

GUIDELINES ON BIOMETRIC STANDARDS

PUBLISHED BY THE NATIONAL IDENTITY MANAGEMENT COMMISSION

These Guidelines shall apply to the following:

- (a) all Ministries, Departments and Agencies (MDAs), Statutory Bodies, Executive Bodies, Institutions, corporate bodies and owners of biometric capture equipment or devices (in these Guidelines referred to as "**Operators**") whose licenses, statutory functions or business functions require biometric capture and authentication for identity management purposes;
- (b) any person or organization licensed, involved in designing, testing, or implementing the National Identification Number (NIN) system, NIN compatible systems, or NIN enrolment for the Federal Government, State Government, Local Governments and the Federal Capital Territory and commercial private organizations;
- (c) any and all users of the NIN system; and
- (d) any other category of persons or organization as may be determined by the National Identity Management Commission (in these Guidelines referred to as the "**Commission**") from time to time.

These Guidelines are published pursuant to the Nigeria Biometric Standards Regulation 2017 S.I. 13 Vol. 104 dated the 6th November 2017.

PART I: ADOPTED STANDARDS

1. All Operators shall adopt the ISO/IEC standard of biometric data capture parameters, data format standards, and other standards within the ISO/IEC body of biometric standards as the Standard of Compliance.

PART II: FACE BIOMETRICS

2. **Face Biometrics Basics**

The dimensions, proportions and physical attributes of a person's face are unique. Face biometrics involves the use of distinctive facial characteristics such as cheekbones, nose location, eye location, and eye socket outline in order to identify individuals.

There are three generic approaches to human face processing namely component-based methods (separable elements perceived as distinct parts), configurable based methods (spatial arrangements), and holistic based methods (face as an unparsed perceptual whole).

- (a) ICAO compliant face images should be captured during enrolment.
- (b) For verification and identification, the user stands in front of the camera for a few seconds, and the scan is compared with the template previously recorded. Facial thermography may be used to record the heat of the face.

3. Face Enrolment Standards

(a) Position

- i. Full frontal face image provides sufficient information for both human visual inspection (by an operator) and automatic face recognition algorithms. In order to obtain a good quality image, 24-bit colour images with a minimum of 90 pixels of inter-eye distance are required.
- ii. These Guidelines recommends at least 120 pixels for optimum quality. The image should contain well-focused nose to ear and chin to crown region.
- iii. Assistance may also be provided in special cases, but in no case should the face or body part (hand, arms) of the assisting person or any object appear in the photograph.

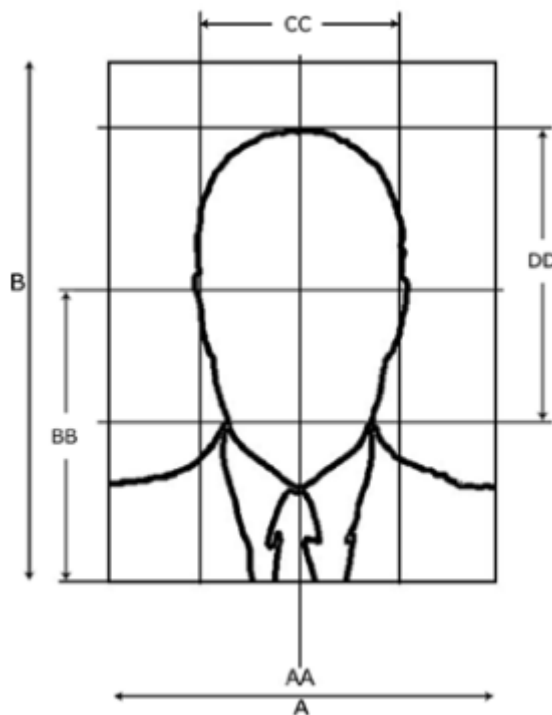


Figure 1: Geometric Characteristics of the Full Frontal Face Image

(b) Tribal Marks

The face image should be captured with the tribal marks; clearly visible for easy verification purposes.

(c) Digital Photographic Requirements

- (i) Face image capture devices may be connected to enrolment workstations and linked to enrollees. The capture device should use auto focus and auto-capture functions if available;
- (ii) The output image should not suffer from motion blur, over or under exposure, unnatural colour, uneven lighting, or radial distortion. Interlaced video frames are not allowed;

- (iii) Enrolment operators should encourage enrollees to adjust to suitable postures and sitting requirements, and may also adjust capture devices to capture suitable face images.
- (d) Expression
Faces should be captured with neutral (non-smiling) expression, mouth closed and both eyes open.
- (e) Illumination
Proper and equally distributed lighting mechanism should be used such that there are no shadows over the face, no shadows in eye sockets, and no hot spots.
- (f) Glasses
 - i. If the person normally wears glasses, it is recommended that the photograph be taken with glasses. However, the glasses should be clear and transparent so that pupils and iris are visible.
 - ii. If the glasses are tinted, then direct and background lighting sources should be tuned accordingly.
- (g) Accessories
Head coverings such as hats or caps are not permitted. If an applicant wears a head covering for religious purposes (e.g. hijabs) or on medical grounds (e.g. eye patches), a photograph of the applicant wearing it will be accepted provided all facial features from bottom of the chin to top of the forehead (including both edges of the applicant's face) are clearly shown.
- (h) Background
A white or off-white background is recommended against an opaque wall/partition.

4. **Operational Process**

- (a) Operator Training and Assistance
The single most important factor in obtaining better image quality is the operational process. System operator training and assistance are important for yielding good quality images. System operators should be trained to obtain the best possible face images that satisfy requirements.
- (b) Liveness Detection
Operators of face biometric systems should require enrollees to smile, blink, or nod their head to prevent an image/photo of the face or a mask from being used. This is known as Liveness Detection.
- (c) Quality check
The quality assessment algorithm should encode parameters like illumination, pose, blur, noise, resolution, inter-eye distance, image

height and width, and horizontal and vertical position of the face. The quality assessment algorithm should be used at the time of enrolment to determine the quality score of the captured face image, and the image is stored only if it meets a certain quality threshold.

- (d) Storage and Compression
The performance of face recognition algorithms reduce significantly if the compression factor is greater than 10. For preserving the quality of image, only uncompressed images should be stored in the database.

5. **Face Authentication Standards**

The verification process shall consist of steps similar to enrolment:

- (a) Image Capture
Image capture for authentication should also follow standards for enrolment as defined earlier in this Part II.
- (b) Compression
Images with JPEG 2000 compression ratio of 10 will suffice. As per ISO standards, the image size after compression should not be less than 11 KB.
- (c) Number of Images
For both manual and automatic authentication, a single full frontal face image is sufficient. The captured image should conform to the digital/photographic requirements and quality thresholds mentioned above in the enrolment section.

PART III: FINGERPRINT BIOMETRICS

6. **Fingerprint Biometrics Basics**

A fingerprint is made of a number of ridges and valleys on the surface of the finger. Ridges are the upper skin layer segments of the finger and valleys are the lower segments. The points where ridges split (bifurcations) or end (ridge endings) are called minutiae. Many types of minutiae exist, including dots (very small ridges), islands (ridges slightly longer than dots, occupying a middle space between two temporarily divergent ridges), ponds or lakes (empty spaces between two temporarily divergent ridges), spurs (a notch protruding from a ridge), bridges (small ridges joining two longer adjacent ridges), and crossovers (two ridges which cross each other). The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points.

There are five general fingerprint patterns: **arch**, **tented arch**, **left loop**, **right loop** and **whorl**. Statistics show that these compositions vary according to race and ethnic origin.

Fingerprints are unique, with no two fingers having the exact same dermal ridge characteristics. There is a large variation in the quality of fingerprints within the population. Acquiring distinct high quality fingerprint data is a complicated task.

7. **Fingerprint Enrolment Standards**

(a) Plain or rolled capture

The rolled image, common in forensic applications contains twice as much information as the plain image. The plain image is easier to capture and can capture up to four plain fingers in one scan. The rolled image in contrast, must be captured one finger at a time. Rolled images requires operator guiding the rolling of each finger.

(b) Number of fingers

i. For all Persons, this Guidelines recommends capturing prints of all ten (10) fingers. This is because, every additional finger increases accuracy and improves matching speed.

ii. For persons in the rural areas and people exposed to physical labour (such as farming, fishing, hunting, masonry, etc.), these Guidelines recommends capturing prints of all ten fingers, the maximum possible. In cases where prints cannot be easily captured due to wear and tear, the easily identifiable ones should be captured and other biometric identifiers like face and iris data should also be captured.

(c) Disabilities

Where disability or other circumstances lead to the inability to capture fingerprints, concerted effort should be made to capture all available fingerprints. If no fingerprints are available, other biometric identifiers like face and iris data will be captured for the disabled person.

8. **Operational Processes**

(a) Capture and quality check

i. Image segmentation and quality checks should be performed after image capture. The enrollee should be asked to retry fingerprint scanning if image quality is poor.

ii. Fingerprint quality metrics should be assigned to fingerprint impressions.

iii. Fingerprint quality metrics adopted by the NIMS is based on the internationally recognized National Institute of Standards and Technology (NIST) NFIQ metric. The NFIQ enables the quantification of the quality of fingerprint images. NFIQ generates a single score, in the range of 1-5, to represent the quality of fingerprints; "1" being of the highest quality and "5" being of the lowest quality.

Table 1 below represents the mapping of NFIQ quality grades to other international quality metrics

NFIQ	MINEX 04	800-76-1	MINEX II
1	100	100	100
2	75	80	80
3	50	60	60
4	25	40	40
5	1	20	20

Table 1: NFIQ Mappings to other quality metric

- (b) Operator Assistance
Operators need to be trained to assist enrollees during data capture in presenting the correct fingers, finger pressure, finger position/orientation, and so on.
- (c) Corrective measures and retries
Where the initial capture is unsatisfactory, the system operator should provide corrective measures such as wiping fingers with a damp cloth or applying lotion. Only after all such measures are exhausted in five attempts will the operator be able to override the quality gate (i.e. force capture).
- (d) Template Format
The data format of storage should be such that other applications can access the data. This includes (but not limited to) WSQ's, ISO/IEC 19794-2, and ANSI INCITS 381-2004 template formats.
- (e) Compression
To preserve the quality, these Guidelines recommend uncompressed images. Transmission of images may be made in JPEG2000 or WSQ_lossless compression for legacy or compatibility purposes. Any form of lossy compression is not recommended.

9. **Fingerprint Device Characteristics**

- (a) A minimum optical resolution of 500 DPI is recommended;
- (b) A minimum FBI IAFIS Appendix F Certification is required for enrolment devices;
- (c) The inclusion of liveness detection is desirable.

10. **Fingerprint Authentication Standards**

- (a) Number of fingers
A single finger is sufficient to successfully ascertain identity. Applications requiring higher levels of confidence may use additional fingers. These Regulations allow for the scanning of any and every finger. Certain fingers, depending on the condition of the finger, will perform better during authentication.
- (b) Retries
The best possible fingerprint impression should be scanned during enrolment and authentication. The operator may "force capture"

if fingerprint impressions are not of optimum quality. A timeout should be implemented after five (5) failed scanning attempts.

- (c) **Compression**
JPEG2000 compression is recommended. WSQ compression may be acceptable for legacy purposes. A compression of up to 15 is acceptable. While uncompressed images will be accepted, it is not recommended. Compression is not relevant if minutiae data is to be sent for verification.
- (d) **Minutiae format**
Minutiae templates should conform to ISO/IEC 19794-2:2005, ANSI INCITS 381-2004, and the MINEX (I or II) template formats.

PART IV: IRIS BIOMETRICS

11. Iris Biometrics Basics

The iris is the elastic, pigmented, connective tissue that controls the pupil. The iris is formed in early life in a process called morphogenesis. Once fully formed, the texture is stable throughout life. It is the only internal human organ visible from the outside and is protected by the cornea. The iris of the eye has a unique pattern, from eye to eye and person to person.

An iris scan will analyse over 200 points of the iris, such as rings, furrows, freckles, and the corona. Glasses, contact lenses, and even eye surgery does not change the characteristics of the iris. To prevent an image/photo of the iris being used instead of a real "live" eye, iris scanning systems will vary the light and check that the pupil dilates or contracts. This is referred to as liveness detection.

12. Iris Enrolment Standards

- (a) **Image**
Capturing two eyes simultaneously provides several advantages because the iris pattern of each eye is not correlated, giving two independent biometric feature sets. It assures correct assignment of left and right eyes and allows for more accurate estimation of roll angle.
- (b) **Capture diameter**
In order to obtain good quality templates, the iris image diameter should be a minimum of 140 native pixels. 170 pixels is recommended for optimum quality.
- (c) **Iris Margins**
The margins around the iris portion of the image need to be at least 50% of the iris diameter on the left and right sides of the image, and a least 25% of the iris diameter on the top and bottom of the image. This will retain sufficient image surrounding the iris for adequate segmentation and authentication.

13. **Operational Processes**

(a) Device Characteristics

- i. The capture device should be more than 300 mm away from the enrollee to be considered non-intrusive. The capture device should use auto focus and auto-capture functions.
- ii. The capture device should allow for some variability in the position of the iris centre relative to the camera. For two eye capture devices, the capture volume dimensions for devices without mechanical alignment aids are 19 mm wide, 14 mm high, and 20 mm deep, and for devices with such aids, 19 mm wide, 14 mm high, and 12mm deep. The ability of an iris image capture device to suppress motion blur and to freeze motion, is a function of exposure time. The maximum allowable value for the exposure time is less than 33ms, recommended being 15ms.
- iii. The capture device should be capable of capturing light in the range of 700 to 900 nanometres. The camera's near infrared illuminator(s) should have a controlled spectral content, such that the overall spectral imaging sensitivity, including the sensor characteristics, transfers at least 35% of the power per any 100 nm-wide sub-band of the 700 to 900 nm range.
- iv. The iris image capture sensor should use progressive scanning. In order to achieve acceptable time-to-capture and FTA rates, the iris image sampling frequency should be at least 5 frames per second.
- v. Illumination shall be compliant with the IEC 825-1 and ISO 60825-1 illumination standard and safety specification.
- vi. To achieve acceptable recognition accuracy, the iris acquisition sensor should achieve a signal-to-noise ratio of at least 36dB. Within the frequency range of interest, 700 to 900 nm, the iris sensor shall generate images with at least 8 bits per pixel.

(b) Operator assistance

The operator and not the enrollee should handle the capture device. The enrollee will be required to sit (or stand) in a fixed position, like taking a portrait photograph; the operator will adjust the camera.

- #### (c)
- The iris capture device or the connected computer should be able to measure the iris image quality. The best practice recommendation is that an initial image quality assessment should be done to provide feedback to the operator during the capture process. The device should alert the operator if the captured iris image is of insufficient quality. The iris capture process is sensitive to ambient light. No direct or artificial light should directly reflect off enrollee's eyes.

- (d) Quality assessment
The device should take successive 3 to 7 images and use local matching algorithm to match against each other (after feature extraction). The image is considered to be of satisfactory quality if hamming distance of the match is below 0.1.
- (e) Compression and storage
The iris images should be stored in ISO standard format using either JPEG 2000 or PNG lossless compression (KIND_VGA). Each enrolment is expected to require 150 Kbytes of storage space.

14. **Iris Verification and Authentication Standards**

- (a) Template Format
The image should be compressed to KIND_CROPPED_AND_MASKED or KIND_CROPPED using JPEG 2000. Resulting image size should be between 2KB to 10 KB. Any of the larger formats specified by the ISO standard area is acceptable, though not necessary.

PART V: MISCELLANEOUS PROVISIONS

- 15. Operators may seek clarification of the application of these Guidelines and acceptable compliance practices from the Commission.
- 16. The Commission may from time to time issue additional directions, decisions or orders on any aspect of these Guidelines, and either of general application or specific to an Operator.
- 17. The Commission may also revise these Guidelines, or part thereof, at any time by publishing replacement Guidelines.