: Principles and framework

Originates as AS ISO/IEC 19795.1—2007.
Second edition 2022.

COPYRIGHT

© ISO/IEC 2022 — All rights reserved
© Standards Australia Limited 2022

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth).

Preface

This Standard was prepared by the Standards Australia Committee IT-032, Biometrics and Identification, to supersede AS ISO/IEC 19795.1:2007.

The objective of this document is as follows:

- (a) Establish general principles for testing the performance of biometrics systems in terms of error rates and throughput rates for purposes including measurement of performance, prediction of performance, comparison of performance, and verifying conformance with specified performance requirements.
- (b) Specify performance metrics for biometric systems.
- (c) Specify requirements on the recording of test data and reporting of test results.
- (d) Specify requirements on test protocols in order to —
 - (i) reduce bias due to inappropriate data collection or analytic procedures;
 - (ii) help achieve the best estimate of field performance for the expended effort; and
 - (iii) improve understanding of the limits of applicability of the test results.

This document is applicable to empirical performance testing of biometric systems and algorithms through analysis of the comparison scores and decisions output by the system, without requiring detailed knowledge of the system's algorithms or of the underlying distribution of biometric characteristics in the population of interest.

This document does not apply to the measurement of error and throughput rates for people deliberately trying to subvert the intended operation of the biometric system (e.g. by presentation attacks).

This document is identical with, and has been reproduced from, ISO/IEC 19795-1:2021, *Information technology — Biometric performance testing and reporting — Part 1: Principles and framework*.

As this document has been reproduced from an International document, a full point substitutes for a comma when referring to a decimal mark.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Contents

Preface	ii
Foreword	vi
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	5
5 Conformance	6
6 General biometric system	6
6.1 Conceptual representation of general biometric system	6
6.2 Conceptual components of a general biometric system	7
6.2.1 Data capture subsystem	7
6.2.2 Transmission subsystem	7
6.2.3 Signal processing subsystem	7
6.2.4 Data storage subsystem	8
6.2.5 Comparison subsystem	8
6.2.6 Decision subsystem	8
6.2.7 Administration subsystem	9
6.2.8 Interface to external application	9
6.3 Functions of general biometric system	9
6.3.1 Enrolment	9
6.3.2 Verification of a positive biometric claim	10
6.3.3 Identification	11
6.4 Enrolment, verification and identification transactions	11
6.5 Performance measures	12
6.5.1 Error rates	12
6.5.2 Throughput rate	12
6.5.3 Types of performance testing	13
7 Planning the evaluation	13
7.1 General	13
7.2 Determine information about the system	14
7.3 Controlling factors that influence performance	15
7.4 Test subject selection	16
7.5 Test size	17
7.5.1 General	17
7.5.2 Collecting multiple recognition transactions per test subject per system	17
7.5.3 Requirements on test size	18
7.6 Multiple tests	18
8 Data collection	19
8.1 Avoidance of data collection errors	19
8.2 Data and details collected	19
8.3 Enrolments	20
8.3.1 Enrolment transactions	20
8.3.2 Enrolment conditions	21
8.3.3 Enrolment failures and presentation errors	21
8.4 One-to-one comparison trials	22
8.4.1 General	22
8.4.2 Collection conditions	22
8.4.3 Frequency of use	22
8.4.4 Systems performing optimization based on enrolled references	23
8.4.5 Systems performing reference adaptation	23

8.4.6	Processes for data entry errors and system misuse.....	23
8.4.7	Failures to acquire.....	23
8.4.8	Adding test data to the corpus.....	23
8.4.9	Online comparison trials.....	23
8.4.10	Offline comparison trials.....	24
8.4.11	Offline non-mated comparison trials when references are dependent.....	25
8.4.12	Offline non-mated comparison trials based on comparison of references.....	25
8.4.13	Use of samples from multi-capture comparison transactions.....	25
8.5	Identification trials.....	26
8.5.1	General.....	26
8.5.2	Identification testing with non-enrolled test subjects.....	26
8.5.3	Use of jack-knife approach for identification testing.....	26
9	Analyses.....	26
9.1	General.....	26
9.2	Performance of biometric enrolment.....	27
9.2.1	Failure-to-enrol rate.....	27
9.2.2	Enrolment transaction duration.....	27
9.3	Performance of biometric acquisition.....	28
9.3.1	Failure-to-acquire rate.....	28
9.3.2	Acquisition process duration.....	28
9.3.3	Other aspects of acquisition performance.....	28
9.4	One-to-one comparison performance.....	29
9.4.1	False non-match rate.....	29
9.4.2	False match rate.....	29
9.5	Verification system performance metrics.....	30
9.5.1	General.....	30
9.5.2	False reject rate.....	30
9.5.3	False accept rate.....	31
9.5.4	Verification transaction duration.....	31
9.5.5	Generalized false reject rate and generalized false accept rate.....	31
9.6	Identification system performance metrics.....	32
9.6.1	General.....	32
9.6.2	False-negative identification rate.....	33
9.6.3	False-positive identification rate.....	33
9.6.4	Generalized false-negative identification rate and generalized false-positive identification rate.....	34
9.6.5	Selectivity.....	34
9.6.6	Closed-sets of identification performance.....	35
9.6.7	Estimation of identification error rates from one-to-one comparison results.....	35
9.6.8	Predicting identification error rates in larger populations.....	35
9.7	Analysis of performance across controlled experimental factors.....	36
9.7.1	Longitudinal analyses.....	36
9.7.2	Pairwise analyses.....	36
9.8	Detection error trade-off.....	36
9.9	Transaction durations.....	37
9.10	Computational workload.....	37
9.11	Uncertainty of estimates.....	38
10	Graphical presentation of results.....	39
10.1	Score distributions.....	39
10.1.1	General.....	39
10.1.2	Boxplots.....	39
10.2	Error rate vs threshold plot.....	39
10.3	DET plot.....	40
10.4	CMC plot / FNIR over rank plot.....	43
10.5	FNIR over number of enrollees plot.....	45
10.6	Heat maps.....	46
11	Record keeping.....	46

12	Reporting performance results	47
12.1	Reporting test details.....	47
12.2	Summary statistics.....	48
12.3	Reporting enrolment performance.....	48
12.4	Reporting acquisition performance.....	49
12.5	Reporting one-to-one comparison performance.....	49
12.6	Reporting verification system performance.....	49
12.7	Reporting identification system performance.....	50
12.8	Reporting performance across factors.....	50
Annex A	(informative) Differences between evaluation types	51
Annex B	(informative) Test size and random uncertainty	53
Annex C	(informative) Factors influencing performance	61
Annex D	(Informative) Pre-selection algorithm performance	66
Annex E	(informative) Identification performance as a function of database size	68
Annex F	(informative) Algorithms for generating DET and CMC	69
Annex G	(informative) DET properties and interpretation	72
Bibliography	76

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_experiences/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 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 JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

This second edition cancels and replaces the first edition (ISO/IEC 19795-1:2006), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Terminology is updated to follow the biometrics vocabulary of ISO/IEC 2382-37:2017;
- Additional detail is provided on testing and reporting of transaction times and computational workload, and on graphical representation of results.

A list of all parts in the ISO 19795 series can be found on the ISO website.

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 is concerned solely with the scientific technical performance testing of biometric systems and devices. Technical performance testing seeks to determine error and throughput rates, with the goal of understanding and predicting the real-world error and throughput performance of biometric systems. The error rates include both false-positive and false-negative rates, as well as failure-to-enrol and failure-to-acquire rates across the test population. Throughput rates refer to the number of individuals processed per unit of time based both on computational speed and human-machine interaction. These measures are generally applicable to all biometric systems and devices. Technical performance tests that are modality-specific, for example, fingerprint scanner image quality, are not considered in this document.

The purpose of this document is to present the requirements and best scientific practices for conducting and reporting technical performance testing. It is acknowledged that technical performance testing is only one form of biometric testing. Other types of testing not considered in this document include:

- reliability, availability and maintainability;
- security, including vulnerability;
- conformance;
- safety;
- human factors, including user acceptance;
- cost/benefit;
- privacy regulation conformance.

Biometric technical performance testing can be of three types: technology, scenario and operational evaluation. Each type of test requires a different protocol and produces different types of results. Other parts of the ISO/IEC 19795 series provide specific advice and requirements for the development and use of such different test protocols. This document addresses specific philosophies and principles that can be applied over a broad range of test conditions.

NOTES

Currently in preview, click buy full version

Australian Standard[®]

Information technology — Biometric performance testing and reporting

Part 1: Principles and framework

1 Scope

This document:

- establishes general principles for testing the performance of biometrics systems in terms of error rates and throughput rates for purposes including measurement of performance, prediction of performance, comparison of performance, and verifying conformance with specified performance requirements;
- specifies performance metrics for biometric systems;
- specifies requirements on the recording of test data and reporting of test results; and
- specifies requirements on test protocols in order to:
 - reduce bias due to inappropriate data collection or analytic procedures;
 - help achieve the best estimate of field performance for the expended effort;
 - improve understanding of the limits of applicability of the test results.

This document is applicable to empirical performance testing of biometric systems and algorithms through analysis of the comparison scores and decisions output by the system, without requiring detailed knowledge of the system's algorithms or of the underlying distribution of biometric characteristics in the population of interest.

Not within the scope of this document is the measurement of error and throughput rates for people deliberately trying to subvert the intended operation of the biometric system (e.g. by presentation attacks).

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/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

3 Terms and definitions

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

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

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

3.1

test subject

individual whose biometric data is intended to be enrolled or compared as part of the evaluation

3.2**test crew**

set of *test subjects* (3.1) utilized in an evaluation

3.3**target population**

set of biometric data subjects of the application for which performance is being evaluated

3.4**test organization**

functional entity under whose auspices the test is conducted

3.5**experimenter**

individual responsible for defining, designing and analysing the test

3.6**test administrator**

individual performing the testing

EXAMPLE Staff conducting enrolments or overseeing verification or *identification transactions* (3.10).

3.7**test observer**

individual recording test data or monitoring the *test crew* (3.2)

3.8**enrolment attempt**

sequence of one or more capture attempts with the aim of producing a biometric reference for a capture subject

Note 1 to entry: An enrolment attempt can require a specific number of capture attempts (e.g. three separate placements of a finger on a sensor within a set period), from which the highest quality sample(s) is/are selected for further processing.

3.9**enrolment transaction**

one or more *enrolment attempts* (3.8) with the aim of producing a biometric reference for a capture subject

Note 1 to entry: If an enrolment attempt fails, further enrolment attempts can be performed within the same enrolment transaction until an attempt succeeds or enrolment is given up.

3.10**identification transaction**

sequence of one or more capture attempts and biometric searches to find and return the biometric reference identifier(s) attributable to a single individual

3.11**channel effect**

variation of the biometric sample due to sampling, noise and frequency response characteristics of the sensor and transmission channel

3.12**presentation effect**

variation of the biometric sample due to the way that biometric characteristics are presented to the sensor