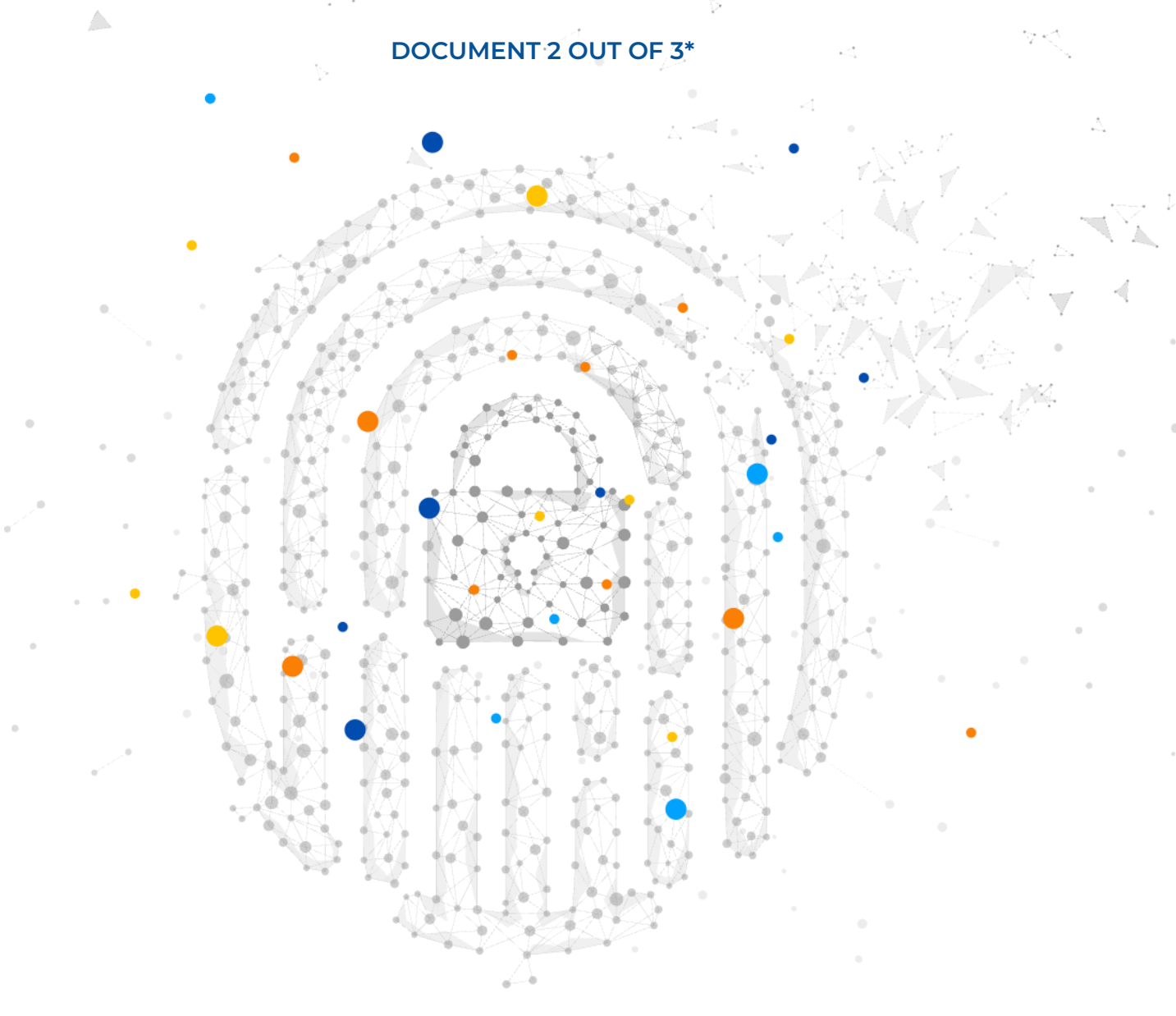
MACP – Device Profiles (V1.0)

Enrolment Devices

DOCUMENT 2 OUT OF 3*



Created in collaboration with BixeLab, with assistance from the members of the Biometric Working Group

*For latest documentation, visit the Biometric Certification Framework on GitHub.

Gates Foundation Norad Pratiksha Trust TATA TRUSTS

MACP Biometric Device Quality Certification Criteria (Draft)

In the context of a developing nation's digital identity ecosystem, biometrics are critical for secure and accurate identification in a range of applications such as citizen enrolment, law enforcement, social welfare programs and government services access, etc.

The quality of biometric data captured during enrolment significantly impacts a system's effectiveness. The modality specific device profiles will assist MOSIP accredited labs in testing the biometric quality of biometric enrolment devices used within a developing nation's digital identity ecosystem, specifically within MOSIP's open-source platform.

Device profiles, referenced for Finger Face and Iris, outline the testing criteria and metrics for evaluating the quality of biometric enrolment devices within applicable specific use cases. Tables under each modality provide some examples of biometric quality testing criteria for enrolment/registration devices. Note that labs may adapt or expand applicable testing criteria for the evaluation based on factors such as device claims, target usage scenarios, device specifications etc.

Testing criteria will be defined based on two scenarios[1]:

1. **Indoor acquisition:** Controllable acquisition environment (for example, environmental factors such as illumination, temperature, humidity, etc., can be controlled in a semi or permanently roofed and constructed structure).
2. **Outdoor acquisition:** Uncontrollable acquisition environment (for example, mobile registration scenarios where environmental factors

[1] Acquisition must be carried out via a supervised collection environment.

such as illumination, temperature, humidity, weather etc., cannot be moderated or controlled).

The rationale for having both options is to allow for scenarios where biometric capture hardware is manufactured with less durable casing or construction method is used, as it will not be exposed to potentially harsh environments and the device usually has a lower cost point. The indoor acquisition devices usually require situations where there is the ability to control the environmental conditions. The Outdoor acquisition devices are designed to be predominately used in outdoor environment scenarios and requires, dust, water, temperature, drop and impact resistance levels for ongoing use. These rugged biometric devices usually have a higher cost point compared to indoor-use-only devices. In this sense, providers can undergo testing for either one or both scenarios based on the device recommended environmental operating conditions. A provider must first obtain certification for Indoor acquisition before undergoing assessment for certification for Outdoor acquisition to demonstrate functionality across both types of environments[2]. **Requiring providers to first obtain certification for Indoor acquisition before undergoing assessment for Outdoor acquisition will help ensure that devices demonstrate reliable functionality in controlled indoor environments, which serves as a baseline assessment.**

Post acquisition: the quality assessment associated with the acquired samples may be undertaken with the help of standard tools such as NFIQ 2.0 for fingerprint and OFIQ for Face. Reporting must clearly indicate the methods used for resolving a pass or a failure outcome associated with the criteria tested.

The MOSIP accredited labs must prepare documentation that details: the test strategy; the test plan, with test scenarios and associated pass/fail in

[2] The test documents such as report and certificate will reflect which scenarios have been tested.

compliance with the published MACP Biometric Device Certification Framework for Quality v1.1; and the test strategy and test plan must be approved by all key stakeholders prior to the commencement of the testing process and logged approval records must be maintained throughout the test period.

Testing to the device profiles will ensure that biometric enrolment devices used meet or exceed the minimum biometric quality standards for reliable and accurate data capture and matching.

Device Profiles

FINGERPRINT

Pre-requisites:

Testing Criteria	Description of evaluated components
Image format compliance (pre-requisite)	MOSIP to validate whether the captured fingerprint images conform to the ISO 19794-4:2011 specifications[3]

The device profile is specific to assessment of fingerprint registration (enrolment) devices in a supervised collection environment.

Assumptions:

1. Ergonomically suitable positioning of the device
2. Indoor (controllable) laboratory environment
3. Contact-based fingerprint capture (plain or rolled)
4. Maximum 5 re-attempts per transaction[4]

[3] It is acknowledged that the specific versions of the standards referenced in this document may be updated over time. Adopters of this framework are responsible for performing due diligence to ensure compliance with the most current versions of these standards as they evolve.
[4] The device providers may nominate their devices' innate decision policies, such as timeouts, retry logic, and any other built-in constraints for capture attempts. The recommendation of a maximum 5 re-attempts serves as a guideline to ensure consistency during testing.

Table 1: Fingerprint testing criteria

Testing Criteria		Capture condition	Test Method	Pass Metric			
				Successful acquisition Rate[5]	Average acquisition duration	NFIQ 2.0 score – for plain	NFIQ 2.0 score – for rolled
Ideal/ Bona fide presentation		Ideal Indoor Capture Conditions	Capture fingerprint as expected by the capture device	>=75%	<30 seconds	>=30	>=20
Adverse Quality Conditions (based on a combination of user sensor interaction and/or environmental conditions)	Adverse presentation angle (pitch: tilt the finger upward and downward from the central axis at angle 15, 45 degrees)	Indoor	Capture fingerprint images with different finger placement angles.	>=50%	Between 30 to 60 seconds	Finger dependent between 10 and 30	Finger dependent between 5 to 20
	Sweaty Fingerprint: Note, the test criteria is based on user trait (i.e., not based on environmental influencing factors)	Indoor	Capture fingerprint images where user has sweaty/moist fingerprints	>=50%	Between 30 to 60 seconds	Finger dependent between 10 and 30	Finger dependent between 5 to 20
	Dry Fingerprint Note, the test criteria are based on user trait (i.e., not based on environmental influencing factors)	Indoor	Capture fingerprint images where user has dry fingerprints	>=50%	Between 30 to 60 seconds	Finger dependent between 10 and 30	Finger dependent between 5 to 20
	Dry Fingerprint Note, the test criteria is based on user trait (i.e., not based on environmental	Indoor	Capture fingerprint images where user has dry fingerprints	>=50%	Between 30 to 60 seconds	Finger dependent between 10 and 30	Finger dependent between 5 to 20

[5]the percentage of biometric capture attempts that result in samples meeting or exceeding predefined quality thresholds suitable for enrolment or verification purposes.

	influencing factors)						
	Low lighting conditions: Note, the test criteria is based on environmental influencing factor such as low-lit indoor environment however, extreme outdoor type capture conditions are not covered.	Indoor	Capture fingerprint images with low indoor lighting levels (<300 lux)	>=50%	Between 30 to 60 seconds	Finger dependent between 10 and 30	Finger dependent between 5 to 20
	Wrinkly fingerprint: Note: Test criteria is based on environmental factor such as rainy conditions.	Outdoor	Capture wrinkly fingerprints in wet or rainy conditions	>=50%	Between 30 to 60 seconds	Finger dependent between 10 to 20	Finger dependent between 5 to 20
	Fingerprint in direct sun exposure conditions	Outdoor	Capture fingerprint under direct sun exposure	>=50%	Between 30 to 60 seconds	Finger dependent between 10 to 20	Finger dependent between 5 to 20
	Fingerprint in no direct sun exposure conditions	Outdoor	Capture fingerprint under no direct sun exposure (in shade)	>=50%	Between 30 to 60 seconds	Finger dependent between 10 to 20	Finger dependent between 5 to 20

The pass criteria for fingerprint are based on the smart borders pilot project report on the technical conclusions of the pilot volume 1. It is expected that the pass/fail criteria will be updated based on the insights from MOSIP accredited labs as they complete testing similar technologies.

Table 2: Pass Fail Criteria

Pass Criteria		
Successful acquisition Rate	Green (Pass)	>=75%
	Orange	50-75%
	Red (Fail)	<50%
Duration	Green (Pass)	<30 seconds
	Orange	>=30 seconds but <60 seconds
	Red (Fail)	>= 60 seconds
NFIQ 2.0 score (Overall first attempt) – for plain	Green (Pass)	>=30
	Orange	<20 but >=10
	Red (Fail)	<10
NFIQ 2.0 score (Overall first attempt) – for rolled	Green (Pass)	>=20
	Orange	<20 but >=5
	Red (Fail)	<5

Note: Current NFIQ 2.0 thresholds are based on the Technical Guideline TR-03121-3 Biometrics for Public Sector Applications report. The minimum thresholds will be updated based on the labs' datapoints established when testing similar technologies.

Thresholds for plain fingerprints and rolled fingerprints used for enrolment are detailed in table 3.

Table 3: Thresholds for plain fingerprints for enrolment

Finger	Finger Code	NFIQ 2.0 score Threshold Plain	NFIQ 2.0 score Threshold Rolled
Right thumb	1	30	20
Right index	2	30	15
Right middle	3	20	15
Right ring	4	10	10
Right little	5	10	5
Left thumb	6	30	20
Left index	7	30	15
Left middle	8	20	15
Left ring	9	10	10
Left little	10	10	5

IRIS

Pre-requisites:

Table 4: Iris pre-requisites

Testing Criteria	Description of evaluated components
Image format compliance (pre-requisite)	MOSIP to validate whether the captured iris images conform to the ISO 19794-6:2011 specifications

The device profile is specific to assessment of iris registration devices in a supervised collection environment.

Assumptions:

1. Ergonomically suitable positioning of the device

2. Indoor (controllable) laboratory environment
3. Device capture enrolls both irises
4. Maximum 3 re-attempts allowed

Note: Since iris modality is impacted by demographic variables, the test crew must adequately represent the physiological traits of the target population, for example, some geographies have a higher percentage of dark eyed individuals as opposed to other geographies.

Note: The device profile does not consider utilising test crew with medical conditions, or usage patterns that may result from uncontrollable factors such as age.

Table 5: Iris Test Criteria

Testing Criteria		Capture condition	Test Method	Pass Metric									
				Successful Acquisition Rate	Average acquisition duration	Grayscale utilisation	Iris pupil concentricity	Iris pupil contrast	pupil dilation	Iris sclera contrast	Margin adequacy	Pupil boundary circularity	Usable iris area[6]
Ideal/ Bona fide presentation		Ideal Indoor Capture Conditions	Capture iris images with subjects' eyes wide open and looking directly at the device using the device	>=75%	< 30 seconds	>=6	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70
	Presentation with eye wear	Indoor	Capture iris images with subject wearing clear	50% to 75%	Between 30 to 60 seconds	>=6	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to	>=70

[6] If < 70% of the iris is visible and then a re-acquisition should be triggered until the target usable area is achieved (within the bounds of the device decision policy for a timeout and maximum re-attempts allowed).

Detection of Adverse Quality Conditions (based on a combination of user sensor interaction and/or environmental conditions) to trigger re-acquisition			glasses or contact lenses									other forms	
	Large subject to camera distance	Indoor	Capture iris with subject present at a distance >= 10 cm meter from the capture device	50% to 75%	Between 30 to 60 seconds	>=60	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70
	Presentation with Clear contacts[7]	Indoor	Capture iris with subject wearing clear contact lenses	50% to 75%	Between 30 to 60 seconds	>=60	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70
	Dilated pupil presentation	Outdoor	Capture iris images with subjects' pupils at different dilation levels	50% to 75%	Between 30 to 60 seconds	>=60	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70
	Constricted pupil presentation	Outdoor	Capture iris images with subjects' pupils at different constricted levels	50% to 75%	Between 30 to 60 seconds	>=60	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70
	Occluded presentation	Outdoor	Capture iris images with subject blinking owing to conditio	50% to 75%	Between 30 to 60 seconds	>=60	>=90	>=30	Between 20 and 70	>5	>80	100 to a circle and [0,100] to other forms	>=70

[7] The test report must clearly identify the type of clear contact lens used for testing.

			ns such as windy weather which may result in iris being occluded										

Note: For adverse quality tests, where a sample is acquired, the ISO/IEC 29794-6 specified quality metrics per sample must meet the same thresholds as set for bona fide tests.

Table 6 below provides the iris pass failure criteria.

Table 6: Iris Pass Fail Criteria

Pass Criteria		
Successful acquisition Rate (both left and right iris patterns) above a given threshold within three attempts	Green (Pass)	>=75%
	Orange	50-75%
	Red (Fail)	<50%
Duration	Green (Pass)	<30 seconds
	Orange	>=30 seconds but <60 seconds
	Red (Fail)	>= 60 seconds
ISO/IEC 29794-6:2015 [Information technology – Biometric sample quality – Part 6: iris image data][8]	Greyscale utilization [0, +inf): The spread of intensity values regarding the pixel values within the iris portion of the image.	>=6
	Iris pupil concentricity [0,100]: The degree to which the pupil	>=90

[8] This is based on published standard and https://github.com/mitre/biqt-iris for now. The minimum pass thresholds may be updated overtime as the labs evaluate similar technologies with traceable datapoints.

	center and the iris center are in the same location.	
	Iris pupil contrast [0,100]: The image characteristics at the boundary between the iris region and the pupil.	>=30
	pupil dilation (9.58, 121.30): The degree to which the pupil is dilated or constricted	Between 20 and 70
	Iris sclera contrast [0,100]: The image characteristics at the boundary between the iris region and the sclera.	>5
	Margin adequacy [0,100]: The degree to which the iris portion of the image is centered relative to the edges of the entire image.	>80
	Pupil boundary circularity [0,100]: The circularity of the iris-pupil boundary.	100 to a circle and [0,100] to other forms
	Usable iris area [0,100]: The fraction of the iris portion of the image that is not occluded by eyelids, eyelashes, or specular reflections.	>=70

FACE

Pre-requisites:

Testing Criteria	Description of Evaluated Components
Image format compliance (pre-requisite)	MOSIP to validate whether the captured face images conform to the ISO 19794-5 specifications

Device profile is specific to assessment of face capture/registration/enrolment devices in a supervised collection environment.

Assumptions:

1. Ergonomically suitable positioning of the device
2. Indoor (controllable) laboratory environment
3. Maximum 3 re-attempts allowed

Note: Since face modality is impacted by demographic variables, the test crew must adequately represent the physiological traits of the target population.

Note: The device profile excludes test crew with medical conditions that would affect the acquisition of their biometrics. Infant biometrics are a separate test case and excluded from this document. A separate device profile will be required to cover infant biometrics.

Table 7: Face Test Criteria

Testing Criteria		Capture condition	Test Method	Pass Metric		
				Successful acquisition Rate	Average acquisition duration	Quality Score (unified)
Ideal/ Bona fide presentation		Ideal Indoor Capture Conditions	face as expected by the capture device	>=95%	<30 seconds	>=50
	Pose variation – yaw (15 – 45 degrees) and pitch (15 – 45 degrees)	Indoor	face with adverse pose angles	>=50%	Between 30 to 60 seconds	>=50
		Indoor	face with partial occlusions owing	>=50%	Between 30 to 60 seconds	>=50

Detection of Adverse Quality Conditions (based on a combination of user sensor interaction and/or environmental conditions) to trigger re-acquisition	Occluded presentation		to clear glasses, facial hair, scarves, etc.			
	Expression variation – smile/frown	Indoor	face with extreme facial expressions such as smile, or frowning	>=50%	Between 30 to 60 seconds	>=50
	Eyes closed	Indoor	face images with subjects' eyes closed during capture	>=50%	Between 30 to 60 seconds	>=50
	Illumination variation	Outdoor	face in direct sunlight condition	>=50%	Between 30 to 60 seconds	>=50
	Illumination variation	Outdoor	ace in not direct sunlight (shadow) condition	>=50%	Between 30 to 60 seconds	>=50
	Multiple people (e.g., people in the background)	Outdoor	face images with multiple faces[9]	>=50%	Between 30 to 60 seconds	>=50
	Blur	Outdoor	face images with subjects' face out of focus/in motion causing blur in captured image)	>=50%	Between 30 to 60 seconds	>=50

[9] Only pristine quality images must be captured i.e., for test cases like multiple faces and blurry faces the device must reject and trigger a re-acquisition until acceptable quality is achieved (within the bounds of the device decision policy for a timeout and maximum re-attempts allowed). The successful acquisition metric assumes suitable active user feedback to ensure at least 50% of the tests result in successful acquisitions.

Note that the pass metrics are currently based on the working draft ISO/IEC 29794-5:2022 and will be revised once the standard is published and as labs evaluate similar technologies and establish traceable datapoints to set thresholds for passing. Currently the pass metric for the unified quality score was set on the basis of the sample utility being mapped to the quality-false rejection correlation – as per use in the case of NFIQ 2 metric.

Specifications outlined in Annex B, Applications of quality values, apply when assessing face acquisition devices under the certification.

Table 8: Face Pass Fail Criteria

Pass Criteria		
Successful acquisition Rate above a given threshold within three attempts or successful rejection rate for adverse presentation cases with ground truth set as reject.	Green (Pass)	>=75%
	Orange	<50%
	fail	<50%
Duration	Green (Pass)	<30 seconds
	Orange	>=30 seconds but <60 seconds
	Red (Fail)	>= 60 seconds
ISO/IEC 29794-5:2022 (WD5)[10]	Quality score (unified) [0,100]	>=50

Note: For adverse quality tests, where a sample is acquired, the ISO/IEC 29794-5 specified quality metrics per sample must meet the same thresholds as set for bona fide tests.

[10] This is based on the published draft standard for now. The minimum pass thresholds may be updated overtime as the labs evaluate similar technologies with traceable datapoints.