Home Office Biometrics (HOB) Programme

Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)

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Document Details

Revision History

Revision Number	Revision Date	Summary of Changes / Iteration Level	Author
3.01	09/02/2021	Original "*Biometric Standards – Requirements and Information for Partners and their Suppliers (HOB-S001)*" document renamed and given new layout.	RG
3.02	16/02/2021	Minor updates following internal review	RG
3.03	27/04/2021	Updates to face standards, including to align face image sizes to support future business usage and expand Appendix B to provide additional guidance on facial image capture devices. Minor clarifications to fingerprint requirements including for FAP50 fingerprint devices.	RG
3.04	09/06/2021	Minor update to add new section covering document governance and change process	RG

Table of Contents

1   Introduction

1.1   The HOB Biometric Service Consumer

The term "HOB Biometric Service Consumer" refers to the immigration, law enforcement or other government department business area overseeing connectivity and provision of biometric requests to Home Office Biometrics (HOB) systems, as well as their supplier(s). The intent of provision of biometric images and accompanying data is related to accessing HOB Biometric Services, such as searching and storage of biometrics.

1.2   About the document

This document is edited and maintained by the HOB Technical Design Authority (TDA). The purpose of the document is to provide conformance requirements for biometric interchange and image standards that must be adhered to by HOB Biometric Service Consumers that wish to access services from biometric matching systems governed by the Home Office Biometrics (HOB) programme, via the HOB BSG[1].

HOB originally published an earlier version of this document in September 2015 (which was adapted for HOB Programme use from an earlier IABS Programme document). In February 2021 the document was re-formatted and the previous title, *"Biometric Standards – Requirements and Information for Partners and their Suppliers",* replaced with the current title.

A key intent of adherence to the biometric conformance requirements stated in this document is the dual objective that the HOB Biometric Service Consumer will receive the best possible matching performance and result back from the HOB biometric service as well as to ensure ongoing performance of the back end biometric subsystems is maintained into the future for all service users. Biometric conformance should thus be seen as providing significant positive benefits for all stakeholders.

1.3   Structure of the document and how to use it

This document is structured to provide chapters covering different biometric image types, so HOB Biometric Service Consumers can readily access those chapters relevant to their implementation. For example, a solution for capturing face images only would only need to refer to a relevant subset of the chapters provided.

For all HOB Biometric Service Consumers, chapters 2 – 4 should be referenced. Chapter 2 gives important introductory information. Chapters 3 and 4 provide general biometric requirements and conformance guidance for all use cases, as well as details of the biometric interchange standard that will be used (HONE-1).

For HOB Biometric Service Consumers utilising fingerprints in their implementation, chapters 5 and 13 (Appendix A) are relevant.

For HOB Biometric Service Consumers utilising posed face images in their implementation, chapters 6 and 14 (Appendix B) are relevant.

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[1] BSG = Biometric Services Gateway. This HOB component is at the boundary of the HOB biometric platform. Service consumers connect to the BSG in order to request biometric services and receive responses.

Other potential biometric images/types and related data are covered in other chapters of the document to be referenced as appropriate.

1.3.1 Handheld/portable exception requirements

The vast majority of transactions sent to HOB systems via BSG are intended to result in an "enrolment" to the appropriate back end biometric system, whereby biometrics are searched and then stored. For enrolment use cases, the full set of requirements set out in the main chapters of this document for the relevant biometric images must be conformed to.

For handheld/portable[2] solution scenarios utilising a "search only" or "verification only" use case there is an allowable variation in some of the biometric conformance requirements specific to these handheld/portable device search only/verification use cases. In these scenarios, biometrics are not stored for later searching in the back end biometric system. These variations are set out in chapter 15 – Appendix D of this document.

1.4 Information on document scope

HOB systems covered in the scope of this document are the HOB Biometric Services Gateway (BSG) and the immigration and law enforcement back end biometric subsystems (currently referred to as "IABS" and "IDENT1".) Although DNA interactions for law enforcement fall under the scope of the HOB programme, they are dealt with on a separate technical platform, are not conveyed via BSG and use a different Interface Control Document (ICD) from HONE-1. DNA is, therefore, intentionally out of scope for this document.

The document covers biometric image standards and requirements for exchange of biometric transactions with HOB systems (apart from those relating to DNA processing) and is <u>not</u> intended to be used as an exhaustive guide for implementation of front end biometric recording solutions. However, although the entirety of front end biometric capture solution requirements is not in the scope of this document, the HOB Design Authorities have many years of collective practical experience in such solutions and can (subject to HOB SMT approval) provide guidance, advice and assurance to business areas involved in developing front end biometric recording solutions that will directly or indirectly interact with HOB systems. Attention is also drawn to separate reference material contained in the "*Best Practice for Biometric Capture*" guide for immigration implementations, authored by HOB.

Biometric standards for direct legacy IDENT1 interfaces and interactions that do not route via BSG are not in scope for this document and will instead be under the governance of separate IDENT1-specific technical documentation.

Although the focus of this document is guidance on biometric data provided to HOB systems (directly or indirectly) via the BSG, Appendix E contains reference information relevant to the suppliers of HOB back end matching components.

1.5 Procedure to follow for new HOB Biometric Service Consumers

Where, in order to gain access to HOB biometric services, there is to be a new interface with HOB systems, or an update to an existing interface, the HOB Biometric Service Consumer should in the first instance contact the HOB PMO (hobpmo2@homeoffice. gov.uk). The HOB

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[2] The definition of "handheld / portable" is provided at Appendix D

PMO will then manage the engagement activity, including involvement from the HOB Design Authorities (business and technical). Copies of the current HONE-1 ICD[3] document set are also available for reference by contacting the HOB TDA via the HOB PMO.

Prior to biometric images and related data being accepted to HOB systems via BSG, an assurance of the HOB Biometric Service Consumer's biometric capture solution will be required. This assurance may be provided by conducting the "HOB Biometric Conformance Process for Service Consumers", which is separately documented and will be discussed with the HOB Biometric Service Consumer following a request to access HOB biometric services.

In the case of a new interface implementation, after the relevant development process is complete the HONE-1 specification will be updated as appropriate with a new HONE-1 Implementation Annexe for the new interface instance.

No transactions with HOB systems can take place without an agreed ICD (HONE-1 Implementation Annexe) being in place.

1.6 HOB Biometric Conformance Requirements governance

The Biometric Conformance Requirements for HOB Biometric Service Consumers are under the governance of the Home Office Biometrics (HOB) Programme.

There is an established process for updating standards and requirements contained in this document in line with international biometric standards developments and requirements of the back end matching solutions. Changes are made in a way to support backwards combability for previous HONE-1 implementations and are discussed with service consumers before being formally distributed as part of the official HONE-1 change process.

If service consumers have comments or suggestions related to this document, they should write to the head of HOB TDA, via the HOB PMO (hobpmo2@homeoffice. gov.uk).

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[3] ICD = Interface Control Document

2 Biometric Exchange Format Standards and Compliance

2.1 Requirement to use HONE-1

HONE-1[4] is the strategic biometric exchange format / interface standard of Home Office and is based on the internationally recognised and widely used NIST[5] standard for biometric data exchange. Providing a single unified interface standard enables a number of business benefits to be realised, including simplifying integration, reducing costs through a reduction of development and testing and, by aligning with the NIST standard, reducing compatibility issues. Biometric suppliers are expected to be familiar with this standard, which will lead to a quicker understanding of HONE-1.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-A010	Biometric interchange standard	All new interface instances for communication with HOB systems via BSG from UK sources are required to use HONE-1, which is the strategic biometric exchange format of Home Office, unless an alternative has specifically been agreed by HOB TDA. HOB Biometric Service Consumers shall ensure full compliance with this requirement.
HOB-BCR-M-A020	Biometric interchange conformance	As part of BSG CoCo[6] assurance, it is necessary to confirm that biometric images supplied in transmissions to HOB systems, via BSG, come from biometric capture solutions that have passed the *HOB Biometric Conformance Process for Service Consumers*. HOB Biometric Service Consumers shall ensure full compliance with this requirement.

No transactions with HOB systems can take place without an agreed HONE-1 Implementation Annexe supporting the intended transactions being in place.

It is recognised that in some situations a HOB Biometric Service Consumer may implement their own choice of format to transport biometric transactions 'internally' within their own systems/boundaries. HONE-1 would then be used from the external boundary of the requesting system into the HOB Biometric Services Gateway (BSG), which will then route transactions to HOB back end matching systems supporting immigration and law enforcement appropriately.

Detailed information relating to HONE-1 is provided to HOB Service Consumers within the HONE-1 document set as part of the implementation of any new BSG interface and ongoing maintenance of existing interfaces.

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[4] HONE = Home Office NIST Exchange
[5] NIST = National Institute of Standards and Technology
[6] CoCo = Code of Connection

Note: HONE-1 is based on an enhanced implementation of the ANSI/NIST ITL 2-2008[7] XML schema. At some point in the future it is expected that this baseline version will be updated to the 2011-2015 version of ANSI/NIST ITL to benefit from improvements to the underlying standard. Such a future change will be co-ordinated with all HONE-1 stakeholders.

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[7] ANSI/NIST ITL 2-2008 XML has some recognised deficiencies but these did not have a significant impact for Home Office use and this version of the standard was the only available option when HONE-1 was originally implemented.

3 General Biometric Capture and Image Standards and Compliance

3.1 General requirements

The table below provides general requirements that must be complied with, regardless of the specific biometric image types used by the HOB Biometric Service Consumer in their implementation.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-B010	Compliance with HOB biometric standards	The HOB Biometric Service Consumer shall ensure that all biometric images for submission to HOB systems are captured and exchanged in conformance with the requirements set out in the HOB TDA document, "*Biometric Compliance Requirements for HOB Service Consumers (HOB-S001)*"
HOB-BCR-M-B020	Image integrity	The HOB Biometric Service Consumer shall ensure that biometric images captured in their front end capture solution are either immediately saved into the required biometric image compression format (compliant with the requirements for that image type set out in this document) or saved into an uncompressed format before subsequently being converted into the required image compression format for transmission to HOB systems. Context: Saving biometric images into one compressed format and then into another different format can introduce undesirable image artefacts and this must not be allowed in the HOB Biometric Service Consumer solution. This is of particular concern for fingerprint images. Saving directly to the required compressed format avoids this issue. Where this is not possible then using an uncompressed format as the intermediate step also mitigates the issue.

4 Fingerprint Capture and Images - Standards and Compliance

4.1 General image requirements - Fingerprints

This section covers general capture and image standards and requirements that **MUST** be adhered to for biometrics that are transmitted to HOB systems via the Biometric Services Gateway (BSG).

Note that, as stated in section 1.3.1, there are **different standards for handheld / portable device capture** equipment used for search only and/or verification scenarios, which are detailed in **Appendix D.**

For the purpose of this section, "fingerprints" can refer to single rolled, single plain (flat) or multi finger plain (slap) images, which are captured via "livescan" units or scanned from paper ink and printed sets.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-C010	Core fingerprint image standard*	The HOB Biometric Service Consumer shall ensure that fingerprints captured and submitted to HOB systems conform to fingerprint image standards of ANSI/NIST ITL 1-2007 / ANSI/NIST ITL 2-2008
HOB-BCR-M-C020	Fingerprint capture equipment (at capture source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for recording fingerprints that are transmitted to HOB systems is certified according to Appendix F of CJIS IMAGE QUALITY SPECIFICATIONS, as contained in the FBI ELECTRONIC BIOMETRIC TRANSMISSION SPECIFICATION (EBTS) IAFIS-DOC-01078-9.3, unless a specific exemption has been agreed with the HOB TDA (for specific circumstances where this certification is not relevant).
HOB-BCR-M-C030	Fingerprint capture equipment (at capture source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for recording fingerprints that are transmitted to HOB systems meet the *Additional HOB Fingerprint Image Standards* detailed at Appendix A of this document.
HOB-BCR-M-C040	Fingerprint file format for 500ppi images	The HOB Biometric Service Consumer shall ensure that fingerprint images recorded and subsequently transmitted to HOB systems at 500ppi are in the Wavelet Scalar Quantization (WSQ) format and that the WSQ compression algorithms comply with IAFIS-IC-

		0010(V3), or a later version as agreed with the HOB TDA.
HOB-BCR-M-C050	WSQ compression ratio	The HOB Biometric Service Consumer shall ensure that WSQ compression ratio is set at nominal value of 12:1. Note: The amount of compression that can safely be applied depends on the specific image content so a strict 12:1 ratio is not enforced. It is allowable to increase to a nominal ratio of 15:1 where this is unavoidable. However, maintaining a compression ratio below 12:1 is recommended.
HOB-BCR-M-C060	Fingerprint file format for 1000ppi images**	The HOB Biometric Service Consumer shall ensure that fingerprint images recorded and subsequently transmitted to HOB systems at 1000ppi are in the JPEG 2000 lossless format (JP2L). Images of 1000ppi resolution must not be introduced into a new or existing business process unless authorised in advance by HOB TDA.

*This row shows the current version of the ANSI/NIST ITL standard on which HONE-1 is based. However, it is expected that this baseline version will be updated to the 2011 (2015 update) version of ANSI/NIST ITL in due course to accommodate the HOB strategic solution and to take advantage of improvements to the underlying standard.

**The majority of fingerprint / palmprint images used currently in HOB systems (outside of some used in specialist law enforcement collections) are of 500ppi resolution. In the future it is expected that 1000ppi images will be more widely supported throughout the end-to-end solution. To ensure appropriate future-proofing, all newly procured print set livescan and cardscan units (not handheld devices) will be expected to support capture at 1000ppi resolution even where only 500ppi is used when initially deployed, unless a specific dispensation is agreed with the Service Consumer by HOB TDA for devices that can only capture at 500ppi. In addition, all biometric matching engines procured by HOB will be expected to support use of 1000ppi resolution images even where only 500ppi images are used initially.

The current version of this document assumes that optical contact[8] fingerprint recording devices only are used by the HOB Biometric Services Consumer. The section may be updated in a future version, if necessary, to accommodate alternative capture devices, such as contactless scanners / approaches.

4.2 Image size requirements - Fingerprints

This section covers requirements specific to image size.

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[8] Some optical/TFT types of contact print set capture devices may be allowable and would be subject to the print standards set out in this document. HOB TDA must be consulted about any such device under consideration before it is incorporated into a recording solution to be used for sending print images to HOB back end systems.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-C070	Fingerprint image size - general	The HOB Biometric Service Consumer shall ensure that fingerprint images transmitted to HOB systems are compliant with the sizing guidance provided in section 5.2 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-C080	Fingerprint image size – NIST (500ppi)	The HOB Biometric Service Consumer shall ensure that fingerprint image sizes for any 500ppi images transmitted to HOB systems are compliant with the NIST/HONE-1 sizing provided in Table 1 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-C090	Fingerprint image size - NIST (1000ppi)	The HOB Biometric Service Consumer shall ensure that fingerprint image sizes for any 1000ppi images transmitted to HOB systems are compliant with the NIST/HONE-1 sizing in mm provided in Table 1 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document (but ignoring the pixel dimensions in the table, which are relevant to 500ppi images).

For new implementations using Type-14 fingerprint image records, fingerprint image sizes must conform to the NIST Specification for Type-14 fingerprint records as follows:

Description	Position	Maximum Image Dimensions (500ppi)	
		Width (mm / pixels)	Height (mm / pixels)
Unknown	0	40.6 / 800	38.1 / 750
Right thumb	1	40.6 / 800	38.1 / 750
Right index finger	2	40.6 / 800	38.1 / 750
Right middle finger	3	40.6 / 800	38.1 / 750
Right ring finger	4	40.6 / 800	38.1 / 750
Right little finger	5	40.6 / 800	38.1 / 750
Left thumb	6	40.6 / 800	38.1 / 750
Left index finger	7	40.6 / 800	38.1 / 750

Left middle finger	8	40.6 / 800	38.1 / 750
Left ring finger	9	40.6 / 800	38.1 / 750
Left little finger	10	40.6 / 800	38.1 / 750
Plain right thumb	11	25.4 / 500	50.8 / 1000
Plain left thumb	12	25.4 / 500	50.8 / 1000
Plain right four fingers	13	81.3 / 1600	76.2 / 1500
Plain left four fingers	14	81.3 / 1600	76.2 / 1500

Table 1 – Fingerprint image sizes (500ppi)

Table 1 aligns to the NIST 2007/8 standard on which HONE-1 is based. Please be aware that later versions of the NIST standard allow for greater maximum image sizes in some positions. However, HONE-1 must continue to align to the sizing requirements of its underlying NIST standard version.

Note that the table shows pixel dimensions based on 500ppi resolution. In 1000ppi capture scenarios, whilst the mm dimensions would remain true the pixel dimensions would necessarily increase.

It should be noted that the maximum sizes for fingerprint positions 1 to 10 in Table 1 assume a "rolled" fingerprint is recorded. However, a large percentage of single fingerprint images used in immigration transactions are derived from segmentation of multiple finger plain images, often known as 'slap hand' images. The size currently used for the majority of these segmented finger images is 500 x 500 pixels. This is the recommended size for segmented slap images.

Requirement Reference	Category	Detail of conditional requirement
HOB-BCR-C-C100	Fingerprint image size – rolled impressions	The HOB Biometric Service Consumer shall ensure that where rolled fingerprint images (positions 1-10) are transmitted to HOB systems that they are sized to the maximum image dimension as noted in Table 1 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-C110	Fingerprint image size – whole slap impressions	The HOB Biometric Service Consumer shall ensure that where whole hand slap and thumb slap images (positions 11-14) are transmitted to HOB systems that they are sized to the maximum image dimension as noted in Table 1 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-C120	Fingerprint image size – segmented images from slaps	The HOB Biometric Service Consumer shall ensure that where single segmented images derived from slap images are used to populate positions 1-10 that they are

		transmitted to HOB systems at a size of 500 x 500 pixels (assuming 500ppi resolution).

For older implementations using Type-4 fingerprint image records, fingerprint image sizes must conform to the NIST Specification for Type-4 fingerprint records. For the NIST 2007/8 standard on which HONE-1 is based, these sizes are the same as those covering Type-14 records in Table 1 above.

In **all cases**, the proposed fingerprint image sizes to be used must be **agreed in advance** with the HOB TDA to ensure compliance before the HOB Service Consumer that intends to transmit images to HOB systems proceed with design work. It is not permissible for HOB Service Consumers to supply images of non-standard or variable sizing that deviate from the expected and agreed sizing.

4.2.1   Additional notes related to image size

1) It is important that segmented slap images are not subjected to compression ratios beyond those stated in the requirements in section 4.1. File sizes found to be lower than expected during initial testing of a new solution should be investigated and compression levels reduced accordingly. As an example, a 500 x 500 pixel segmented finger image at 12:1 compression should produce a file size of up to around 20KB.

2) For whole hand slap images, i.e. "Plain right four fingers" and "Plain left four fingers" shown in Table 1, the expected size is 1600 x 1500 pixels. For historic reasons (related to compatibility with some legacy interfaces), many of the biometric recording solutions used by Immigration business units output slap images that are 1600 x 1000 pixels in size. This size will continue to be supported for legacy images, but it is required that new implementations will use the standard 1600 x 1500 size (as per requirement HOB-BCR-M-C110 stated in the table above) and older implementations should be upgraded over time to this size if they are not already doing so. Although technically possible to capture four slap fingers on a 1600 x 1000 pixel capture device, it requires angling of the fingers. This can be problematic for automated fingerprint matching, especially in scenarios where segmented slap images are used, and submission of slanted fingers is actively discouraged. (Note: NIST takes the same position on 1600 x 1000 capture devices and the FBI states that all friction ridge prints should be captured as closely as possible to an upright position.)

3) Note specific to Five Countries Conference (FCC / IDSC / SRTP) partners: Some transactions received from FCC partners may have originated from a NIST Type-14 record that has subsequently been converted in order to comply with current IABS processing requirements. Newer Type-14 records do not have the same image size restrictions as those conforming to the older NIST standard on which HONE-1 is based. This means that IABS provides a specific exception to the normal maximum image dimensions for these FCC transactions only. Details are contained in Appendix C of this document.

4.3 **Image format / data set requirements - Fingerprints**

This section covers requirements specific to fingerprint images format / data set for search and storage by HOB systems.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-C130	Fingerprint image data set	The HOB Biometric Service Consumer shall ensure that a full set of single and slap fingerprint images (14 images in total) are transmitted to HOB systems, via BSG. The single images (in positions 1-10) may either be recorded as rolled images or be segmented from slap images. There are two exceptions may apply: 1) Where a legacy interface has agreed an exception with HOB for only segmented single images and no slap images to be provided. (This exception is expected to be addressed when a future replacement allows.) 2) For individual transactions where one or more fingerprint images are genuinely not available from the subject being fingerprinted (e.g. due to being amputated/injured). In this case, the HONE-1 ICD requirements for stating missing finger images will be followed.

Fingerprint positions used:

The 14 finger positions described in requirement HOB-BCR-M-C120 are as follows:

Finger Position	NIST Code
Right thumb	1
Right index finger	2
Right middle finger	3
Right ring finger	4
Right little finger	5
Left thumb	6
Left index finger	7
Left middle finger	8
Left ring finger	9
Left little finger	10
Plain right thumb (slap thumb image)	11
Plain left thumb (slap thumb image)	12
Plain right four fingers (right hand slap)	13
Plain left four fingers (left hand slap)	14

Table 2 – NIST Finger Positions

4.3.1 Extra considerations for use of images segmented from slaps

A large percentage of single fingerprint images sent to HOB systems (for example related to visa applications) are derived from the segmentation of 'slap' hand (and slap thumb) images. Where this occurs, standard practice is to send both the slap and single segmented finger images to BSG.

It is normally expected that there should be consistency between the fingerprint image in a single segmented plain image and the finger image from the corresponding position in the full hand slap, within the set of images sent in a HONE-1 transaction. This is because in most cases segmented single slap images are cropped from the same full hand slap image submitted to the back end. However, it is recognised that some recording solutions may make multiple recordings of a hand slap and assess the best quality segmented images to use from these multiple recordings. In this case, it is possible the single hand slap image selected to send to the back end does not precisely match the segmented single image from the corresponding position (although it is obviously from the same subject). There is something of a trade-off between image consistency and maximising image quality potential between the two different approaches. Where segmented slap images are to be used in a new interface implementation, the Biometric Service Consumer is asked to make it clear to HOB TDA the approach their solution takes to selection of the images to use as part of implementation discussions and activities.

One impact of the slap segmentation process is the potential for friction ridge detail from an adjacent finger or thumb to be present in periphery of a segmented plain image. This extraneous friction ridge detail is undesirable for a number of reasons, including related to matcher operation. Therefore, recording solutions must ensure that it is not present in segmented slap images provided to HOB back end systems. However, a resolution to this by cropping the fingers tight and provide segmented slap images of various sizes and that deviate from the expected image size – 500 x 500 pixels – would not be ideal. Therefore, specific processing may be required to crop the finger and then pad out the image with "white space" (it is recommended to use the greyscale value of the boundary white pixels of the image to avoid the result looking artificial) to meet the required image dimension. It is important that any such processing measures do not in any way change the friction ridge detail of the fingerprint.

Segmented plain images should be centred horizontally but vertical centring must not be done on the core of the fingerprint pattern. This might lead to friction ridge detail at the lower end of the finger being missed with considerable white space above the tip. Instead vertical centring should be implemented such that the finger image starts at or close to the distal interphalangeal joint – the joint closest to the fingertip. In most cases, this will ensure that all available friction ridge detail is present in the segmented single image. In some cases, related to segmentation of thumb slaps, the segmented image might occupy a dimension greater than the allowable image size. In this case, the same principle is followed, i.e. to ensure the thumb image starts at the lowest edge in line with the distal interphalangeal joint of the thumb – the joint closest to the tip. It is permissible in this case for ridges right at the tip of the thumb to potentially be lost in favour of recording those just above the distal interphalangeal joint.

Requirement Reference	Category	Detail of conditional requirement
HOB-BCR-C-C140	Use of single plain images segmented from slaps – avoiding extraneous ridge detail	The HOB Biometric Service Consumer shall ensure that where single segmented images derived from slap images are used to populate positions 1-10 that their capture solution contains functionality to prevent friction ridge detail from an adjacent finger or thumb being

Requirement Reference	Category	Detail of mandatory requirement
		present in the periphery of any segmented plain image submitted to HOB systems.
HOB-BCR-C-C150	Use of single plain images segmented from slaps – maintaining sizing	The HOB Biometric Service Consumer shall ensure that where requirement HOB-BCR-M-C130 is met that functionality is provided to ensure consistent single segmented image sizes compliant with requirement HOB-BCR-M-C110 but without compromising the integrity of the friction ridge detail of the finger image to be submitted.
HOB-BCR-C-C160	Use of single plain images segmented from slaps – centring	The HOB Biometric Service Consumer shall ensure that where requirement HOB-BCR-M-C130 is met that functionality is provided to ensure the available friction ridge detail is centred in in the final image to be submitted, such that horizontal (side to side) centring is done on the core of the fingerprint but vertical centring (up and down) should be implemented such that the finger image starts at or close to the distal interphalangeal joint – the joint closest to the fingertip.

4.4 Image quality metric requirements - Fingerprints

HOB systems can receive and retain fingerprint image quality metrics, including non-proprietary NFIQ (NIST Fingerprint Image Quality) metrics. It is not in scope of this document to include all relevant details here and this information can be obtained by reference to the current HONE-1 ICD.

For all new implementations, it will be expected to receive the NFIQ 2.0 quality measure as the default mandatory metric provided in enrolment transmissions to HOB systems, via BSG. It may be desirable, but not in all cases mandatory, to receive other supported biometric quality metrics, where these are available. This might include the older NFIQ 1.0 quality measure as well as any proprietary quality measures used by the biometric capture solution. What is supplied as part of the transmission to BSG will be agreed between the HOB Biometric Service Consumer and the HOB TDA as part of the relevant ICD implementation annexe and approval process.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-C170	Fingerprint image quality metric – NFIQ 2.0	The HOB Biometric Service Consumer shall ensure that an NFIQ 2.0 quality metric has been provided for each of the fingerprints in position 1-10 submitted to HOB systems (unless provision of this metric has been specifically agreed as out of scope by HOB TDA or where a legacy HONE-1 interface implementation is used that did not previously require it).

HOB-BCR-M-C180	Fingerprint image quality metric – other	The HOB Biometric Service Consumer shall, as part of the ICD implementation annexe process, agree with the HOB TDA on any other biometric quality metric data that will be provided as part of the submission to HOB systems. Any such data sent must comply with the HONE-1 ICD.

4.5 Target fingerprint quality

Appendix A of this document provides detailed information related to fingerprint quality. It is noted in this section that it is critical that the 'best possible quality' image is recorded whenever fingerprints are presented to the recording equipment. It is recognised that some subjects' fingerprints (friction ridge skin) may be inherently low in available detail (poor quality). This means it is not possible to set a simple quality threshold that must be passed in all cases and for all subjects in order for the solution to be accepted (because a poor quality output may not be down to the capture equipment or process). However, it is possible to set an expectation related to target fingerprint quality where these exceptions do not apply.

Using the non-proprietary NFIQ (NIST Fingerprint Image Quality) version 1.0 metric as a guide, NFIQ 1.0 quality scores of 1, 2 or 3 for the thumbs and fingers would be considered acceptable for provision to HOB systems. (Note: Little fingers may be challenging to capture, and their size often means there is insufficient detail to achieve a high quality assessment score. They are, therefore, excluded from this target quality statement.)

Please note that NFIQ 1.0 has been replaced by NFIQ 2.0 and, therefore, the guidance in the paragraph above will be replaced in due course to reflect an appropriate NFIQ 2.0 scoring range, rather than an NFIQ 1.0 range. However, the NFIQ 1.0 is retained for now as most existing fingerprint capture solutions are still using the NFIQ 1.0 metric.

Further information on fingerprint quality considerations is provided at Appendix A.

Minimum contractual requirements for biometric quality
Further to the notes above, it is critical to record biometric images of the 'best possible quality'. In order to achieve this, following of standards and best practice may not be enough. In many cases it will be necessary for the Biometric Service Consumer to set and include some minimum contractual requirements for biometric quality in the commercial agreement with their Supplier. In order to avoid genuine reasons for poor quality described above being confused with a poor solution or operator behaviour, it may be necessary to agree a minimum biometric quality profile across a period of enrolments, rather than measuring and scoring simply on an individual enrolment basis. This approach smooths out the impact of individual enrolment scores and seeks to understand performance across a wider dataset.

Management of biometric quality is not straightforward. Given the difficulty in setting effective but also fair minimum contractual requirements for biometric quality it is recommended that the Biometric Service Consumer seeks advice from HOB TDA early on in planning their procurement process and before requirements are provided to bidders.

4.6 **Fingerprint image NIST record type used**

At the time when HONE-1 was originally implemented, the transactions it was required to support already conveyed fingerprints using the NIST type-4 record in their legacy interface formats. It was decided, largely to ease integration and transition, that the type-4 record would remain standard for HONE-1. NIST subsequently announced that the type-14 record would replace the type-4, although support for the type-4 remains in more recent versions of the NIST standard to allow for backwards compatibility for older implementations.

HONE-1 was updated in February 2019 to include type-14 record support and it is the intention to now use the type-14 record rather than the type-4 record where possible. However, support for the older type-4 record will be maintained for the foreseeable future.   If a new interaction proposing to use HONE-1 has a specific need to use the type-4 rather than type-14 record format, this should be communicated to HOB TDA as soon as possible so that appropriate decisions on implementation can be agreed.

4.7 **Fingerprint legacy formats**

4.7.1 Legacy JPEG image format

For historic reasons some biometric systems may use a JPEG format internally for storage of 500pi fingerprint image data. These 500ppi JPEG file format images are not supported within the NIST standard for new implementations and will not be permitted to be used within a HONE-1 transaction, via BSG. (Any such legacy images will need to be transformed to an allowable image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.) There is potentially an exception process to use the legacy JPEG image format within a type-14 record for specific legacy only reasons. However, use of this exception will only be possible if agreed in advance by HOB TDA and documented within the relevant HONE-1 ICD implementation annexe.

4.7.2 IDENT1 legacy TIFF image format

For historic reasons some biometric systems may use the TIFF format for internal storage of fingerprints images in certain circumstances. This image format may continue to be used and supported for internal reasons. However, the TIFF file format is not a compression format supported by NIST standards and will not be permitted to be sent within a HONE-1 transaction via BSG. (Any such legacy images will need to be transformed to an allowable image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.)

5 Palmprint Capture and Images - Standards and Compliance

The capture of palmprints is currently only relevant to law enforcement business scenarios. Immigration business scenarios do not currently require palmprint capture, search or storage on HOB systems.

5.1 General image requirements - Palms

This section covers general capture and image standards and requirements that **MUST** be adhered to for biometrics that are transmitted to HOB systems via the Biometric Services Gateway (BSG).

For the purpose of this section, "Palm refers to all areas of the palm, including "upper" and "lower" palm and "writers edge", as defined by the ANSI/NIST ITL standard, which are captured via "livescan" units or scanned from paper ink and printed sets.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-D010	Core palm image standard*	The HOB Biometric Service Consumer shall ensure that palmprints captured and submitted to HOB systems conform to fingerprint image standards of ANSI/NIST ITL 1-2007 / ANSI/NIST ITL 2-2008
HOB-BCR-M-D020	Palm capture equipment (at capture source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for recording palmprints that are transmitted to HOB systems is certified according to Appendix F of CJIS IMAGE QUALITY SPECIFICATIONS, as contained in the FBI ELECTRONIC BIOMETRIC TRANSMISSION SPECIFICATION (EBTS) IAFIS-DOC-01078-9.3, unless a specific exemption has been agreed with the HOB TDA (for specific circumstances where this certification is not relevant).
HOB-BCR-M-D030	Palm capture equipment (at capture source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for recording palmprints that are transmitted to HOB systems meet relevant sections of the *Additional HOB Fingerprint Image Standards* detailed at Appendix A of this document.
HOB-BCR-M-D040	Palm file format for 500ppi images	The HOB Biometric Service Consumer shall ensure that palm images recorded and subsequently transmitted to HOB systems at 500ppi are in the Wavelet Scalar Quantization (WSQ) format and that the WSQ

		compression algorithms comply with IAFIS-IC-0010(V3), or a later version as agreed with the HOB TDA.
HOB-BCR-M-D050	WSQ compression ratio	The HOB Biometric Service Consumer shall ensure that WSQ compression ratio is set at nominal value of 12:1.

Note: The amount of compression that can safely be applied depends on the specific image content so a strict 12:1 ratio is not enforced. It is allowable to increase to a nominal ratio of 15:1 where this is unavoidable. However, maintaining a compression ratio below 12:1 is recommended. |
| HOB-BCR-M-D060 | Fingerprint file format for 1000ppi images** | The HOB Biometric Service Consumer shall ensure that palm images recorded and subsequently transmitted to HOB systems at 1000ppi are in the JPEG 2000 lossless format (JP2L).

Images of 1000ppi resolution must not be introduced into a new or existing business process unless authorised in advance by HOB TDA. |

*This row shows the current version of the ANSI/NIST ITL standard on which HONE-1 is based. However, it is expected that this baseline version will be updated to the 2011 (2015 update) version of ANSI/NIST ITL in due course to accommodate the HOB strategic solution and to take advantage of improvements to the underlying standard.

**The majority of fingerprint / palmprint images used currently in HOB systems (outside of some used in specialist law enforcement collections) are of 500ppi resolution. In the future it is expected that 1000ppi images will be more widely supported throughout the end-to-end solution. To ensure appropriate future-proofing, all newly procured print set livescan and cardscan units (not handheld devices) will be expected to support capture at 1000ppi resolution even where only 500ppi is used when initially deployed, unless a specific dispensation is agreed with the Service Consumer by HOB TDA for devices that can only capture at 500ppi. In addition, all biometric matching engines procured by HOB will be expected to support use of 1000ppi resolution images even where only 500ppi images are used initially.

The current version of this document assumes that underlined optical contact[9] fingerprint recording devices only are used by the HOB Biometric Services Consumer. The section may be updated in a future version, if necessary, to accommodate alternative capture devices, such as contactless scanners / approaches.

5.2 Image size requirements - Palms

The scope of this HOB Biometric Conformance document only covers law enforcement transactions via the Biometric Services Gateway (BSG) using HONE-1 and not capture and

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[9] Some optical/TFT types of contact print set capture devices may be allowable and would be subject to the print standards set out in this document. HOB TDA must be consulted about any such device under consideration before it is incorporated into a recording solution to be used for sending print images to HOB back end systems.

transmission directly within the HOB law enforcement collection back end system (IDENT1). At the time of writing this version of the document, a use case where palm images are sent to IDENT1 via BSG using HONE-1 is currently being considered for the Mobile Biometric Enrolment (MBE) project. For this purpose, it is important to note that IDENT1 currently supports the following palm image sizes:

Type	DPI	Min Image Pixels	Max Image Pixels
Palm Lower	500	1200w x 1200h	2400w x 3500h
Palm Upper	500	1200w x 1200h	2400w x 3500h
Palm Writer's Edge	500	250w x 1200h	800w x 2500h

Table 3 – Existing IDENT1 palm sizes supported

It should be recognised that these legacy IDENT1 palm dimensions do not align to the maximum limit recommended in the NIST Specification for Type-15 palm records, which is as follows:

Description	Position	Image Dimensions (500ppi)	
		Width (mm / pixels)	Height (mm / pixels)
Unknown Palm	20	139.7 / 2750	203.2 / 4000
Right Full Palm	21	139.7 / 2750	203.2 / 4000
Right Writer's Palm	22	44.5 / 900	127.0 / 2500
Left Full Palm	23	139.7 / 2750	203.2 / 4000
Left Writer's Palm	24	44.5 / 900	127.0 / 2500
Right Lower Palm	25	139.7 / 2750	203.2 / 4000
Right Upper Palm	26	139.7 / 2750	203.2 / 4000
Left Lower Palm	27	139.7 / 2750	203.2 / 4000
Left Upper Palm	28	139.7 / 2750	203.2 / 4000
Right Interdigital	31	139.7 / 2750	203.2 / 4000
Right Thenar	32	76.2 / 1500	114.3 / 2250
Right Hypothenar	33	76.2 / 1500	114.3 / 2250
Left Interdigital	34	139.7 / 2750	203.2 / 4000
Left Thenar	35	76.2 / 1500	114.3 / 2250
Left Hypothenar	36	76.2 / 1500	114.3 / 2250

Table 4 – NIST palm sizes

Note: Table 4 aligns to the NIST 2007/8 standard on which HONE-1 is based. Please be aware that later versions of the NIST standard allow for greater maximum sizes in some positions. However, HONE-1 must continue to align to the sizing of its underlying standard.

Changes may be made in the future to bring IDENT1 size ranges in line with the NIST specification.

In **all cases**, the proposed palm image sizes to be used must be **agreed in advance** with the HOB TDA before the Biometric Service Consumer that intends to transmit palm images to HOB systems, via BSG, proceeds with design work. It is not permissible for HOB Biometric Services Consumers to supply images of non-standard or variable sizing that deviate from the expected and agreed sizing.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-D070	Palm image size - general	The HOB Biometric Service Consumer shall ensure that palmprint images transmitted to HOB systems are compliant with the sizing guidance provided in section 6.2 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-D080	Palm image size – NIST (500ppi)	The HOB Biometric Service Consumer shall ensure that palmprint image sizes for any 500ppi images transmitted to HOB systems are compliant with the NIST/HONE-1 sizing provided in Table 3 of the *Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)* document.
HOB-BCR-M-D090	Palm image size - NIST (1000ppi)	The HOB Biometric Service Consumer shall ensure that palmprint image sizes for any 1000ppi images transmitted to HOB systems are agreed with HOB TDA before they are transmitted to HOB systems.

5.3 **Palmprint legacy formats**

5.3.1 *Legacy JPEG image format*

For historic reasons some biometric systems may use a JPEG format internally for storage of 500pi palmprint image data. These 500ppi JPEG file format images are not supported within the NIST standard for new implementations and will not be permitted to be used within a HONE-1 transaction, via BSG. (Any such legacy images will need to be transformed to an allowable image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.)

5.3.2 *IDENT1 legacy TIFF image format*

For historic reasons some biometric systems may use the TIFF format for internal storage of palmprints images in certain circumstances. This image format may continue to be used and supported for internal reasons. However, the TIFF file format is not a compression format supported by NIST standards and will not be permitted to be sent within a HONE-1 transaction via BSG. (Any such legacy images will need to be transformed to an allowable

image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.)

6 Face Capture and Images – Posed / Controlled Facial Images Standards and Compliance

This chapter sets out standards and requirements for facial images that are from a posed / controlled environment and transmitted to HOB systems for all immigration use cases and transactions for law enforcement transactions submitted via the Biometric Services Gateway (BSG). Face images that do not meet the required standards are expected to be rejected by HOB systems. Note that there are some different standards for handheld / portable (search only and/or verification scenarios), which are detailed in Appendix D. They are also different standards for unposed / uncontrolled facial images, which are covered in the following section. In addition, Appendix B contains additional guidance related to face image standards and face capture devices.

A number of important factors and intended business use by face images drives the importance of the requirements and standards provided in the sections below, including:
- Ensuring the provided face image can be successfully searched and added to the HO facial recognition matching platform (and matched in future searches)
- Providing face images of a suitable resolution and quality to allow human comparison of the face image where required
- Ensuring the provided face image can be used in subsequent ongoing business processes, such as biometric document/products (where relevant)

Facial images are used to support a variety of use cases and may be used to identify that person for the next decade or support criminal investigations. Poor quality capture processes and equipment result in a variety of issues for the individual and the business. These can manifest in a number of ways, such as the inability to reliably use eGates or facilitating identity crime.

Note: Face images are not currently provided to HOB back-end systems as part of any law enforcement enrolment or search request (although these requests can receive face images in responses to some searches made of the immigration database). However, as this process changes the following requirements and standards will need to be met for these law enforcement transactions.

6.1 General Image requirements - Face

The following table provides general requirements relevant to all facial image types a posed / controlled environment and transmitted to HOB systems, via the Biometric Services Gateway (BSG):

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-E001	Colour images	The HOB Biometric Service Consumer shall ensure that all facial images included in HONE-1 submissions are colour images. Greyscale images are not permitted. The captured face image shall be a true-colour representation, and the capture solution set in order to achieve high fidelity skin tones for all skin types.

		The sensor of the camera shall capture the entire visible wavelength, i.e. the wavelength between 400 nm and 700 nm (ICAO Annex C).
HOB-BCR-M-E002	Colour depth and colour space	The HOB Biometric Service Consumer shall ensure compliance with the HONE-1 ICD Type-10 record description for compliance with colour depth and colour space specifications.
HOB-BCR-M-E003	Lens distortion	The HOB Biometric Service Consumer shall ensure their front-end capture solution avoid lens barrel distortion, through correct lens placement and distance to subject in the setup of the capture environment. The HOB Biometric Service Consumer shall ensure that distortion shall not be perceptible to the human eye. It is recommended that radial distortion is less than 2.5%. The maximum magnification distortion rate shall not be greater than 5% and ideally should not be greater than 4%. (ICAO Annex B)
HOB-BCR-M-E004	Depth of field	The HOB Biometric Service Consumer shall ensure that the focus and depth of field of the camera used in their capture solution shall be set so that the subject's captured facial image is in focus from nose to ears. Note: In most cases, a depth of field of 15 cm will be sufficient (ICAO Annex E)
HOB-BCR-M-E005	Face image integrity – face position	The HOB Biometric Service Consumer shall ensure that face image processing in their solution meets strictly with the items allowed and forbidden in the three points below: 1) Whilst it is expected that subjects are straight on to the camera with head straight, recording solutions are **allowed** to use post-processing to correct for "roll" pose angle using eye location if this functionality is built into their design. This is because rotation based on eye level does not change the original image beyond simply correcting its rotation. The solution may also use this approach to straighten and appropriately crop a final image from the initial auto-capture image. 2) Use of post-processing software techniques to correct for "pitch" or "yaw" pose angle issues is **forbidden**. This type of post-processing manipulates the original image to try and recreate what the face

		would look like if it was straight on to the camera, which is against image integrity requirements of the original image and not allowed. 3) Any other facial morphing or related image manipulation techniques that change the original captured image are **forbidden**. For the avoidance of doubt, these statements refer to the source biometric recording solution and any other subsequent element of the HOB Biometric Service Consumer solution, prior to sending the biometric image to HOB systems, via BSG.
HOB-BCR-M-E006	Face image integrity – ICAO/ISO corrections	The HOB Biometric Service Consumer shall ensure that there is **no** face image processing in their solution that attempts to address non-compliance with required ISO/ICAO standards by manipulation of the captured image. For example, changing closed eyes to open eyes, correcting an open mouth, etc. This type of post-processing manipulation of the original image is strictly forbidden. For the avoidance of doubt, this statement refers to the source biometric recording solution and any other subsequent element of the HOB Biometric Service Consumer solution, prior to sending the biometric image to HOB systems, via BSG.
HOB-BCR-M-E007	Face mirroring	The HOB Biometric Service Consumer shall ensure that if their solution shows a mirror image to the subject as part of the capture process that the saved face image provided to HOB systems is the correctly orientated true likeness of the face and not a mirror image.

6.2 Image requirements – Full Frontal Face JPEG

In HONE-1 use cases/transactions requiring a face image, it is a Full Frontal Face Image Type in JPEG format that is the default. The following table provides requirements for Full Frontal Face Image Type JPEG images that are from a posed / controlled environment and transmitted to HOB systems, via the Biometric Services Gateway (BSG):

Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-E010	Facial image standards	The Biometric Service Consumer shall ensure "posed / controlled" face image recordings meet ISO19794-5 standards (Full Frontal face image types). Note: When implementing this ISO/IEC standard in practice it is important that the key original intent of the ICAO standard on which it is based – to introduce standardisation, improve capture quality and facial recognition performance and reduce interoperability issues – is met, but in a way that still enables live operations to be maintained (see Appendix B for further details). The nature and operation of quality assessment measures (automated and manual) to verify that face images meet this ISO 19794-5 standard and the setup of the operational capture environment are critical to ensure that face images of appropriate quality are delivered to HOB systems. How these elements are addressed in the Biometric Service Consumer solution, particularly taking into account management across different locations, as well as the potential need for pragmatic adjustment of QA tool thresholds, will require assessment and agreement by HOB TDA before the Biometric Service Consumer transmits images to HOB systems.
HOB-BCR-M-E020	Facial image file format (JPEG)	The Biometric Service Consumer shall ensure that facial images recorded and subsequently transmitted to HOB systems are in the Joint Photographic Experts Group (JPEG) format. The Biometric Service Consumer is requested to discuss and agree with the HOB TDA the quality settings and image file sizes to be used in images transmitted to HOB systems.
HOB-BCR-M-E030	Pixels between the eyes	For solutions implemented from January 2022 onwards: The HOB Biometric Service Consumer shall ensure that the minimum number of pixels between the eyes is 240 pixels. For solutions implemented prior to January 2022: The HOB Biometric Service Consumer shall ensure that the minimum number of pixels between the eyes is 120 pixels. Ideally, the Biometric Service Consumer solution will produce a minimum allowable number of 240 pixels between the eyes, where a larger sized image than the minimum allowable is used.

Biometric Conformance Requirements for HOB Biometric Service Consumers (HOB-S001)

HOB-BCR-M-E050	Image size*	For solutions implemented from January 2022 onwards: The HOB Biometric Service Consumer shall ensure an image size of 1600 (h) x 1280 (w) pixels. For solutions implemented prior to January 2022: The Biometric Service Consumer must agree with HOB TDA the image size to use for existing implementations, with the intent to migrate to the new image size requirement when a suitable opportunity arises. (
HOB-BCR-M-E060	Compression level and output file size**	The HOB Biometric Service Consumer shall ensure that the level of compression ("JPEG quality") is set at a level to produce an efficient file size but where no image degradation or compression artefacts are noticeable (compared to the uncompressed original image). For solutions implemented from January 2022 onwards, with an image size of 1600 (h) x 1280 (w) pixels, the target range for output file size is 200KB to 600KB. The minimum allowable file size is 130KB. The maximum allowable file size is 1500KB. For solutions implemented prior to January 2022, the Biometric Service Consumer must agree with HOB TDA the compression value and target output file size to use for existing implementations.
HOB-BCR-M-E070	Resolution - general	The HOB Biometric Service Consumer shall ensure that all provided Full Frontal face type images have the quality (sufficient fidelity, focus and depth of field, level of detail, etc.) to support both large scale automated identification and verification by manual comparison processes.
HOB-BCR-M-E080	Resolution – face details disclosure	For solutions implemented from January 2022 onwards, the HOB Biometric Service Consumer shall ensure that the camera used in their face capture solution is capable of accurately rendering fine contrasted facial details (such as wrinkles and moles) as small as 1 mm in diameter on the face. Note: Spatial resolution is a measure of the smallest discernible detail in an image. The methods generally involve photographing a standard target and analysing

		the resulting images to compute a value. Test pattern: ISO 12233:2014. (ICAO Annex D)

* An image size of 525 (h) x 420 (w) pixels was historically used as the default size for face images provided to HOB systems as this matched the standard used originally for UK passport face images size. However, the image size and resolution for the Full Frontal Face Image Type has been increased in HOB biometric conformance requirements in order to better suit modern biometric matching algorithms and also provide better definition in images for manual comparison by human specialists and for other business purposes for which face images are now used. IABS release 18, planned for January 2022, will include changes that remove some historic pixel size and file size constraints from IABS and enable the new sizing in requirement HOB-BCR-M-E050 above to be enabled.

It is recognised that some future Law Enforcement use cases may benefit from the ability to provide face images of larger size than outlined in requirement HOB-BCR-M-E050E050. Where this is the case, options for larger image sizing must be discussed and agreed with HOB TDA <u>before</u> any new implementation sends face images to HOB systems.

** It has been observed that some older implementations use a higher level of compression on face images than necessary. Using a lower compression ratio/level (i.e. setting "JPEG quality" higher) will result in better quality face images being supplied. From January 2022 onwards, when the new sizing in requirement HOB-BCR-M-E050 comes into place for new implementations, requirement HOB-BCR-M-E060 sets out target output file size in order to ensure that the compression level used does not introduce image degradation / compression artefacts but also limits the file size from the potential maximums if only minimal compression is used. . Note: In previous versions of this documentation, it was stated that a compression ratio of no more than 15:1 across the region of the face for JPEG images was allowable. The wording in requirement HOB-BCR-M-E060 has been updated to provide a more straightforward statement for the majority of HOB Biometric Service Consumers to conform to.

In **all cases**, the proposed face image sizes to be used must be **agreed in advance** with the HOB TDA <u>before </u>the Biometric Service Consumer that intends to transmit images to HOB systems proceed with any design work.

6.3 Image requirements – Token Face JPEG2000

There may be particular business circumstances where, in addition to the standard JPEG face image, there is a need to also supply a Token Face Image Type in JPEG2000 format that will be subsequently be passed on to a separate system to be used in the production of a biometric identity document / product. Where a JPEG2000 image is included it must be provided in addition to the JPEG face image and not instead of it. Where JPEG2000 images are provided, the following requirements apply:

Requirement Reference	Category	Detail of conditional requirement
HOB-BCR-M-E100	Facial image standards	The HOB Service Consumer shall ensure face image recordings meet ISO19794-5 standards, specifically for the Token Face Image type.

HOB-BCR-M-E105	Facial image format (JPEG2000)	JPEG2000 Token images must meet the Joint Photographic Experts Group 2000 (JPEG2000) format if included as part of a HONE-1 ICD implementation and transmitted to HOB systems.
HOB-BCR-M-E110	Image size*	The HOB Biometric Service Consumer shall ensure that the aspect ratio of the image meets the requirements for Token face images as specified in ISO 19794-5. The HOB Biometric Service Consumer shall ensure that the Token face image meets the following image size: 480 (h) x 360 (w) pixels The HOB Service Consumer must agree with HOB TDA any variation to this image size intended for a new or existing HONE-1 implementation.
HOB-BCR-M-E120	Compression Ratio/Level**	The HOB Biometric Service Consumer shall use a suitable compression in order to produce the best image quality possible but ensure that the JPEG2000 file size does not exceed the allowable maximum of 20KB.

* In practice an image size of 480 (h) x 360 (w) pixels has historically been used for token images within immigration use cases, and provided to HOB systems. A key factor in selection of this image size has been to ensure the token image and resulting file size is compatible with the biometric identity product process for which the token image is used.

** A greater compression ratio/level is possible for JPEG2000 images over standard JPEG ones, as the JPEG2000 format can tolerate greater levels of compression without the introduction of undesirable image artefacts / image quality degradation, than is true of the JPEG format. The level of compression used must enable the best quality face image possible to be produced within the maximum 20KB file size permissible.

In terms of creation of the JPEG2000 token image, attention is drawn to requirement HOB-BCR-M-B020 in section 3.1. The JPEG2000 token image must be produced from the original face image capture in uncompressed format (or held in memory). It is **not** allowable for the JPEG2000 token image to be produced from a saved JPEG Full Frontal image in the Biometric Service Consumer's solution.

6.4 Scanned face images

In the vast majority of use cases it is expected that face images will be captured live via a suitable photographic device. However, there are some business scenarios where a face image could be scanned from a paper photograph, such as would be submitted for a postal passport application. The face image in the paper photograph in such a scenario must meet the General Image Requirements and Full Frontal Face Image requirements set out in the previous sections. In addition, the scanning resolution used for digital capture of the paper photograph from a suitable dedicated scanning device must be 300ppi.

7 Face Capture and Images – Unposed / Uncontrolled Facial Images Standards and Compliance

7.1 Image requirements

The following table provides details of mandatory standards and requirements for facial images that are from an unposed / uncontrolled environment (such as from CCTV) and are transmitted to HOB systems via the Biometric Services Gateway (BSG).

Whilst it is not currently in scope for these unposed / uncontrolled facial images to be searched using HOB face matching capabilities they may be stored for intelligence and investigative purposes and manually reviewed.

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-F010	Facial image file format	The HOB Biometric Service Consumer shall ensure, for the purposes of transmission of unposed / uncontrolled facial images for the purpose of storage on HOB systems, that facial images recorded and subsequently transmitted to HOB systems are in one of the following file formats: • JPEG • BMP (would be classified as uncompressed in HONE-1) • PNG (*See note below regarding TIFF format)
HOB-BCR-M-F030	Image size and compression metrics	The HOB Biometric Service Consumer must agree with HOB TDA the image size the quality settings (including compression ratios where these are relevant to the file format) to use for biometric images transmitted to HOB systems, via BSG.

*The HONE-1 standard does not support transmission of TIFF format images within a type-10 record, due to a constraint on allowable file formats in the underlying NIST standard on which HONE-1 is based. If HONE-1 is used for transmission of unposed / uncontrolled facial images that are from an original TIFF source, then a file format conversion from TIFF to an allowable format would be required to comply with the standard for the type-10 record.

In **all cases**, the proposed face image sizes to be used must be **agreed in advance** with the HOB TDA before the HOB Biometric Services Consumer that intends to transmit images to HOB systems proceed with any design work.

8 Latent Mark Images – Standards and Compliance

8.1 Image requirements - general

The following table provides details of mandatory standards and requirements for latent mark (finger and palm) images that are transmitted to HOB systems via the Biometric Services Gateway (BSG).

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-G010	Core fingerprint image standard*	The HOB Biometric Service Consumer shall ensure that latent marks submitted to HOB systems conform to latent image standards of ANSI/NIST ITL 1-2007 / ANSI/NIST ITL 2-2008.
HOB-BCR-M-G020	Latent mark capture equipment (source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for scanning / capturing latent marks that are transmitted to HOB systems is certified according to Appendix F of CJIS IMAGE QUALITY SPECIFICATIONS, as contained in the FBI ELECTRONIC BIOMETRIC TRANSMISSION SPECIFICATION (EBTS) IAFIS-DOC-01078-9.3, unless a specific exemption has been agreed with the HOB TDA (for specific circumstances where this certification is not relevant or where legacy capture solutions are allowed to continue).
HOB-BCR-M-G030	Fingerprint file format for 500ppi images	The HOB Biometric Service Consumer shall ensure that latent mark images recorded and subsequently transmitted to HOB systems at 500ppi are in the Wavelet Scalar Quantization (WSQ) format and that the WSQ compression algorithms comply with IAFIS-IC-0010(V3), or a later version as agreed with the HOB TDA.
HOB-BCR-M-G040	WSQ compression ratio	The HOB Biometric Service Consumer shall ensure that the WSQ compression ratio is set at nominal value of 12:1. Note: The amount of compression that can safely be applied depends on the specific image content so a strict 12:1 ratio is not enforced. It is allowable to increase to a nominal ratio of 15:1 where this is unavoidable. However, maintaining a compression ratio below 12:1 is recommended.

| HOB-BCR-M-G050 | Fingerprint file format for 1000ppi images** | The HOB Biometric Service Consumer shall ensure that latent mark images recorded and subsequently transmitted to HOB systems at 1000ppi are in the JPEG 2000 lossless format (JP2L).

Images of 1000ppi resolution must not be introduced into a new or existing business process unless authorised in advance by HOB TDA. |

*This row shows the current version of the ANSI/NIST ITL standard on which HONE-1 is based. However, it is expected that this baseline version will be updated to the 2011 (2015 update) version of ANSI/NIST ITL in due course to accommodate the HOB strategic solution, especially to natively support the need for the NIST Extended Feature Set (see further details below).

**Latent mark images used currently in HOB systems are of 500ppi or 1000ppi resolution. 1000ppi latent images will be supported throughout the HOB strategic end-to-end solution. To ensure appropriate future-proofing, all latent marking scanning devices will be expected to support capture at 1000ppi resolution even where only 500ppi is used when initially deployed, unless a specific dispensation is agreed with the Service Consumer by HOB TDA for devices that can only capture at 500ppi. In addition, all biometric matching engines will be expected to support use of 1000ppi resolution images even where only 500ppi images are used initially.

Note: The maximum latent image file size allowable for passing into IDENT1 is 70Mb.

8.2 Image requirements – latent mark image size

The following table provides details of mandatory image sizing requirements for latent mark (finger and palm) images that are transmitted to HOB systems via the Biometric Services Gateway (BSG).

Requirement Reference	Category	Detail of requirement
HOB-BCR-M-G060	Latent mark image size	The Biometric Service Consumer shall ensure that latent mark image sizes to be used for any images transmitted to HOB systems are agreed in advance with HOB TDA as appropriate and must not exceed the HOB systems maximum size limit.

Latent mark image sizes to be used for any interaction using HONE-1 will be agreed as part of development of the relevant HONE-1 implementation annexe.

In **all cases**, the proposed latent image sizes to be used must be **agreed in advance** with the HOB TDA before the HOB Service Consumer that intends to transmit images to IDENT1 proceed with design work.

8.3 Latent mark templates

An important aspect of latent mark processing for HOB systems is the requirement for manual feature encoding, or "expert mark up", in a non-proprietary format. In order to provide suitable interoperability and compatibility with currently used older standards, HONE-1 supports the ANSI-INCITS 378 standard for feature encoding where required to do so. HOB's preferred non-proprietary format going forward will be the NIST Extended Feature Set (EFS) standard. Whilst this is used for internal processing for some HOB systems it is not currently supported in the HONE-1 standard to be used natively by HOB Biometric Service Consumers. This will be addressed at a future update to the HONE-1 standard. (The exact fields from the EFS block to be used in the future will be agreed and documented within the relevant implementation annexe.)

In addition, in some circumstances use of a proprietary format latent mark template may be allowable in addition to provision of non-proprietary format data, where this has been agreed by HOB TDA for specific integration / interoperability reasons. In this case, HONE-1 uses a NIST type-99 record for wrapping the proprietary template.

Requirement Reference	Category	Detail of requirement
HOB-BCR-C-G070	Latent mark templates	The Biometric Service Consumer shall ensure, where latent mark templates are to be transmitted to HOB systems, that the format(s) are agreed in advance with HOB TDA as appropriate.

8.4 Latent Mark search accuracy and scanner information considerations

This section provides important information regarding the use and configuration of scanner equipment and how images captured on this equipment could impact accuracy when subsequently passed to HOB back end biometric systems for search.

Two requirements that directly affect the ability to search a mark in HOB back-end systems are resolution and geometric accuracy (a measure of the pixel-pixel and row-row accuracy). Since minutiae are measured in relation to each other, inaccuracies in distances between minutiae will result in lower search accuracy. Search accuracy depends on the pixel to pixel distances being the same across the image and the same as the reference images in the HOB back-end system collection.

Scanner Resolution – scanners available today typically have a hardware resolution of from 1200-4800 pixels per inch. This is usually called the native resolution of the scanner. When an image resolution of something other than the native resolution is requested, the scanner uses a very simple algorithm to deliver an image with the specified resolution. For example, if a 500ppi image is requested, the scanner scans at 4800ppi, then it drops 5 pixels of every 6 to get to an 800ppi image and then drops 3 of every 8 pixels to deliver the 500ppi image. This results in geometric inaccuracies as well as a loss of information in the image. A mitigation

for this type of scenario, when a native image resolution is greater than 500ppi, is to ensure that the image is re-sampled to 500ppi using an algorithm that retains the geometric accuracy and as much of the information as possible. Given this is unlikely to be available in the scanner itself this functionality must be provided in the software application to which the scanner is attached.

Greyscale Response – scanners are usually advertised as 24, 36, or 48 bits per pixel. Since they are colour-capable, this means that the scanner outputs 8, 12, or 16 bits per pixel per channel (Red, Green and Blue), respectively. 8 bits is equivalent to 256 shades; 12 to 4096, and 16 to 65536. For greyscale, the Green output is usually used. In less expensive scanners, the response may not actually be a true 8, 12 or 16 bits. Rather, the scanner hardware may be capable of measuring 200 shades of a primary colour and the other 56 shades are not captured. However, when an image is sent from the scanner, the full 8 bits are sent. The 56 shades that weren't captured essentially become an avenue for noise to be added to the image. This type of issue must be avoided in provision of scanning equipment for provision of biometric samples to HOB systems. It is important to use the greyscale response of the scanner to the greatest extent possible, utilising images with 256 shades of grey. The 256 shades of grey should cover the region of interest in the lift. If a lift is aluminium powder, then the scanner software should be set to select appropriate shades of grey from the greyscale spectrum.

8.5 Latent mark legacy formats

8.5.1 Legacy JPEG image format

For historic reasons some biometric systems may use a JPEG format internally for storage of 500pi latent mark image data. These 500ppi JPEG file format images are not supported within the NIST standard for new implementations and will **not** be permitted to be used within a HONE-1 transaction, via BSG. (Any such legacy images will need to be transformed to an allowable image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.)

8.5.2 IDENT1 legacy TIFF image format

For historic reasons some biometric systems may use the TIFF format for internal storage of latent mark images in certain circumstances. This image format may continue to be used and supported for internal reasons. However, the TIFF file format is not a compression format supported by NIST standards and will **not** be permitted to be sent within a HONE-1 transaction via BSG. (Any such legacy images will need to be transformed to an allowable image format as necessary to comply with the HONE-1 standard where they are transmitted over HONE-1.)

9 Signature Images – Standards and Compliance

9.1 Image requirements - general

The following section provides details of standards and requirements for signature images that are transmitted to HOB systems. (Note: Signature images are not currently provided as part of any law enforcement enrolment or search request via BSG.)

9.2 Signature images format

There may be particular business circumstances where there is a need to supply a signature image in JPEG format. Only a simple image is provided, so this is not to be confused with a behavioural signature biometric that records vector information, for example.

Requirement Reference	Category	Detail of requirement
HOB-BCR-M-H010	Signature image format (JPEG)	The Biometric Service Consumer shall ensure that signature images recorded and subsequently transmitted to HOB systems are in the Joint Photographic Experts Group (JPEG) format.
HOB-BCR-M-H020	Signature image resolution	The Biometric Service Consumer shall ensure a minimum of 96ppi resolution for signature image capture. Note: The recommended resolution is 300ppi.
HOB-BCR-M-H030	Image size	The Biometric Service Consumer shall ensure that the image size and image compression settings and file sizes to be used in images transmitted to HOB systems are agreed in advance with HOB TDA.

Note that the Maximum image size supported by IABS is 400 (h) x 1200 (w) pixels.

In **all cases**, the proposed signature image sizes to be used must be **agreed in advance** with the HOB TDA before the Biometric Service Consumer that intends to transmit images to IABS proceed with design work. It is not permissible for Biometric Service Consumer to supply images of non-standard or variable sizing that deviate from the expected and agreed sizing.

10 Identity Document Image

Some enrolment transactions have historically had an option to include scanned images from identity documents, such as a copy of the passport biodata page. These optional identity documents are not allowed to be sent to HOB systems without being alongside standard biometric images (e.g. fingerprints and face) provided in the transaction. The images are stored for future viewing by business users alongside the biometric record. They are not used for any searching purposes.

Whilst this chapter is included simply for reference, if optional document images are supplied then the stated standards below must be followed.

10.1 Identity document image requirements

The following table provides details of standards and requirements for identity document images that are transmitted to HOB systems as part of a biometric enrolment transaction via the Biometric Services Gateway (BSG).

Requirement Reference	Category	Detail of mandatory requirement
HOB-BCR-M-J010	Core image standard	The HOB Biometric Service Consumer shall ensure that document images submitted to HOB systems conform to image standards of ANSI/NIST ITL 1-2007 / ANSI/NIST ITL 2-2008
HOB-BCR-M-J020	Document image capture equipment (source location)	The HOB Biometric Service Consumer shall ensure that equipment supplied for scanning / capturing identity document images for transmission to HOB systems is suitable for accurate capture of the image to the required resolution.
HOB-BCR-M-J030	Document image type	The Biometric Service Consumer shall ensure that document images recorded and subsequently transmitted to HOB systems are in the Joint Photographic Experts Group (JPEG) format.
HOB-BCR-M-J040	Document image resolution	The Biometric Service Consumer shall ensure a minimum of 96ppi resolution for signature image capture. Note: The recommended resolution is 300ppi.
HOB-BCR-M-J050	Image size	The Biometric Service Consumer shall ensure the general document image size constraint of 443 (h) x 624 (w) pixels is observed. Context: There are some image size constraints related to viewing document images that are

		imposed by the operation of the bureau user interface. Hence this image size constraint requirement.

In **all cases**, the proposed document image sizes to be used must be **agreed in advance** with the HOB TDA <u>before </u>the HOB Biometric Services Consumer that intends to transmit images to IABS proceed with design work.

11 Biographic Data

This section covers information on biographic data to accompany biometric images that are transmitted to HOB systems for all immigration transactions or via the Biometric Services Gateway (BSG) for law enforcement transactions.

11.1 General principles

11.1.1 Reason for biographic data on HOB systems

Whilst IABS and IDENT1 are strategic biometric storage and matching solutions of the Home Office, they **are not** strategic biographic data stores. IABS and IDENT1 are **not** intended to contain all the data present in a case working system or to be the 'ground truth' source for this data. There are various practical and legacy reasons why some biographic is required to be supplied in transactions to IABS and IDENT1. The agreement of which items are to be mandatory, which are conditional, and which are optional will be made between the HOB Biometric Services Consumer and the HOB TDA as part of the HONE-1 ICD development process of the specific implementation.

11.1.2 No "biographic only" enrolments permitted to HOB systems

Enrolment requests must not be sent to HOB systems in HONE-1 via BSG containing biographics only. A fundamental principle for each transaction received via HONE-1 that will lead to an enrolment on IABS is that it will contain biometrics and biographics. Normally this would include a full set of fingerprint images and a face image. However, as stated previously in this document, there are exceptions made on an individual transaction basis where a full set of biometrics genuinely cannot be obtained from the subject being recorded. It should be noted that any such exception event must contain a minimum of at least one biometric sample. This minimum requirement may either be a face image or a single finger image. (Note that some individual interface instances/technical specifications in the HONE-1 ICD may require more than this minimum for some transactions. In addition, the future "biometric reuse" process for visas will provide a specific exception where a request can be provided by UKVI systems for a search using previous biometrics enrolled on IABS.)

11.2 Biographic data required

As stated above, the agreement of which biographic data items are to be mandatory, which are conditional, and which are optional will be made between the HOB Biometric Services Consumer and the HOB TDA as part of the ICD approval process. Examples of the type of biographic data likely to be required / allowable can be found by reference to the current HONE-1 ICD document set "Extended Mapping" spreadsheets (which shows mandatory, conditional and optional biographic data items for the various transactions that HONE-1 supports).

Requirement Reference	Category	Detail of requirement
HOB-BCR-M-K010	Biographic data	The HOB Biometric Services Consumer shall agree with the HOB TDA on the biographic data that will be provided as part of the submission to

		HOB systems. Any such data sent must comply with the agreed HONE-1 ICD implementation.

11.2.1 Biographic data used in search requests

Note that biographic data may sometimes be used in a search request to help reduce the scope of the search being undertaken (sometimes known as reducing the "penetration rate"). This approach can be particularly beneficial to improve face matching accuracy when a large face gallery is being searched into, especially if the age of the subject being searched is young or to avoid adult face images from being searched against those from juveniles, etc.

It is outside the scope of this document to explore these biographic filtering options in detail and in general this type of approach is not currently supported for requests received via the HONE-1 ICD and will not be relevant to most HOB Biometric Services Consumers. Where the option is made available, it is recommended that any such use of biographic data for "binning" or "post search filtering" is discussed with HOB TDA to ensure that the impact of doing so is understood by the HOB Biometric Services Consumer, the requirements of the ICD are complied with and that matching accuracy is not inadvertently reduced by filtering out correctly matching responses from the response returned by the HOB matcher.

12 Appendix A - Additional HOB Fingerprint Image Standards and Fingerprint Capture Quality

As per the mandatory requirements set out in section 4 of this document, HOB Biometric Service Consumers are required to ensure that equipment supplied for recording fingerprints that are transmitted to HOB systems is certified according to Appendix F of CJIS IMAGE QUALITY SPECIFICATIONS, as contained in the FBI ELECTRONIC BIOMETRIC TRANSMISSION SPECIFICATION (EBTS), unless a specific exemption has been agreed with the HOB TDA (for specific circumstances where this certification is not relevant).

Historically, fingerprint capture requirements for HOB systems have relied on the provision of equipment conforming to "Appendix F" certification as an assurance that fingerprint images to the required standard would be delivered to back end biometric systems (even though the certification process has been adapted and was originally designed for paper fingerprint scanning hardware and not for testing optical scanners). However, some cases have been noted in the last few years where potentially undesirable image artefacts/anomalies have been observed from scanner models that have passed Appendix F certification. Therefore, in order to provide an additional level of assurance to the quality of fingerprint images provided to HOB systems, these *Additional HOB Fingerprint Image Standards* are documented here, which the HOB Biometric Services Consumer must confirm are met for any solution they provide that will be used to record fingerprints to be sent to HOB systems.

The *Additional HOB Fingerprint Image Standards* are intended to complement (and not replace) the existing "Appendix F" certification requirement. In particular, they are used to ensure that the following statement from section 2.6 of the existing "Appendix F" documentation is adequately met for UK purposes:

> *Requirement – Fingerprint Artefacts and Anomalies:*
>
> *Artefacts or anomalies detected on the fingerprint images that are due to the scanner or image processing shall not significantly adversely impact support to the functions of conclusive fingerprint comparisons (identification or non-identification decision), fingerprint classification, automatic feature detection, or overall Automated Fingerprint Identification System (AFIS) search reliability.*

In addition, there are significant aspects to the fingerprint recording solution (software) and configuration of fingerprint quality thresholds that will impact the quality of fingerprint images provided to HOB systems and that require a level of confirmation as having been addressed in the solution provided by the HOB Biometric Services Consumer. These aspects are also covered in this Appendix.

(Note: If in the future FBI revises the fingerprint hardware certification process in order to take into account a wider range of factors than is covered by existing Appendix F certification, HOB may be able to reduce the scope of these *Additional HOB Fingerprint Image Standards.*)

Prior to enabling an interface with HOB systems, the HOB Biometric Services Consumer must confirm that their fingerprint capture solution (recording application software and associated fingerprint capture hardware/scanner) have successfully passed testing and assurance processes to confirm that the *Additional HOB Fingerprint Image Standards* are met.   This assurance may come from undertaking the "HOB Biometric Conformance Process for Service Consumers" (see section 1.5).

Note that the *Additional HOB Fingerprint Image Standards* will equally apply to new implementations and cases where fingerprint recording solutions are proposed to be updated in an existing implementation.

From time to time, HOB TDA may undertake a review of fingerprint images provided to HOB systems by the solution of the HOB Biometric Services Consumer to ensure that they are of the quality required and do not exhibit undesirable image artefacts. Inconsistencies found are likely to lead to a request for the HOB Biometric Services Consumer to conduct further testing and take steps to resolve the issues found.

12.1 Key aspects covered by the Additional HOB Fingerprint Image Standards:

These key aspects are related to ensuring that there are no undesirable artefacts or inaccuracy in reproduction of the fingerprint friction ridge detail by the HOB Biometric Services Consumer solution. The following <u>must not</u> be present in the resulting fingerprint images submitted to HOB systems:

A1) **Ghost images**: Residual images or artefacts visible in the background of the captured fingerprint or outside the area of the captured finger but present in the captured image. Generally caused by a scanner detecting latent friction ridge detail on the platen from the existing or a previous subject. May sometimes be referred to a "dirty platen".

A2) **Halo effect**: A grey or black area around the outside of the finger image(s), can appear like a horseshoe over the tip of a finger or a black/grey area between fingers. This is often considered to be caused where the temperature difference between the platen and fingers results in condensation. (Note: The operational temperature range that the unit is specified to operate at will be provided to HOB by the HOB Biometric Services Consumer, along with details of any measures provided by the unit to deal with misting and condensation, such as a heated platen facility.)

A3) **Unnatural / wavy ridge flow**: Friction ridge or ridges that exhibit curvatures similar to waves. Can involve a large area of the print and normally found towards the upper part of the image.

A4) **Ridge stretching or blurring**: Unclear friction ridge detail apparent due to stretching and appearing out of focus. These features are normally witnessed at the top of the image or at either outer edge.

A5) **Ridge Misalignment / Superimposition and Spurious Minutia**: Various distortions can affect the proper, accurate continuous agreement of ridge characteristics in sequence. For example, a scanned fingerprint displays areas where the friction ridge path is abruptly stopped and then restarted with an offset in the ridge path. Or a fingerprint image displays duplicated and/or overlapped friction ridges with minutiae that are not present in an inked impression of the same finger. These effects can be observed particularly for rolled impressions when the 'stitching' process of multiple image captures being made by the scanner is not operating accurately. As such, they are most relevant only where the HOB Biometric Services Consumer solution must deliver rolled fingerprint images.

A6) **Pixilation**: Where the friction ridges appear 'blocky' and square edges are visible along the outside of the ridge rather than a 'smooth' curve.

A7) **Feathering**: This effect is similar to what might be observed if the ridges were wet lines and a dry brush was passed over them. This feature can also occasionally be found on inked impressions but is a problem where exaggerated in images from fingerprint scanners to the extent that comparisons would be impacted (particular in latent mark scenarios).

A8) **Grey Shading**: A light grey shadow is observed behind the main fingerprint image itself.

12.2 The Importance of Capturing the 'Best Possible Quality' Fingerprint Images

The ability to accurately match fingerprints automatically is significantly impacted by the quality of the biometric sample provided. In addition, biometric quality impacts the ability of fingerprint examiners to make manual comparisons if these are required. It is critical, therefore, to ensure the best possible fingerprint capture quality from front end equipment (and the associated recording application) that is deployed in the field and will provide biometrics to the HOB back end systems.

Fingerprint capture quality is a function of:

- The optical / electronic capabilities of the capture equipment, its ease of use/usability* and the feedback provided during the capture process;
- The skill of the operator and/or the level of co-operation/experience of the person presenting their fingerprints;
- The inherent (physical) quality of the fingerprints presented by the subject.

* "usability" of the whole fingerprint recording set-up is important, including for example the height and positioning of platen (and the potential to adjust the height for ease of access etc.)

It is critical that the 'best possible quality' image is recorded whenever fingerprints are presented to the recording equipment. The term 'best possible quality' is used here because even if perfect processes and equipment were available the fingerprints (friction ridge skin) of a particular subject may be inherently low in available detail (poor quality). For example, manual workers may have 'poor quality' fingerprints due to the definition of the friction ridge skin being worn down as a result of the occupation of the individual. Therefore, it is not possible to set a simple quality threshold that must be passed in all cases and for all subjects in order for the solution to be accepted. Instead, the fingerprint capture solution should provide all possible measures to achieve the highest quality captured image and do nothing to further denigrate the quality of images from subjects with inherently low friction ridge detail.

The importance of ensuring appropriate requirements for any front-end biometric recording solution that will generate biometric images to be subsequently transmitted to IABS or IDENT1 – particular with respect of ensuring 'best possible' capture quality - cannot be stressed highly enough.

12.3 Key aspects related to Fingerprint Quality:

These key aspects are related to abilities of the HOB Biometric Services Consumer solution to ensure optimal quality fingerprint images are provided. The following areas must be accommodated in the solution for recording fingerprint images that are submitted to HOB systems:

B1) **Image cropping/segmentation and centring**: Images should be centred correctly within the fingerprint image boxes that will go into the separate NIST Type-14 (or potentiallyType-4) records. If any of the four sides of the fingerprint image are abruptly cut in a straight line this would be considered as inappropriate centring (unless due to a particularly wide rolled impression that exceeds the allowable image width limit). In scenarios where instead of rolled impressions being taken the main ten finger images have been segmented from a slap (plain) capture process, the resulting segmented slap single finger images must not contain ridge detail from the adjacent image (see additional requirements in section 4.3.1 of this document).

B2) **Amount of "3rd Level Detail" provided in the image**: According to an internationally recognised scale there are three levels of details that can be graded in a fingerprint image. It must be possible to view the lowest level of detail (3rd Level Detail) in images produced by the HOB Biometric Services Consumer solution and submitted to HOB systems.   This finer level of detail of the friction ridge skin includes visibility of pores located on the ridges and details on the edges of each ridge. Note: HOB systems currently require that 500ppi fingerprint images are provided from scanners used for fingerprint capture. It is accepted that there are constraints on the 3rd Level Detail that can be revealed through 500ppi resolution fingerprint scanners and images (as opposed to 1000ppi for example) and that, at 500ppi resolution, it may not be possible for this detail to be fully revealed in all subjects (particularly those will smaller fingers and/or worn friction ridge skin).

B3) **Good contrast**: Clear contrast is evident when the friction ridges appear dark and the furrows (spaces between the ridges) are much lighter or white. The higher the clarity, the easier it is for an Automated Fingerprint Identification System and human fingerprint examiner to differentiate ridges and the details within them.

B4) **Capabilities to help overcome dry or moist skin conditions**: Excessively dry or moist friction ridge skin can lead to poor fingerprint capture quality. Some fingerprint recording solutions provide measures to help overcome these issues (without the need for moisturising the hands of the subject, for example). These measures might include special membranes on the scanner platen, software or hardware adaptations. It is important that any physical measures provided are sustainable (i.e. a membrane can last the rigour of live operations) and maintain a true image (i.e. image processing is not used that would alter the integrity of the friction ridge detail). Note: As there are some conflicting advantages and disadvantages to the use of membranes in practice, the HOB Biometric Services Consumer should not use these in their solution without discussion and agreement from HOB TDA.

B5) **Capabilities to help overcome / detection of slippage during rolled capture**: (Note: This aspect is only relevant where the HOB Biometric Services Consumer solution is required to submit rolled fingerprint images.) Capabilities to detect and report to the operator potential instances of slippage during rolled fingerprint capture are very important to the quality of rolled finger images. In addition, some solutions provide measures to help prevent finger slippage on the platen as the finger is rolled. As mentioned in the section above, these measures might include special membranes on the scanner platen. It is important that any such measures provided are sustainable (i.e. a membrane can last the rigour of live operations) and do not detract from the quality of the capture image, i.e. image capture would not be improved if the membrane was removed. In addition, where a membrane or similar physical aid is available as an optional product that can be retro fitted or removed the device should be assessed discretely (with and without the accessory) by the HOB Biometric Services Consumer against image quality criteria. Note: As there are some conflicting advantages and disadvantages to the use of membranes in practice, the HOB Biometric Services Consumer should not use these in their solution without discussion and agreement from HOB TDA.

B6) **Calibration**: For some recording devices the design of the unit means the geometric accuracy cannot change and therefore there is a one-off calibration by the manufacturer with no further calibration in the field required. For many devices, a regular calibration process is necessary and provides the best operational performance in the given environment, especially where the ambient lighting is important for the unit to detect and calibrate to. The HOB Biometric Services Consumer must follow the guidance from the device manufacturer as to the calibration process and how frequently this needs to occur.

B7) **Setting and maintenance of fingerprint quality thresholds:** The "appropriate" setting of thresholds for the fingerprint quality assessment tool provided in the HOB Biometric Services Consumer solution will require assessment by and agreement with HOB TDA before the HOB Biometric Services Consumer transmit images to HOB systems. "Appropriate" in this context is intended to imply that there is not a simple, default quality pass bar that can be universally implemented (for example, little fingers quality thresholds will be set differently to thumbs). In addition, the setting of the threshold will need to balance obtaining the best possible quality with operator usability.   Note that there may be operational circumstances where a lower setting of the quality threshold is appropriate, and this will be taken into account in the HOB TDA assessment and agreement.

In addition to agreement of the initial setting, it will **not** be permitted for this configuration to be subsequently amended without further assessment by and agreement with HOB TDA. The technical processes and procedures in place to ensure this requirement is met will need to be provided by the HOB Biometric Services Consumer.

12.4 Additional Guidance Related to Fingerprint Quality:

The points below do not form part of the formal *Additional HOB Fingerprint Image Standards.* However, they are provided here to provide additional guidance to the HOB Biometric Services Consumer when considering requirements and operation of their front-end fingerprint capture solution.

Ability to deal with amputated fingers: Where a subject has one or more amputated fingers it is important that the fingerprint recording solution can deal with this scenario. This includes providing the capability for an operator to mark, prior to capture starting, that the subject has missing finger(s). The fact that fingers are missing will be important to auto capture and quality assessment workflow of the solution. One particular area that the solution needs to deal with is where the subject has lost the tip of a finger (distal phalanges) but the rest of the digit (mid and proximal phalanges) remain. In this case the solution should not record friction ridge skin from the remains of an amputated digit as being from a full finger as it will lead to the presentation of an error for having "too many fingers" where the operator had previously marked the fact that a finger was missing. Note: For rolled capture processing, the ability to conduct sequence checking against the slap (plain) images captured initially captured is expected to be standard functionality. The rolled capture sequence would need to take into account amputated fingers.

Provision of rapid quality assessment and timely feedback to operator: For the slap capture process of a right or left hand, solutions often conduct rapid fingerprint ridge detail quality assessments and capture the set of four fingers when all pass the appropriate quality threshold available. Alternatively, several full hand slaps may be captured, assessed for quality and then the best complete set retained. Regardless of the process, where quality failures occur from a full hand slap, quality assessment information provided back to the operator via the user interface of the solution should be clear enough to guide the operator to correct the problem and quickly retry. In particular, an indication must be given as to which finger(s) has failed the quality threshold and why.

Usability related to the platen: It is important that the design of the platen and its surrounding areas does not hamper the ability of the subject to place their fingers (or palm) comfortably and for a good image to be captured across the full area of interest. For example, usability issues might arise from a raised lip/bezel if such a design exists around the platen. In particular, it must be possible to record a good image for subjects with large fingers (or hands).

Integration between fingerprint hardware and capture application: It is important that the integration between the fingerprint scanner and the recording application ensures that the location of the subject's fingers on the scanner platen are in the optimum position for capture of the best available quality fingerprints. In particular, the onscreen display should not be configured in such a way that it requires the subject to move their fingers towards the top of the platen into an undesirable position, i.e. that reduces the quality of the captured finger images, in order to "fit the fingers in the box" (where the boundary box is not configured to be in the right place).

Capture environment: Fingerprint capture solutions can be affected by the operational environment that they work in. (For example, strong lighting directly above a platen may impact the calibration/function of an optical reader, high humidity environments may experience more issues with moist fingers, etc.) The HOB Biometric Services Consumer will need to take into account the operational environment where the solution is to be deployed and assess and resolve impacts from environmental conditions.

13 Appendix B – Additional Face Image Quality and Capture Device guidance (for posed /controlled capture environments)

13.1 The importance of applying ISO/IEC 19794-5 appropriately

ISO/IEC 19794-5 provides a face image format for face recognition applications requiring exchange of face image data, including applications where human examination of facial images takes place and those relevant to computer automated face biometric verification / identification.

For HOB systems, an alternative interface standard is used for the biometric data exchange format, but the scene constraints, photographic properties and digital image attributes of ISO/IEC 19794-5 are used in relation to face capture and quality standards for HOB systems.

When it comes to providing capabilities for face recording solutions to measure captured face quality against the ISO/IEC 19794-5 standard, some of the individual elements of the standard are simple for a software tool to measure, for example the size of the captured image in pixels. Others are relatively straightforward for an appropriate software tool to assess, for example the greyscale density of the image or the roll of the head calculated from finding the eye points. However, some elements are quite subjective and more difficult to measure automatically, for example the pitch (pointing down or up) orientation of the face. As a result of this, for an automated assessment tool to provide a strict assessment across all the different measures in the standard with 100% accuracy is not possible. Some level of human intervention will be required where this type of assessment is run.

The nature of the ISO/IEC 19794-5 face image standard and some of the elements that it covers provides a challenge for automated assessment by (even the best) industry software tools. If the thresholds in these tools are set inappropriately then a high level of quality assessment "false rejections" will occur, leading to undesirable operational impacts. This includes the unintended consequence, if thresholds are set too high, that operators come to regard overriding as the norm, which will reduce the care and attention they take over capturing a highly compliant facial image. Conversely, setting thresholds too low will lead to images being accepted that are not appropriately compliant to the ISO/IEC standard. The implementation of the standard should be used to improve the face capture process and environment and eliminate instances of extremely poor quality face image submissions which may have previously escaped rejection.

When implementing ISO/IEC standard in practice it is important that the key original intent of the standard – to introduce standardisation, improve capture quality and facial recognition performance and reduce interoperability issues – is met, but in a way that still enables live operations to be maintained. There may be some flexibility allowed for in the interpretation of the standard by HOB TDA for those measures that are known to be less important for automated facial recognition purposes, in order to maintain a workable and supportable rejection rate in practice. In addition, the customer base of organisations sending face images to HOB systems is diverse and it is important that the thresholds set for operation of the automated assessment tool take into account this diversity so as to avoid situations where a particular ISO/IEC measure delivers false rejection readings, particularly for one segment of the population. The appropriate setting of thresholds for the face quality assessment tool provided in the demonstration unit (and subsequently implemented in a full solution) will require assessment by and agreement with HOB TDA before the HOB Biometric

Services Consumer transmit images to HOB systems. In addition, it will not be permitted for this configuration to be subsequently amended without assessment by and agreement with HOB TDA.

13.2 Face image background requirements

The use of "18% grey[10]" as a background for controlled face image capture in Home Office systems has been the de facto position for many years. This approach stems from historic ICAO/ISO requirements, although the current version of the standard has been relaxed in terms of the range of acceptable backgrounds and no longer specifically references 18% grey (although it does include grey, which would encompass 18% grey).

The previous version of the ISO (ICAO) standard (19794-5 2005 version) stated (in the Informative Annexe on best practices):

A.2.4.4 Background examples

A typical background to enhance machine-assisted face recognition performance is 18% grey with a plain smooth surface. Plain light-coloured backgrounds such as light blue are also acceptable. A white background is acceptable provided there is sufficient distinction between the face/hair area and the background.

Going back to the original ICAO 9303 standard (2003) from which the newer ISO standard derived, the statement was much narrower as follows:

5.1.3.4 Gray Background Preferred

The preferred background to enhance machine-assisted face recognition performance is 18% gray with a plain smooth surface.

So, it is possible to see why, historically, 18% grey was the background chosen for UK government face capture scenarios, even though the current ISO 19794-5 standard is now more flexible. Whilst the current standard no longer stipulates 18% grey as the only recommended choice of background shade, this remains as HOB's preference to be used in practice where possible. It is important that the shade selected for the background in any implementation adequately caters for the range of subjects that are relevant to Home Office processing. For example, whilst a white background is now supported within the scope of the current ISO (ICAO) standard it must also be demonstrated by any Supplier proposing to use it to be an appropriate choice in a working solution to meet the needs of the range of subjects requiring enrolment services. There must not be adverse impacts on exposure of the face image that might not occur with a different choice of background shade.

Where it is proposed by a Supplier to use a lit background in their solution (i.e. a large, white light panel behind the subject), this will require specific testing to ensure that face images are of the correct quality and that the background lighting does not overwhelm the main lighting on the face of the subject or otherwise cause exposure or related issues. Any solution where a lit background is proposed must be capable of being set to a fixed lumen output that has been agreed in testing as optimal. A solution where users can manually change the level of lighting output and potentially set it (accidentally or deliberately) to a level not previously agreed would not be acceptable.

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[10] In photography, middle grey is a tone that is perceptually about halfway between black and white on a lightness scale; it is typically defined as 18% reflectance in visible light. This tone of grey is often used to provide a standard reference object, or grey card, for exposure determination.

13.3 Face capture device guidance

13.3.1 Acceptable types of face capture device

Historically, in order to meet requirements for face capture and provide facial images of appropriate quality, it has been necessary to integrate into the biometric capture solution a dedicated camera – compact camera or SLR – controlled via USB through SDK functionality.

In the past, "webcam" type technology was not capable of producing face images at the resolution and quality required to meet ICAO/ISO standards and be suitable for Home Office purposes, including for automated facial recognition and manual (human) comparison activities. This meant that this type of device was not allowed to be used in biometric capture solutions producing face images to be sent to HOB systems. However, in recent years there has been significant advances in the imaging capabilities of the high-end versions of these devices. At the same time, the use cases in the wider world for traditional cameras controlled via SDK has diminished and, as such, it is becoming more difficult to source such devices. Typically, it is now only higher-end SLR units from one or two manufactures that are available to be procured. Despite the quality of the facial images they can produce, the bulk and cost of these devices also has implications. This is particularly true for use cases where a portable solution is required.

All of this means that high-end webcam type of devices will now be considered as part of the HOB biometric conformance process, alongside more traditional SLR camera units. By high-end, this would imply devices capable of high resolution capture, e.g. 4K. The key point is that the camera device must be capable of meeting all of the requirements and standards set out in sections 3.13 and 6 of this document. It is required that the selected camera device is disclosed to HOB TDA as early as possible as part of the onboarding and biometric conformance process in order to agree suitability or resolve any issues.

13.3.1 Live capture and associated quality assessment

Following on from section 13.3.1 above, due to the traditional approach to provision of face capture devices it was normally the case that a single "still" face image was captured and that this was subsequently reviewed against ICAO/ISO and related image quality metrics within the biometric capture application. The assessment was then presented to the operator in order to determine whether to recapture the face or not. With high-end webcam type devices, it would more normal for a live video stream to be used and from this stream a single frame identified and used for the captured face image. Historically the use of this kind of live video stream would not have been permitted due to the quality compromises compared to traditional still face capture. However, with high resolution video streaming (e.g. 4K), it is now possible to select face images of very high quality as a frame from the stream. In addition, it is possible for the capture solution to automatically conduct a quality review of the "live" stream in order to identify and use a facial image from this video stream that meets the required ICAO/ISO face quality standards.

It is required that the intended method for face quality assessment, aligned to the selected camera device, is disclosed to HOB TDA as early as possible as part of the onboarding and biometric conformance process in order to agree suitability or resolve any issues.

14 Appendix C - Fingerprint Image Size and Position allowance for Five Countries Conference (FCC / IDSC / SRTP) partner transactions only)

IABS provides a specific exception to the normal maximum image dimensions for FCC transactions only.

For FCC (IDSC / SRTP) transactions only, IABS supports image sizes up to the maximum limit as follows:

Description	Position	Max Image Dimensions	
		Width (mm / pixels)	Height (mm / pixels)
Unknown	0	40.6 / 800	38.1 / 750
Right thumb	1	40.6 / 800	**50.8 / 1000**
Right index finger	2	40.6 / 800	38.1 / 750
Right middle finger	3	40.6 / 800	38.1 / 750
Right ring finger	4	40.6 / 800	38.1 / 750
Right little finger	5	40.6 / 800	38.1 / 750
Left thumb	6	40.6 / 800	**50.8/ 1000**
Left index finger	7	40.6 / 800	38.1 / 750
Left middle finger	8	40.6 / 800	38.1 / 750
Left ring finger	9	40.6 / 800	38.1 / 750
Left little finger	10	40.6 / 800	38.1 / 750
Plain right thumb	11	**26.0/ 512**	50.8 / 1000
Plain left thumb	12	**26.0/ 512**	50.8 / 1000
Plain right four fingers	13	81.3 / 1600	76.2 / 1500
Plain left four fingers	14	81.3 / 1600	76.2 / 1500

Table 5 – FCC image sizes

Variations from the standard IABS maximum image dimensions are shown in red text in Table 5 above.

Note that IABS does not support finger position 15. Any transactions originally provided by an FCC partner using position 15 would need to be transformed before submitting to IABS in order to split the position 15 image into position 11 and 12 images.

15 Appendix D - Handheld / Portable Biometric Capture Solutions

Scope of this Appendix: This Appendix covers Handheld and Portable equipment in "search only" and/or "verification" (1-to-one) use case scenarios only. Portable devices (depending on their configuration) can potentially also be used for enrolment use cases, i.e. "search and store". However, when enrolment use cases are being followed for portable devices, they will be required to meet the requirements and standards set out in the main body of this document, rather than just this Appendix.

15.1 Fingerprint Capture Standards / Requirements related to handheld / portable solutions

Important Definition: For the purpose of this Appendix, the following defined terms are used to help separate different "mobile ID" equipment types:

- Handheld: meaning a biometric capture device that is capable of being held in a single hand to operate and is normally used in the field (e.g. outside in a street or at a premises raid). The capture device might either be a single bespoke unit, or a smart device connected to a fingerprint reader in a cradle or similar docked arrangement;

- Portable: meaning a biometric capture solution that is placed on a surface to operate (not held in a hand) and intended to be used in a temporary location. This type of solution would have a larger fingerprint reader, capable of capturing up to four fingers at a time, that is tethered to a smart device (e.g. smartphone or tablet) hosting the capture software. It could also cover a larger laptop and four-finger platen capture device in a suitcase type of arrangement.

Since the term "mobile" can mean different things to different people, these two defined terms are used instead in this Appendix in order to avoid misunderstandings.

Reference standards:
Standards required and guidance related to handheld / portable fingerprint capture solutions used for "search only" and/or "verification" (1-to-one) use cases is provided in this Appendix. The Appendix is distinct from some of the standards in the main body of this document, the latter of which is intended to cover solutions capable of biometric recording to meet enrolment requirements). If enrolment use cases are being followed for portable devices, they will be required to meet the requirements and standards set out in the main body of this document.

As stated at the beginning of this document, the current version of HONE-1 is based on ANSI/NIST-ITL 2-2008. In the 2011 update of the ANSI/NIST-ITL standard, a number of extra items were included that were related to version 1 of the NIST document "Mobile ID Best Practice Recommendation (BPR)", which was released in 2009. Until the base standard version for HONE-1 is uplifted, it does not contain many of these useful additions related to handheld/portable fingerprint capture. Therefore, a number of the standards used within the latest version of the NIST BPR document are incorporated into this Appendix to provide details of the biometric image standards that must be adhered to by HOB Biometric Services Consumers when fingerprints are recorded on a handheld / portable fingerprint capture solution for search only and/or verification purposes. (Although closely tied to the ANSI/NIST-ITL standard in content, the BPR is a separate document and may be used independently of the standard. It has been referenced in many Government procurement

acquisitions and has provided information helpful to companies developing handheld/portable ID solutions.)

The current version of the referenced document, which is NIST Special Publication 500-280v2, is called, "Mobile ID Device Best Practice Recommendation Version 2.0"

It needs to be understood that NIST BPR v2.0 covers a wide range of use cases / scenarios and is not limited to handheld / portable fingerprint capture devices. In particular, the standards and guidance within this NIST document include enrolment scenarios with non-fixed recording equipment. Since this Appendix specifically does not cover use cases for handheld / portable equipment being used for enrolment (search and store), it is important to note that the reference to enrolment scenarios within the NIST BPR documentation is not relevant to the scope of this Appendix. In addition, references in the NIST BPR documentation to latent capture scenarios, palm or plantar capture scenarios, iris capture scenarios, and voice capture scenarios is not relevant to the scope of this Appendix. The NIST BPR documentation references capture of rolled fingerprint images. However, it is not expected that rolled fingerprints would be captured for search only and/or verification use cases.

The Risk profiles and table on page 54 of NIST BPR v2.0 do not follow UK practices in terms of the recommended capture biometric modality options shown. This table should, therefore, be disregarded in terms of relevance to this Appendix.

The Face standards in the NIST BPR document will not be used and are not relevant to this Appendix (see section on "Additional Face Capture Guidance" below for further information).

Fingerprint Acquisition Profile (FAP): NIST has defined a set of characteristics for the handheld / portable (mobile) ID device and its use, that is defined by 'level.' This allows a device manufacturer, and also a customer, to state what combination of features is available/required in a particular device.

The table below provides a subset of the FAP levels that are considered relevant to this Appendix. The rows are copied from NIST BPR v2.0 (table on page 19). An additional row has been inserted to provide a quick reference on platen pixel size (alongside the original size in inches from the NIST table).

Capture detail	FAP 30	FAP 40	FAP 45	FAP 50	FAP 60
Acquire Flat / Plain Images	Yes	Yes	Yes	Yes	Yes
Acquire Rolled Images	No	Optional	Optional	Optional	Optional
Minimum Grey Levels	256	256	256	256	256
Acceptable Image Resolution (pixels)	500 +/- 2%	500 +/- 2%	500 +/- 1%	500 +/- 1%	500 +/- 1%
Minimum Image Dimension (W x H) inches	0.8"x 1.0"	1.6"x1.5"	1.6"x1.5"	3.2"x2.0"	3.2"x3.0"
Minimum Image Dimension (W x H) pixels (based on 500ppi)	400 x 500 pixels	800 x 750 pixels	800 x 750 pixels	1600 x 1000 pixels	1600 x 1500 pixels
Maximum Compression Ratio	10:1	15:1	15:1	15:1	15:1

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Compression Algorithm	WSQ 2.0+	WSQ 2.0+	WSQ 2.0+	WSQ 3.1+[11]	WSQ 3.1+[12]
Simultaneous number of Fingers	1	1-2	1-2, maybe 1-4[13]	1-4[14]	1-4
FBI Sensor Certification	PIV*	PIV*	Appendix F	Appendix F	Appendix F

Table 6 – NIST FAP levels

* The PIV sensor certification information is included in this table as it appears in the original NIST BPR table quoted above. However, it should be noted that PIV is a lower-level standard designed for one-to-one verification. For one-to-many applications, Appendix F would generally be considered more relevant although not mandated for mobile devices that will communicate with HOB back end systems.

The HOB TDA view is that the minimum pixel size required for effective matching, especially given the scale of HOB-governed fingerprint databases, would be 400x500 pixels, which equates to the FAP 30 level. For this reason, FAP 10 and FAP 20 from the original NIST BPR v2.0 are not included as allowable profiles for communication with HOB systems as part of this Appendix (with the exception of specific dispensations, see note below for further details). There is a statement on page 16 (section 7.1.1.1) of NIST BPR v2.0, which says: "*It should be noted that the very small platens associated with FAP 10 might not capture a sufficient area of the fingerprint for certain applications, resulting in a high False Non-Match Rate when compared to a large database. It is strongly recommended that single-finger units be a minimum level of FAP level 30 for mobile applications.*" This position taken by NIST was arrived at by consensus as the opinion, following observation and practical experience, of the group of persons/organisations responsible for drafting and reviewing the NIST best practices document. It is in agreement with and supports the HOB TDA view.

Note on specific dispensations: There will be some specific exemptions to this ruling of FAP 30 as a minimum allowable profile that will be addressed on a case-by-case basis and agreed with HOB TDA as dispensations. For example, some legacy handheld biometric capture units already in use in the field that comply with a lower FAP rating than FAP 30 will be permitted to continue to be used for a limited period until the point that they are replaced by a new handheld biometric capture solution. In addition, it is possible that there could be a project with specific requirements for a limited size device where a search is required into a limited target fingerprint dataset only and not against the entire national collection of fingerprints. In these circumstances a dispensation may be agreed if it is desirable for the business to use a unit that is not capable of meeting FAP 30.

FAP 60 details have been included in the table above, in case relevant to a portable solution. A portable device used for search only or verification use case could certainly use a FAP 60 sensor. However, it would not be expected that a FAP 60 compliant sensor would be used as part of a handheld device. (Note: FAP60 sensors would be expected to be used for full enrolment scenarios but these scenarios are not in scope for this Appendix and are instead relevant to the main body of this document).

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[11] Larger platens require WSQ 3.1 or higher.

[12] Larger platens require WSQ 3.1 or higher.

[13] Up to 4 fingers may be allowed where the proposed unit is capable of taking two images and stitching them into one output image. 2 fingers fit without stitching on one image for this size platen.

[14] NIST states the following, "Although technically possible to capture four slap fingers on a FAP 50 device, it requires angling of the fingers, which may be problematic for certain systems. Some application profiles actively discourage slanted fingers. The FBI states that all friction ridge prints should be captured as closely as possible to an upright position."

The use of FAP 40 specification devices may provide some advantage over FAP 30 devices in allowing the simultaneous capture of two fingers. In particular, this capability speeds up the capture process and has some advantage in helping guarantee the finger sequence.

The decision on which of the FAP level devices from the table above to specify for each project is expected to be made jointly between the project and HOB, taking into account the business and technical requirements and the biometric matching performance required.

Environmental Profile: NIST BPR v2.0 provides a set of specifications related to a particular type of environmental conditions in which the handheld / portable (mobile) ID device will be used. These profiles (described in Section 16 of the document) are:
- Indoor
- Outdoor – Heavy Use (Law enforcement-like)
- Outdoor – Rugged Use (Military-like)

For the purposes of this Appendix, the "Outdoor – heavy use" is the closet match to the most likely business scenario for which handheld devices will be required. Portable devices may fall into the same category but morel likely the "Indoor" category, depending on the use case.

The "Law Enforcement Profile Recommendations" for "Outdoor – heavy use" (from page 60 of NIST BPR v2.0) are as follows:

Operating temperatures	From 14°F to 122°F (-10°C to 50°C)
Storage temperatures	From -4°F to 140° F (-20°C to 60°C)
Relative humidity	10% - 90% non-condensing
Ingress Protection Rating (IP Code)	IP 54 or higher, in operational configuration, with any existing expansion port closed
Drop resistance	Resistance to multiple drops on concrete from a height of 3 feet (91 cm).

Important Notes:

1) There are a number of other standards produced by international standards bodies which may cover some aspects of handheld/portable biometric recording, such as *CEN/TS 16921_2016* for example.   However, the coverage and detail provided by *NIST BPR v2.0* has been agreed by HOB TDA and CAST as sufficient reference for the purposes of this document. (Note: Since biometric standards evolve over time, this position will be reviewed in the future and standards references updated as necessary.)

2) The decision on the specific handheld / portable capture devices to be obtained by a particular project will be agreed in advance of purchase by the project with HOB. In particular, where a non-optical capture technology is proposed to be used, this selection decision must be shown to have taken into account the business and technical requirements and the biometric matching performance required on back end HOB systems. (Note: Other aspects will also be relevant to this decision, such as security accreditation aspects, but these are out of scope of this document.)

3) The use of contactless fingerprint capture technology is not currently within the scope of this Appendix or the document in general. If required in the future, relevant standards and sections for this type of technology will be added in an updated version of this document.

15.2 Face Capture Standards / Guidance (handheld solutions)

Whilst the key reason currently for a handheld biometric recording device will be to capture fingerprints, there are use cases when capture of face image may be useful. Historically,

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capture of such face images have been held locally on the device only (not submitted for search) and have been used to assist officers to match returning results to the right candidate when a group of subjects was captured at the same time.

With the expansion of availability of facial databases, it is understandable that there may be a growing business requirement to consider capture and search of face images from handheld devices. However, one of the challenges for this scenario operationally is the lack of control of the capture environment (lighting, background, pose angle, etc.) and the impact that this has on the captured image. In particular, it will likely be impossible to meet ISO19794-5 standards for the Full Frontal Face Image type in operational usage and this will affect the potential matching accuracy (against a large database). So, expectations will need to be appropriately set between matching accuracy of face images captured from this type of scenario and those related to accuracy testing using perfect standards compliant images.

It is not intended (at this stage) to use the Subject Acquisition Profiles (SAP) and related requirements from the NIST BPR v2.0 document, to govern this additional face image capture. Instead, where the business process requires capture of a face image the HOB Biometric Services Consumer will be required to ensure face image recordings from handheld capture devices meet the mandatory requirements on face capture stated in chapter 6 of this document. The intent of this requirement is to ensure that a device is *capable* of capturing face images that meet relevant ISO standards (in ideal conditions) even though the operational reality is that this will be challenging to achieve in practice. This operational reality is taken into account in the following requirement variances from the mandatary requirements of chapter 6 for facial images that are captured **on handheld devices** and may be transmitted to HOB systems.

Requirement reference	Category	Detail of variation requirement
HOB-BCR-M-N010	Facial image standards – handheld variation of requirement HOB-BCR-M-E010	The HOB Biometric Services Consumer shall ensure that their handheld solution is capable of capturing face images that meet ISO19794-5 standards for the Full Frontal Face Image type where a suitable environment is provided to make this possible (e.g. correct lighting, uniform background, etc.). In operational situations where a controlled environment is not possible then allowances will be made due to lack of control of the environment (especially in terms of lighting, background, pose angle, etc.) but the solution of the HOB Biometric Services Consumer must encourage the operator to capture face images that meet ISO19794-5 standards for the Full Frontal Face Image type to the closest extent possible*.
HOB-BCR-M-N020	Facial image standards – handheld	The HOB Biometric Services Consumer shall ensure that their handheld solution meets all other requirements of chapter 6 of this document for face images.

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*Note: In meeting the objective of assisting the operator to capture a face image that meets the ISO standards to the largest extent possible, the following measures should be considered in the solution:

- Feedback on the device/display to the operator indicating whether they are getting closer or farther away from a compliant image as the image capture conditions change (e.g. lighting, pose, background);
- On screen support to help centre the face image;
- Feedback on the device/display to show particular features of the captured image which are considerably far from ISO compliance (e.g. a non-neutral facial expression).

In all cases, the proposed face image sizes to be used must be agreed in advance with the HOB TDA before the HOB Biometric Services Consumer that intends to transmit images to HOB systems proceed with any design work.

16 Appendix E - Concerning HOB back-end strategic biometric matching solution image size constraints

This Appendix is relevant to HOB TDA but should be ignored by HOB Biometric Service Consumers.

The main sections of this document cover biometric image size requirements for biometrics sent to IABS or IDENT1 via the BSG, using HONE-1. HOB is introducing a strategic matching subsystem to replace matching subsystems of the existing IDENT1 and IABS solutions. The introduction of the strategic matching solution will be transparent to end consumers of HONE-1 interfaces. However, this Appendix is included for reference by HOB TDA in order to document the baseline biometric image constraints of the HOB strategic matching solution. Since there are multiple biometric matching engine (algorithm) providers used within the strategic matching platform, this baseline position has been arrived at from the lowest common denominator. The baseline has been negotiated with the biometric matching engine supplier that had the most restrictive image size handling capabilities to ensure that back end matching allowances were at least as or more tolerant of any constraints applied at the front end, so that the back-end matcher did not become a driver for front end constraints in image size. The baseline has also taken into account the NIST 2015 standard, which in many cases allows larger image sizes than the 2007/8 NIST standard, to ensure compatibility when HONE-1 eventually updated to use this version of NIST as the underlying standard. Having a single baseline like this is important in order to ensure that Central subsystems do not have to be "matching engine software / algorithm" aware, and to promote a loosely coupled solution.

Note that the number of pixels, in the below tables, assumes resolution of 19.68 pixels per mm (500ppi). The Strategic Matcher also supports higher resolution images of 39.37 pixels per mm (1000ppi). For the higher resolution 1000ppi images the maximum and minimum number of pixels allowable can be doubled.

16.1 Fingerprint image sizes - Matcher standard

Description	Position	Image Dimensions (500ppi)			
		Min Width (mm / pixels)	Max Width (mm / pixels)	Min Height (mm / pixels)	Max Height (mm / pixels)
Right thumb	1	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Right index finger	2	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Right middle finger	3	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Right ring finger	4	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Right little finger	5	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768

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Left thumb	6	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Left index finger	7	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Left middle finger	8	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Left ring finger	9	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Left little finger	10	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768
Plain right thumb	11	6.5 / 128	25.4 / 500	6.5 / 128	76.2 / 1500
Plain left thumb	12	6.5 / 128	25.4 / 500	6.5 / 128	76.2 / 1500
Plain right four fingers	13	6.5 / 128	81.3 / 1600	6.5 / 128	76.2 / 1500
Plain left four fingers	14	6.5 / 128	81.3 / 1600	6.5 / 128	76.2 / 1500

Table 7 – Finger image sizes – Matcher standard

Note: The individual fingerprint size constraints, described in the above table, allows for slightly larger images than the ANSI/NIST-ITL 1-2011 Update:2015 standard adopted by the Matcher subsystem. Technically, the Matcher can process the slightly larger images. Therefore, the above described size constraints have been adopted, rather than the slightly smaller NIST standard maximum width of 40.6 / 800 and maximum height of 38.1 / 750. It is intended that the small uplift in size between the NIST standard and the Matcher supported sizing will avoid what would otherwise require additional image manipulation by at least one of the Central subsystems. However, it should be noted that HOB will continue to enforce the smaller NIST standard sizing when delivering and assuring front-end capture subsystems.

16.2 Latent fingermark image size - Matcher standard

		Image Dimensions (500ppi)			
Description	Position	Min Width (mm / pixels)	Max Width (mm / pixels)	Min Height (mm / pixels)	Max Height (mm / pixels)
Latent Finger Mark	0-10	6.5 / 128	42.3 / 832	6.5 / 128	39.0 / 768

Table 8 – Latent fingermark image size – Matcher standard

16.3 Palm print image sizes - Matcher standard

Description	Position	Min Width (mm / pixels)	Max Width (mm / pixels)	Min Height (mm / pixels)	Max Height (mm / pixels)
Full Palm	21,23	6.5 / 128	139.7 / 2750	6.5 / 128	215.9 / 4250
Lower Palm	25,27	6.5 / 128	139.7 / 2750	6.5 / 128	177.8 / 3500
Upper Palm	26,28	6.5 / 128	139.7 / 2750	6.5 / 128	177.8 / 3500
Writer's Palm	22,24	6.5 / 128	45.7 / 900	6.5 / 128	127.0 / 2500

Table 9 – Palm print image sizes – Matcher standard

16.4 Latent palm mark image size - Matcher standard

Description	Position	Min Width (mm / pixels)	Max Width (mm / pixels)	Min Height (mm / pixels)	Max Height (mm / pixels)
Latent Palm Mark	20- 28	6.5 / 128	139.7 / 2750	6.5 / 128	203.2 / 4000

Table 10 – Latent palm mark image size – Matcher standard

16.5 Face image size - Matcher standard

Note: The first stage of implementation of the strategic matching platform will support finger and palm prints and marks but not face images. A later stage of implementation will introduce face matching. When this stage is in development this document will be updated here to add information of matcher face image size constraints.

In addition, it is possible that HOB systems may in the future store two versions of a face image. One for automated matching and another high quality image that can be used for manual review by a face bureaux comparison specialist where so required. Should this possibility be taken forward, the main face section of this document will be updated accordingly to include this requirement, where it is needed.

[HOB TDA note: The IABS face matcher has a limit of 20Mb for RAW face images.]

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