INTERNATIONAL STANDARD

ISO/IEC 19794-10

First edition
2007-06-01

Information technology — Biometric data interchange formats —

Part 10: Hand geometry silhouette data

Technologies de l'information — Formats d'échange de données biométriques —

Partie 10: Données de la silhouette de la géométrie de la main

Reference number
ISO/IEC 19794-10:2007(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 19794-10 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

ISO/IEC 19794 consists of the following parts, under the general title *Information technology — Biometric data interchange formats*:

— *Part 1: Framework*

— *Part 2: Finger minutiae data*

— *Part 3: Finger pattern spectral data*

— *Part 4: Finger image data*

— *Part 5: Face image data*

— *Part 6: Iris image data*

— *Part 7: Signature/sign time series data*

— *Part 8: Finger pattern skeletal data*

— *Part 9: Vascular image data*

— *Part 10: Hand geometry silhouette data*

The following part is under preparation:

— *Part 11: Signature/sign processed dynamic data*

Introduction

In the Access Control and Time Management communities, hand geometry has been an option to add biometrics to traditional security systems. While several hand geometry systems have been developed into products, each vendor has traditionally relied on a proprietary algorithm and has stored a proprietary template. This has made it impossible to transfer data from one vendor's system to another's, forcing end users to sole-source their hand geometry solution. To allow integration of hand geometry systems from multiple vendors, a nonproprietary interchange format must be adopted.

This part of ISO/IEC 19794 is intended to provide a data interchange format (a CBEFF biometric data block – BDB) for applications requiring an interoperable hand geometry record. The information consists of a variety of mandatory and optional items including data capture parameters, standardized hand position and vendor-specific information. This information is intended for interchange among organizations that rely on automated devices and systems for identification or verification purposes based on the information from hand geometry. While this part of ISO/IEC 19794 mandates a particular data format, it does not mandate a particular algorithm. For example, a user may be enrolled on a system from one vendor and verified on a system from another.

Because hand geometry products have historically relied on measurements taken from a hand silhouette, this format stores hand silhouette data rather than color or grayscale image data. To increase the flexibility of the data format, provisions have been made to store views of the left and right hands, in addition to multiple views of each hand. Specific implementations of this part of ISO/IEC 19794 that are constrained by storage space (such as smart card applications) may wish to limit the number of views stored for each hand. Such limitations are outside the scope of this part of ISO/IEC 19794, but reduced choices can prejudice interoperability.

It is well known that the presentation of a biometric sample affects algorithm performance. While image acquisition and hand placement requirements are outside the scope of this part of ISO/IEC 19794, Annex B is provided as guidance for those wishing to adhere to industry "best practices".

Information technology — Biometric data interchange formats —

Part 10:
Hand geometry silhouette data

1 Scope

This part of ISO/IEC 19794 specifies a data interchange format (a CBEFF biometric data block – BDB) that can be used for storing, recording and transmitting the information obtained from a hand silhouette.

This part of ISO/IEC 19794 defines the content, format and units of measurement for the exchange of hand silhouette data in a BDB.

Information formatted in accordance with this part of ISO/IEC 19794 can be recorded on machine-readable media or transmitted by data communication between systems.

2 Conformance

A biometric data block conforms to this part of ISO/IEC 19794 if it satisfies the format requirements specified within the normative clauses of this part of ISO/IEC 19794 and has internal consistency based on capture from an actual hand.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19785-1, *Information technology — Common Biometric Exchange Formats Framework — Part 1: Data element specification*

ISO/IEC 19784-1, *Information technology — Biometric application programming interface — BioAPI specification*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
biometric data block
BDB
block of data with a defined format that contains one or more biometric samples or biometric templates

NOTE In the case of this part of ISO/IEC 19794, the BDB contains the hand silhouette of one or both hands, perhaps with multiple views.

4.2
biometric sample
information obtained from a biometric device, either directly or after further processing

NOTE The silhouette of a hand is an example of a biometric sample.

4.3
camera point of view
effective location and orientation of a camera that would result in the observed hand silhouette

NOTE The effective location is specified rather than the actual location due to the possibility of algorithmic transformations and various hand-scanning technologies such as movable linear arrays, etc.

4.4
capture
process of taking a biometric sample from an end user

4.5
Freeman Chain Code
FCC
compact method for representing the contours of an object

NOTE First made popular by Herbert Freeman.

4.6
image resolution
number of pixels per unit distance in the interchanged image

NOTE This may be the result of processing a captured image. The original captured image may have been subsampled, scaled, interpolated or otherwise processed to produce a silhouette suitable for automated hand recognition.

4.7
live capture
process of capturing a biometric sample through an interaction between an end user and a biometric system

4.8
hand geometry view record
HGVR
block of data that contains a hand silhouette captured from one camera point of view during one hand placement

NOTE The block contains metadata, silhouette data and optional extended data.

4.9
pixel
picture element located on an *n* by *m* matrix of picture elements, where *n* is the horizontal component and *m* is the vertical component

4.10
platen
reference surface on which a hand is placed during imaging

NOTE The platen will often contain alignment pins to promote repeatable finger placement.

4.11
side-view
data taken from the thumb side or the little-finger side of the hand

cf. **top-view**

4.12
side-view reference plane
physical or imaginary plane on which the side-view silhouette is projected

4.13
tip
⟨finger⟩ end of the fingernail or the end of the flesh at the end of the finger, whichever produces the longer silhouette

NOTE See Figure 3 a).

4.14
top-view
data taken from the palm side of the hand or the back side of the hand

cf. **side-view**

4.15
web
area connecting two adjacent fingers at their connection point to the palm

NOTE See Figure 3 a).

5 General

5.1 Byte order

For the purposes of transfer and storage of the BDB, the more significant bytes of any multi-byte quantity are present before less significant bytes.

NOTE This is commonly referred to as a "big-endian" encoding, or "network byte" order.

Within a byte, the bits are numbered from 0 to 7, where 7 is the "most significant bit" (MSB) and bit 0 the "least significant bit" (LSB).

5.2 Use of FCCs for data compression

To conserve space, the hand silhouette shall be recorded using a Freeman Chain Code (FCC).

NOTE This representation requires only 2-3 bits per pixel along the perimeter of the silhouette. The FCC has long been used to represent black-and-white contours.

Each element of the FCC shall be stored immediately following its predecessor, without regard to byte boundaries. If necessary, the silhouette shall be padded with trailing zeros to ensure that the BDB is an integral number of octets.

Two forms of FCC are supported by this part of ISO/IEC 19794. The 8-way FCC uses three bits per pixel to represent the direction from one pixel to an adjacent pixel. The 4-way FCC uses two bits per pixel by eliminating the diagonal directions allowed in the 8-way FCC.

Silhouette data contained in BDBs conforming to this part of ISO/IEC 19794 (see clause 2) shall be body-centric and not grid centric FCCs as shown in Figure 1 (starting/ending points are shown as squares, intermediate points as circles).

a) Body-centric 8-way FCC = 4,4,4,7,7,0,2,2

b) Grid-centric 8-way FCC = 4,4,4,5,7,7,7,0,1,2,2,3

Figure 1 — Body-centric and grid-centric Freeman Chain Code

5.3 CBEFF Format owner and format type

The BDB format specified in this part of ISO/IEC 19794 shall be embedded in a CBEFF-compliant Biometric Information Record (BIR) according to ISO/IEC 19785-1. The structure of a hand geometry silhouette BIR is depicted in Figure 2, where the CBEFF Standard Biometric Header (SBH) is mandatory, and the CBEFF Security Block (SB) is optional.

Figure 2 — Overview of a hand geometry silhouette biometric information record

NOTE The CBEFF signature holds data that enables the integrity and/or the originator of the hand geometry silhouette BIR to be verified [electronic signature or message authentication code (MAC)].

The CBEFF Format Owner identifier assigned by the CBEFF Registration Authority to ISO/IEC JTC 1/SC 37 shall be used in the CBEFF SBH associated with the BDB. This is the sixteen-bit value 0x0101 (hexadecimal 101 or decimal 257).

There is one CBEFF Format Type code assigned to the data record specified in this part of 19794. This code shall be included in the CBEFF SBH. The sixteen-bit value 0x0018 (hexadecimal 18 or decimal 24) shall be used for data records specified in this part of 19794.

6 Silhouette acquisition requirements

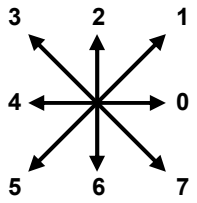
6.1 Overview

It is not the purpose of this part of ISO/IEC 19794 to specify the method of data capture or the order of process steps used to capture the silhouette. However, after data acquisition and processing, each silhouette shall have the orientation shown in Figure 3 a) for top-view images, or Figure 3 b) for side-view images.

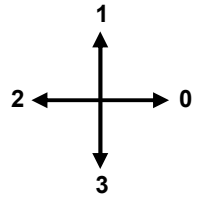
6.2 Hand orientation

The silhouette shall represent either the left or right hand and shall be presented in one of the orientations depicted in Figures 3 a) and 3 b).

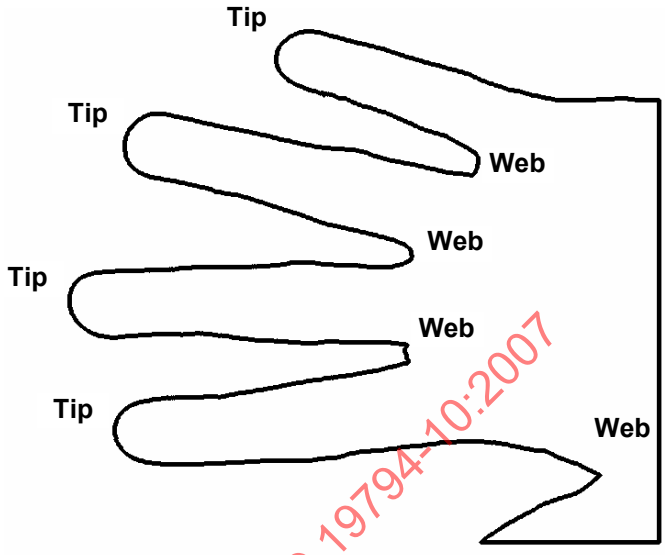
NOTE Silhouettes taken from a left hand pinned platen shall be flipped (mirror image) to match the form of Figure 3a).



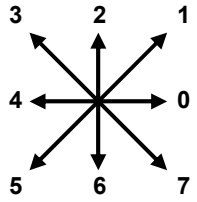
8-way FCC Directions



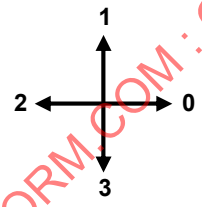
4-way FCC Directions



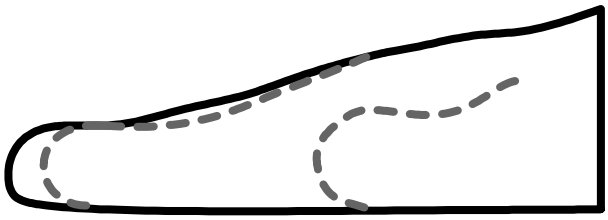
a) Top-view images



8-way FCC Directions



4-way FCC Directions



b) Side-view images

Figure 3 — Standard hand orientation for images

6.3 Aspect ratio

The aspect ratio shall be 1:1, within a tolerance of ± 2%.

NOTE 1 The following example may be useful in calculating the aspect ratio: Assume a grid with 25 mm spacing is placed at the camera centerline, with the grid normal to the centerline axis. The aspect ratio of a captured image may be calculated by counting the number of pixels between the grid lines ± 25 mm from the origin. A system that counts 100 pixels in the x direction and 108 pixels in the y direction has an 8% error compared to the ideal 1:1 aspect ratio.

NOTE 2 “Aspect ratio” relates to the digital characteristics of the stored data, not to physical characteristics of the scanning device.

6.4 Presentation

In order to obtain the best hand recognition performance and interoperability, certain mandatory requirements regarding presentation of the hand must be observed. Optional “best practices” for hand placement, platen design, and optical system design are addressed in Annex B.

Mandatory requirements are as follows.

— The starting point shall be in the rightmost column of the silhouette in Figure 1, at the uppermost row occupied by the silhouette in that column. Successive points shall trace the outline in a counterclockwise direction.

— The silhouette shall be a closed shape (i.e., it shall have no gaps in the outline, and the final outline point shall be collocated with the starting point).

— The starting point shall occur exactly twice in the silhouette, as the first and last points only (the silhouette will not cross through the starting point at any other time).

— The right column shall be vertical (i.e., the penultimate point shall occur directly below the starting point, and no points occur to the right of the starting point).

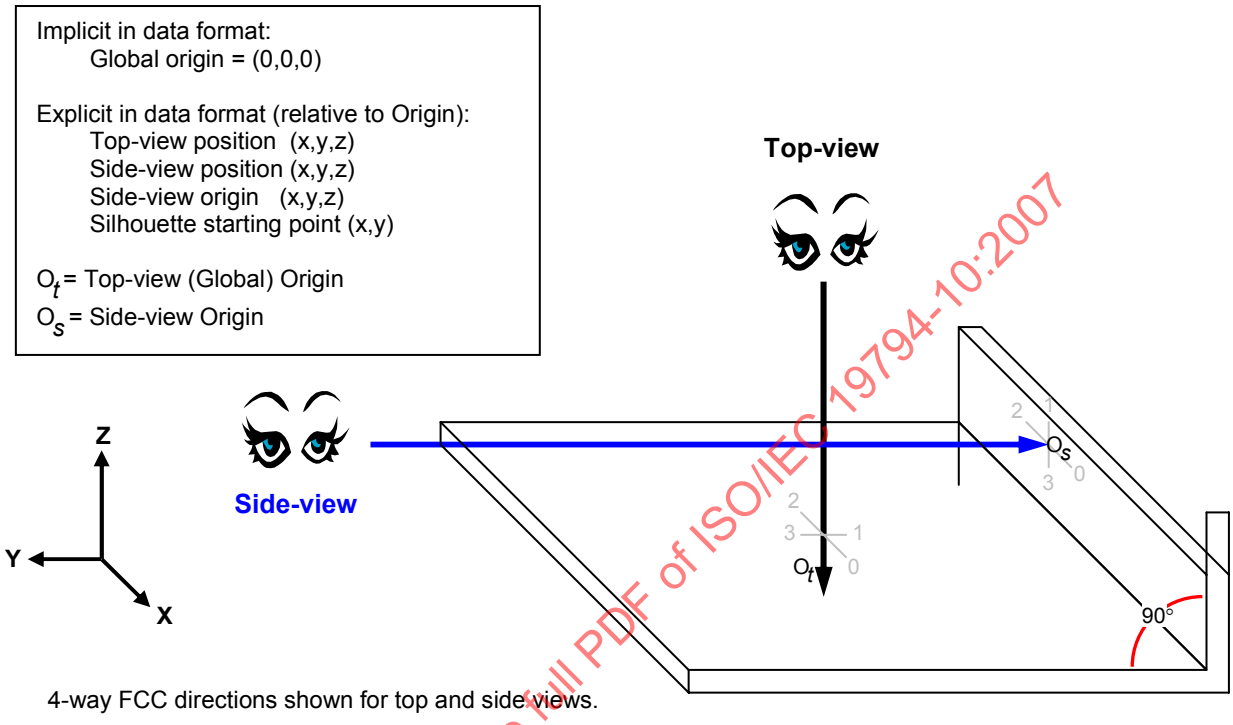
6.5 Coordinate system

For imaging systems utilizing optical cameras, interoperability is influenced by the location of the camera relative to the hand. As such, this part of ISO/IEC 19794 includes fields for recording the camera point of view of the imaging device used to capture the hand silhouette. This section defines the coordinate system used in recording camera point of view.

Figure 4 shows the relationship between the camera points of view, the platen, and the side-view reference plane. The global origin (0,0,0 in 3D space) is defined as the point at which the top-view optical axis intersects the platen. The side-view origin, which is defined relative to the global origin, is the point at which the side-view optical axis intersects the side-view reference plane. The platen shall form a right angle with the side-view reference plane.

For imaging systems utilizing optical cameras, the optical axis for top-view images shall be orthogonal to the platen. Likewise, the optical axis for side-view images shall be orthogonal to the side-view reference plane.

NOTE The reason for the orthogonality requirements is that interoperability decreases as the optical axes diverge from the normal orthogonal positions.



NOTE 4-way FCC directions shown for top and side views.

Figure 4 — Coordinate system linking top and side view images

7 Hand geometry interchange format (BDB format)

Silhouette data shall be represented in a common format, containing both basic and extended data. With the exception of the Format Identifier and the Version number, which are null-terminated ASCII character strings, all data is represented in binary format. There are no record separators or field tags; fields are parsed by byte count.

The BDB format specified in this part of ISO/IEC 19794 shall be embedded in a CBEFF-compliant Biometric Information Record (BIR) as described in 5.3.

The organization of the BDB is as follows:

— a fixed-length (15-byte) general record header containing information about the overall record;

— one or more variable-length hand geometry view records (HGVRs), each containing a single hand silhouette.

Figure 5 depicts the hierarchy of BDB elements within a CBEFF BIR, where the CBEFF SBH is mandatory, and the CBEFF SB is optional.

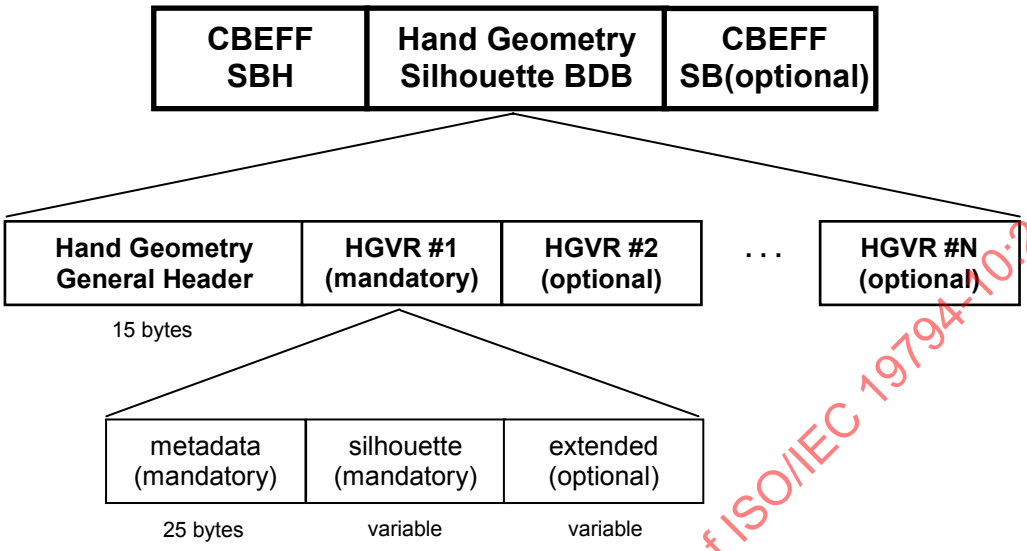


Figure 5 — Hierarchy of BDB elements

7.1 General record header

The general record header is specified in Table 1.

Table 1 — Hand geometry general record header

Field	Size	Valid values	Notes
Format identifier	4 bytes	0x484E4400 ('H' 'N' 'D' 0x00)	"HND" – Hand Geometry Record
Version number	4 bytes	0x30313000 ('0' '1' '0' 0x00)	The current version is 1, and the revision level is 0
Record length	4 bytes		Size of the entire BDB, including this header and multiple HGVRs
Number of HGVRs	1 byte		Number of HGVRs in the record
Reserved for future use	2 bytes		Bytes shall be set to zero by producers of a BDB, and should be ignored by users of the BDB.

7.1.1 Format identifier

The BDB shall begin with the three ASCII characters "HND" to identify the record, followed by a zero byte as a null string terminator.

7.1.2 Version number

The number for the version of this part of ISO/IEC 19794 used for constructing the BDB shall be placed in four bytes. This version number shall consist of three ASCII numerals followed by a zero byte as a NULL string terminator. The first and second characters will represent the major version number and the third character will represent the minor revision number. Upon approval of this specification, the version number shall be "010" – Version 1 revision 0.

7.1.3 Record length

This four-byte field indicates the total size of the BDB, including the general header and one or more HGVR (see 7.2).

7.1.4 Number of HGVRs

The number of hand silhouettes included in the BDB shall be recorded in one byte. Multiple silhouettes of the same hand shall be counted separately. Top-view and side-view silhouettes that are linked by the same HGVR index (see 7.2.2) shall be counted separately.

7.1.5 Reserved for future use

These bytes are not used, and are only a placeholder for future use. Bytes shall be set to zero by producers of a BDB, and should be ignored by users of the BDB.

7.2 Hand geometry view record (HGVR)

The HGVR provides metadata, silhouette data, and possibly extended data for one view of a single hand placement. Table 2 defines the location and description of the 25-byte metadata, variable-length silhouette data, and optional variable-length extended data.

Table 2 — Hand geometry view record

Field	Size	Valid values	Notes
Length of HGVR	2 bytes		Includes metadata, silhouette, and extended data
HGVR index	1 byte		Used for linking groups of images to the same capture sequence
Hand identifier	1 byte		Bitmapped field. See 7.2.3.
Hand integrity	1 byte		Bit-mapped field. See 7.2.4.
Data resolution	1 byte	0, 1-255	Pixels per centimeter 0 = unknown
Distortion	1 byte		signed value, increments of 0,1% 0x80 = unknown
Silhouette quality	3 bytes	0x0000XX	The two high bytes are zero, the low byte has a valid range of 0-100

Camera X position	1 byte		Signed distance in FCC Direction 4 and 2, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else XPOS = millimeters / 4
Camera Y position	1 byte		Signed distance in FCC Direction 2 and 1, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else YPOS = millimeters / 4
Camera Z position	1 byte		Distance normal to the platen 255 = unknown 254 = greater than max value else ZPOS = millimeters / 4
Target X position	1 byte		Signed distance in FCC Direction 4 and 2, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else XPOS = millimeters / 4
Target Y position	1 byte		Signed distance in FCC Direction 2 and 1, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else YPOS = millimeters / 4
Target Z position	1 byte		Signed distance above the platen 127 = more positive than 126 128 = unknown 129 = more negative than 130 else ZPOS = millimeters / 4

X Position of silhouette starting point	1 bytes		Distance in FCC Direction 4 and 2, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else XPOS = millimeters / 4
Y Position of silhouette starting point	1 bytes		Distance in FCC Direction 2 and 1, for a 8-way and 4-way FCC, respectively. 127 = more positive than 126 128 = unknown 129 = more negative than 130 else YPOS = millimeters / 4
Data compression algorithm	1 byte	0-1	0 = 8-way FCC 1 = 4-way FCC
Hand Scanning Technology	1 byte	0-2	0 = unspecified 1 = optical camera 2 = linear scanning array 3-255 = reserved for future use
Extended data length	2 bytes		Length, in bytes, of extended data associated with this HGVR
Reserved for future use	3 bytes		Bytes shall be set to zero by producers of a BDB in this version of this part of ISO/IEC 19794, and should be ignored by users of the BDB.
Silhouette data	variable		This is the silhouette data block
Extended data	variable		Associated with CBEFF format owner

7.2.1 Length of HGVR

This two-byte field contains the length in bytes of a particular HGVR. It shall specify the total number of bytes including the length of the metadata, the silhouette data and the extended data for that view.

7.2.2 HGVR index

This one-byte field is assigned to an HGVR when it is captured.

NOTE Where several HGVRs are captured at the same time, it is normal (but not required) to assign the same HGVR index to all the HGVRs. When HGVRs are captured separately, distinct HGVR indices are normally assigned.

7.2.3 Hand identifier

This bitmapped one-byte field shall identify the hand and camera orientation used to capture the associated hand (or subset thereof) silhouette. Bits 0-4 indicate which fingers the system attempts to image, where bit-values of one indicate that the system attempts to image the indicated finger. The mapping is as follows:

View indicator		Hand	Thumb	Index	Middle	Ring	Little
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

This field also indicates which hand was scanned, and from which direction it was scanned. Bit 5 indicates whether the silhouette represents a right hand (0) or a left hand (1). Bits 7 and 6 are used together to indicate the direction of the view as follows:

0 0 Top view imaged from the palm-side of the hand

0 1 Top view imaged from the back-side of the hand

1 0 Side view imaged from the thumb-side of the hand

1 1 Side view imaged from the little-finger-side of the hand

EXAMPLE The top-view silhouette from a two-finger device imaging the index and middle fingers from the back of the right hand would have a Hand Identifier value of 0x4C (binary 01001100).

7.2.4 Hand integrity

This one-byte field shall identify hands that have missing/mangled digits and/or hands that have difficulty being placed flat against the platen. Bit-values of zero indicate no known problem, while bit-values of 1 indicate a problem. The mapping is as follows:

Hand			Thumb	Index	Middle	Ring	Little
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Bits 5-6 are undefined in this revision of this part of ISO/IEC 19794. They shall be set to zero by producers of a BDB in this version of this part of ISO/IED 19794, and should be ignored by users of the BDB.

7.2.5 Data resolution

This one-byte field shall specify the resolution of the silhouette, measured in pixels per centimeter. This resolution shall apply to both the horizontal and vertical resolution. A value of zero indicates unknown.

7.2.6 Distortion

This signed byte indicates the geometric distortion of the system used to capture the hand silhouette. Distortion is calculated as the displacement of the image from the ideal position when measured at a distance of 7,62 cm from the camera centerline and expressed as a percentage. To increase the resolution of the stored value, the percentage is scaled by 10X during this calculation. Specifying the distortion at this radius characterizes the acquisition system over an area able to contain a typical adult hand, as shown in Figure 6. Figure 7 indicates the convention for positive and negative distortion.

The equation defining distortion (D) is

$$D = 100 \times \frac{R_{\text{apparent}} - R_{\text{ideal}}}{R_{\text{ideal}}} \times 10$$

where

R is the radius (distance) from the camera centerline;

R_{apparent} is the radius as measured by the capture device;

R_{ideal} is the radius as measured by an ideal capture device (one that is free of geometric distortion and parallax).

Because this equation assumes that distortion is symmetric about the optical axis, distortion may be measured at any point on the platen 7,62 cm from the point at which the optical axis intersects the platen. One convenient point to measure distortion in a test image, then, is at the pixel location 7,62 cm left, right, above, or below the intersection of the optical axis with the platen.

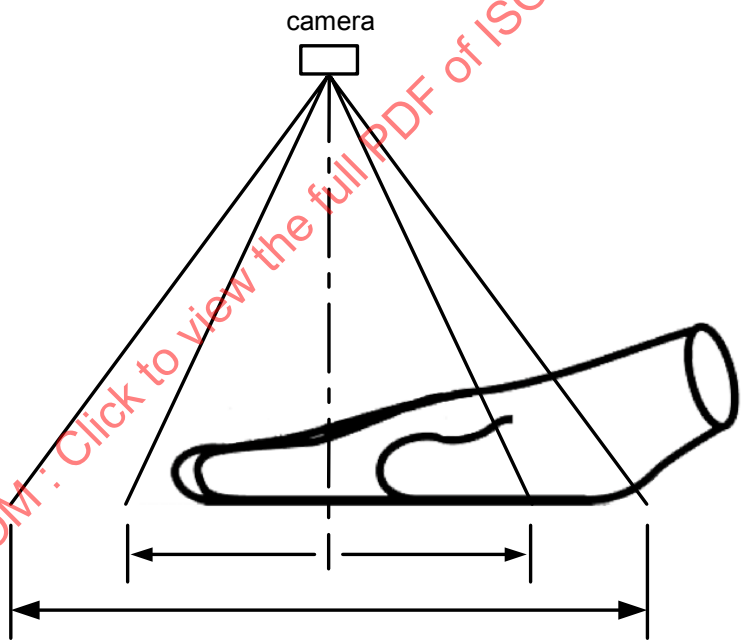
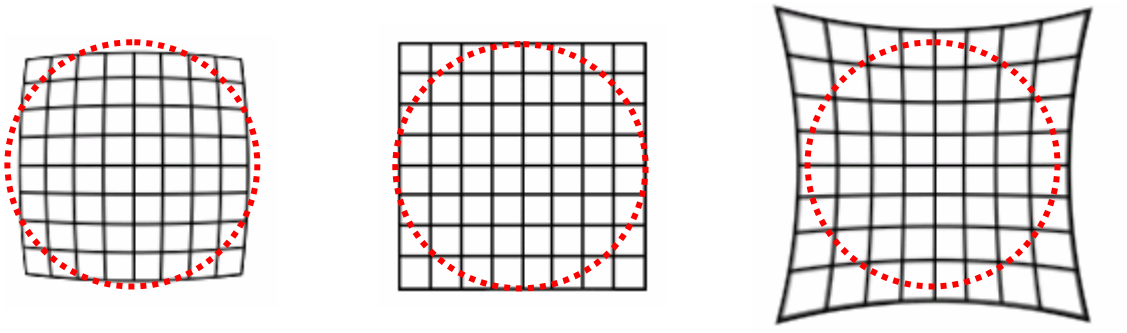


Figure 6 — Region of interest for optical distortion measurement



negative distortion no distortion positive distortion

NOTE The ideal location of 7,62 cm radius is shown as a dashed red circle.

Figure 7 — Sign convention for optical distortion

The following example may be useful in calculating distortion: Assume a developer places one vertex of a grid with 25.4 mm spacing at the camera centerline, and captures an image where the acquisition resolution at the camera centerline is 5 pixels/mm. An undistorted image would place the third edge from the camera centerline $3 \times 25{,}4 \times 5 = 381$ pixels away. If, however, the gridline was measured at 400 pixels, the distortion would be characterized as $100 \times (400 - 381)/381 = 5\%$, which corresponds to a stored value of positive 50 (0x32) since the data format stores 10X the distortion percentage.

7.2.7 Silhouette quality

The quality of the overall Hand Silhouette Data shall either be between 0 and 100 or encoded as –1 or –2 as specified for BioAPI_QUALITY in ISO/IEC 19784-1, and recorded in the low byte of this 3-byte field. This quality number is an overall expression of the quality of the silhouette record, and represents quality of the original image, of the edge extraction and any additional operations that may affect the silhouette data. A value of 0 shall represent the lowest possible quality and the value 100 shall represent the highest possible quality (the value 0 also represents an unknown quality factor). The comparison algorithm may use this value to determine its certainty of verification.

The 2 high bytes in this field are reserved for future quality measures, and are set to zero for this version of this part of ISO/IEC 19794.

7.2.8 Camera X position

7.2.8.1 Position of the camera, relative to the global origin as defined in 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 4 and 2 (for 8-way and 4-way FCCs) as positive displacements [see Figures 3 a) and 3 b)].

7.2.8.2 A camera position is determined by measuring its displacement (in millimeters) in a given direction. This field is a signed byte (holding values –128 to +127). If the position of the camera is unknown, then this field shall contain the value –128, otherwise this field shall be set using the value POS:

POS = displacement / 4

If POS is in the range –126 to +126 then the field shall contain the POS value.

If POS is greater than +126 then the field shall contain the value +127.

If POS is less than –126 then the field shall contain the value –127.

7.2.9 Camera Y position

Position of the camera, relative to the global origin as defined in 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 2 and 1 (for 8-way and 4-way FCCs) as positive displacements [see Figures 3 a) and 3 b)].

7.2.10 Camera Z position

Position of the camera, orthogonal to the platen. Note that this field indicates magnitude only, not direction. This field shall be calculated as

Z-POS = (uint8) millimeters / 4

for values of 0-253. Value 254 represents a special case, where the camera position is an unknown number larger than that corresponding to 253. Value 255 indicates an unknown camera Z position, including the use of movable linear arrays.

7.2.11 Target X position

Location at which the camera is aimed, relative to the global origin as defined in Section 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 4 and 2 (for 8-way and 4-way FCCs) as positive displacements (see Figures 3a and 3b).

7.2.12 Target Y position

Location at which the camera is aimed, relative to the global origin as defined in 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 2 and 1 (for 8-way and 4-way FCCs) as positive displacements [see Figures 3 a) and 3 b)].

7.2.13 Target Z position

Location at which the camera is aimed, relative to the global origin as defined in 6.5. This field is encoded as specified in 7.2.8.2, using the height above the platen for positive displacements and the depth below the platen for negative displacements.

7.2.14 X-position of the silhouette starting point

Position of the silhouette starting point as defined in section 6.4, relative to the view origin defined in 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 4 and 2 (for 8-way and 4-way FCCs) as positive displacements [see Figures 3 a) and 3 b)].

7.2.15 Y-position of the silhouette starting point

Position of the silhouette starting point as defined in 6.4, relative to the view origin defined in 6.5. This field is encoded as specified in 7.2.8.2, using FCC directions 2 and 1 (for 8-way and 4-way FCCs) as positive displacements [see Figures 3 a) and 3 b)].

7.2.16 Data compression algorithm

Currently the only supported compression methods for the silhouette data are the 8-direction and 4-direction FCC, represented by values of zero and one respectively.

7.2.17 Hand scanning technology

This one-byte field indicates the sensor technology used in the original data capture. Valid scanning methods are:

0 = unspecified

1 = optical camera

2 = linear scanning array

Values 3-255 are reserved for future use.

7.2.18 Extended data length

This two-byte field contains the length in bytes of the extended data block. A value of zero indicates a hand geometry record with no extended data.

7.2.19 Reserved for future use

These bytes are not used, and are only a placeholder for future use. Bytes shall be set to zero by producers of a BDB in this version of this part of ISO/IEC 19794, and should be ignored by users of the BDB.

7.2.20 Silhouette data

The hand silhouette, formatted as described in 5.2. The length of the silhouette data is the length of the HGVR (specified in the HGVR header; see 7.2.1) minus the length of the header (25 bytes) minus the length of the extended data block (indicated in the record header for this view; see 7.2.18).

7.2.21 Extended data

This section of the Record is reserved for any application-specific or proprietary data used by the System Vendor. The Product ID in the CBEFF wrapper (see 5.3) shall be used to uniquely identify the system Vendor or Producer or Owner and the Type of the encoding equipment that generated the extended data. The length of extended data is specified in 7.2.18.