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Information Technology:

American National Standard for Information Systems

Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information

National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

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<u>Information Technology:</u>

American National Standard for Information Systems -

Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information

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Reports on Information Technology

The Information Technology Laboratory (ITL) at the National Institute of Standards and Technology (NIST) stimulates U.S. economic growth and industrial competitiveness through technical leadership and collaborative research in critical infrastructure technology, including tests, test methods, reference data, and forward-looking standards, to advance the development and productive use of information technology. To overcome barriers to usability, scalability, interoperability, and security in information systems and networks, ITL programs focus on a broad range of networking, security, and advanced information technologies, as well as the mathematical, statistical, and computational sciences. Special Publication 500-series reports on ITL's research in tests and test methods for information technology, and its collaborative activities with industry, government and academic organizations.

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Foreword

This foreword is not part of the American National Standard

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Law enforcement and related criminal justice agencies, as well as identity management organizations, procure equipment and systems intended to facilitate the determination of the personal identity of a subject or verify the identity of a subject using biometric information. To effectively exchange identity data across jurisdictional lines or between dissimilar systems made by different manufacturers, a standard is needed to specify a common format for the data exchange.

Biometric data refers to a digital or analog representation of a behavioral or physical characteristic of an individual that can be used by an automated system to distinguish an individual as belonging to a subgroup of the entire population or in many cases, can be used to uniquely establish or verify the identity of a person (compared to a claimed or referenced identity). Biometric modalities specifically included in this standard are: fingerprints, plantars (footprints), palmprints, facial images, DNA and iris images. Identifying characteristics that may be used manually to establish or verify the identity of an individual are included in the standard. These identifying characteristics include scars, (needle) marks, tattoos, and certain characteristics of facial photos, iris images and images of other body parts. Latent friction ridge prints (fingerprint, palmprint and plantars) are included in this standard and may be used in either an automated system or forensically (or both).

Some data may be stored and/or transmitted in original and/ or processed versions. The image or other data (such as a video or audio clip) may be 'raw' (as captured), compressed, cropped, or otherwise transformed. An example of processed information is minutiae from friction ridge images. It is important, therefore, that descriptive information associated be transmitted to the receiving organization.

The Information Technology Laboratory (ITL) of the National Institute of Standards and Technology (NIST) led the development of this American National Standards Institute (ANSI) approved American National Standard using the NIST Canvass Method to demonstrate evidence of consensus. This updated standard replaces ANSI/NIST-ITL 1-2007 and ANSI/NIST-ITL 2-2008 standards and the amendment ANSI/NIST-ITL 1a-2009. Send suggestions for the improvement of this standard to the attention of:

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Introduction

Information compiled and formatted in accordance with this standard may be recorded using machine-readable media and may be transmitted by data communication facilities. Law enforcement, criminal justice agencies, and other organizations that process biometric data use the standard to exchange identity data such as images of fingerprints, palmprints, plantars, faces, iris and other body parts including scars, marks and tattoos (SMT). Marks, as used in this standard, means needle marks typical of drug use. The term 'marks' in some nations denotes what is called 'latent prints' in the terminology of this standard. The standard also allows the exchange of forensic markups of images of faces, irises, other body parts, and latent friction ridge prints.

The first version of this standard, *ANSI/NBS-ICST 1-1986*, was published by NIST (formerly the National Bureau of Standards) in 1986. It was a fingerprint minutiae-based standard. Revisions to the standard were made in 1993, 1997, 2000, and 2007. Updates to the standard are designed to be backward compatible, with new versions including additional information. All of those versions use "Traditional" encoding. In 2008, 'NIEM-conformant encoding' using Extensible Markup Language (XML) was adopted. NIEM, the National Information Exchange Model, is a partnership of the U.S. Department of Justice and Department of Homeland Security. NIEM is designed to provide a common semantic approach in XML applications. With some minor exceptions, the 2007 and 2008 versions of the standard are equivalent except for the encoding format. In 2009, an amendment to the 2007 and 2008 versions was approved that extended codes to handle multiple finger capture.

This version of the standard (2011) does not restrict encoding to any particular format. However, in cases where an alternative encoding (i.e, other than Traditional or NIEM-conformant XML) is used, the sending and receiving parties shall document encoding rules and assumptions.

This standard defines the structure and format of the records contained in a transaction that may be transmitted to another site or agency. An ANSI/NIST-ITL transaction is called a file in Traditional encoding and an Exchange Package in XML encoding.

A transaction is comprised of records. Each Record Type is defined in this standard. Certain portions of the transaction may be in accordance with definitions provided by the receiving agency, as described in the standard. The transaction shall contain records pertaining to a single subject. Biometric data used to identify another individual shall be contained in a separate transaction. However, some records (such as Record Type-18) may include biometric data from another person if that data is used to corroborate or establish the identity of the subject of the transaction.

This version of the standard is available in PDF format, which preserves internal cross-reference links. Such links are shown in **green**. External hyperlinks are shown in blue.

1 Scope

This standard defines the content, format, and units of measurement for the electronic exchange of fingerprint, palmprint, plantar, facial/mugshot, scar, mark & tattoo (SMT), iris, deoxyribonucleic acid (DNA), and other biometric sample and forensic information that may be used in the identification or verification process of a subject. The information consists of a variety of mandatory and optional items. This information is primarily intended for interchange among criminal justice administrations or organizations that rely on automated identification systems or use other biometric and image data for identification purposes.

2 Conformance to the standard

2.1 Verbal forms for the expression of provisions

The following terms are used in this standard to indicate mandatory requirements, recommended options, or permissible actions.

- The terms "shall" and "shall not" indicate requirements to be followed strictly in order to conform to this standard and from which no deviation is permitted.

- The terms "should" and "should not" indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is discouraged but not prohibited.

- The terms "may" and "need not" indicate a course of action permissible within the limits of this standard.

A system is conformant to this standard if it is capable of generating or using transactions that are morphologically, syntactically and semantically conformant to the requirements of this standard. Transactions shall consist of one Type-1 record and one or more of the Type-2 to Type-99 records. For the structure of a transaction, see **Section** 5.1. For a description of the Record Types, see **Section** 5.3. Prior versions of the standard only required a Type-1 record.

2.2 Syntactical (Level 1) conformance

Syntactical conformance deals with the form and structure of the internal content and verifies data structures exist and have allowable values. Specifically, it checks for the structure and value of each field, subfield and information item in a transaction.

A transaction conforms syntactically to this standard if it satisfies all of the normative morphological requirements related to its data structure and data values, as specified throughout **Section 7 Information associated with several records** and **Section 8 Record type specifications**. If the system claims conformance with a particular encoding, then it shall satisfy the requirements of either **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**, as appropriate.

Table 1 Excerpt from Table 24: Type-4 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
4.004	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	N	T=1 X=1	T=1 X=3	$0 \le$ FGP ≤ 15 or FGP = 255 integer See **Table 8**	6	6

The excerpt above is taken from **Table 24 Type-4 record layout**. Notice the "Value Constraints" column. See **Section 8 Record type specifications** for an explanation of the entries in this type of table.

This example illustrates conformance of the data values.

- Valid values for **Field 4.004: Friction ridge generalized position / FGP** are shown in **Table 24.** Testing this type of conformance for **Field 4.004** involves verifying that the value for **FGP** is zero or that it is a positive integer less than or equal to 15 or that it is equal to 255. A value of 10 is conformant; however, a value of 250 is not conformant. A value of 4.25 is not conformant since it is not an an integer, has more than 3 characters, contains a special character (the period is not allowed in numeric data – shown as "N" in the 'Character Type' column), and the value is not in **Table 8**.

Table 2 Excerpt from Table 85: Type-19 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
19.024	**FQM**	**FRICTION RIDGE - PLANTAR PRINT QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	FRMP	friction ridge metric position	M⇑	N	2	2	60 ≤ FRMP ≤ 79 positive integer	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1

The excerpt above is taken from **Table 85 Type-19 record layout**. This excerpt illustrates a field with repeating subfields that each contain four mandatory information items. (See **Section 5.1 Structure of a transaction** for information about fields, subfields and information items). If the transaction contains a Type-19 record with **Field 19.024: Friction ridge - plantar print quality metric / FQM** present, then **QAP** shall be present in each subfield. If **QAP** is not present in a subfield, then the field would not be syntactically conformant. (The same applies to **FRMP**, **QVU** and **QAV**). Another example of non-conformance is to have 10 instances of the subfield within the field.

2.3 Morphological (Level 2) conformance

Morphological conformance deals with explicit requirements that check for internal consistency and ensure that values are compatible with this standard. Specifically, morphological conformance checks for the relationships between fields, subfields, or information items within a transaction to other values within the same transaction as specified in this standard.

Transactions that claim morphological conformance to this standard shall satisfy all of the normative requirements related to the relationships between fields, subfields, or information items as described in **Sections 7** and **8** for each implemented record type. If the system claims conformance with a particular encoding, then it shall satisfy the morphological requirements of either **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**, as appropriate.

An example of this type of conformance is:

- If **Field 17.031: Subject acquisition profile – iris / IAP** is 40, then **Field 17.026: Iris diameter / IRD** shall be greater than or equal to 210. (See **Table 13** for **IAP** constraints by level). A value of 200 for **Field 17.031** (with **IAP** = 40**)** would be morphologically conformant. Testing for morphological conformance involves comparing values within a transaction, therefore, if **IAP** is 40, an **IRD** value of 200 is not syntactically conformant, while an **IRD** value of 220 is morphologically conformant.

2.4 Semantic (Level 3) conformance

Semantic conformance checks if the biometric transaction is a faithful representation of the parent biometric data and ensures requirements are satisfied that are not merely syntactical or morphological. Individual fields may have explicit semantic requirements in addition to syntactic requirements.

Transactions that claim semantic conformance to this standard shall satisfy the semantic requirements, as described in **Sections 7** and **8** of this standard, for each implemented record type.

Some examples of semantic conformance are:

- For a Type-9 minutiae record, there is a minutia corresponding to each set of coordinates (x, y, t) of the location encoded in the record. See **Section 5.1** for a description of transactions, records and fields.

- For a Type-10 record, a subject acquisition profile (SAP) level-50 image shall comply with semantic requirements including the position and size of the face within the image, angle of view, and lighting. See **Section 7.7.5.1** for the face SAP specifications.

3 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. All standards are subject to revision, and parties using this American National Standard are encouraged to investigate the possibility of applying the most recent versions of the standards indicated below.

AAMVA *International Specification – DL/ID Card Design.* It is available at http://www.aamva.org/KnowledgeCenter/DLIDStandards/

ANSI X3.4-1986 (R1992), *Information Systems --- Coded Character Sets --- 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII)*.[1]

ANSI/EIA - 538-1988 *Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Equipment.*[1]

ANSI/IAI 2-1988, *Forensic Identification --- Automated Fingerprint Identification Systems --- Glossary of Terms and Acronyms*. It is available at https://www.theiai.org/publications/

ANSI/INCITS 398 *The Common Biometric Exchange Formats Framework.* It is available at http://www.incits.org

ANSI/NIST-ITL 1-2007, NIST Special Publication 500-271, *Data Format for the Interchange of Fingerprint, Facial and Other Biometric Information – Part 1.* [2]

ANSI/NIST-ITL 2-2008, NIST Special Publication 500-271, *Data Format for the Interchange of Fingerprint,* Facial a*nd Other Biometric Information – Part 2: XML Version.*[2]

ANSI/NIST ITL 2011 NIEM IEPD Exchange and Subset Schemas[2]

Department of Defense, Office of GEOINT Sciences (SN), Coordinate Systems Analysis Branch, *Military Grid Reference System*. It is available at http://earth-info.nga.mil/GandG/coordsys/grids/mgrs.doc

Federal Bureau of Investigation; *The Science of Fingerprints*; Rev 12-84; ISBN 0-16-076078-X. It is available online at Project Gutenberg http://www.gutenberg.org/ebooks/19022
and from the Government Printing Office
http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=027-001-00033-5.

FBI CJIS, Personal Identity Verification (PIV): Image Quality Specifications for Single Finger Capture Devices, 10 July 2006.[3]

Federal Information Processing Standard 180-x, *Secure Hash Standard.* It is available at http://csrc.nist.gov/publications/PubsFIPS.html

[1] ANSI and ISO documents are available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.
[2] ANSI/NIST-ITL documents are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm
[3] These documents are available at https://www.fbibiospecs.org/

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4 Terms and definitions

The following definitions and those given in the American National Standard Automated Fingerprint Identification Systems --- *Glossary of Terms and Acronyms, ANSI/IAI 2-1988*, apply to this standard.

AABB

The American Association of Blood Banks.

AAMVA

The American Association of Motor Vehicle Administrators.

AFIS

Automated Fingerprint Identification System.

allele

One member of a series of possible alternative forms of a DNA sequence found at a particular genetic location.

allele call

The value identified for the allele, either via expert system or by an analyst.

ANSI

The American National Standards Institute, Inc.

Appendix F certified devices

This refers to devices that have successfully completed a test of fingerprint capture devices that is performed in accordance with procedures established by the FBI in EBTS Appendix F. The list of such approved devices is available at https://www.fbibiospecs.org/

ASCII

The American National Standard Code for Information Exchange.

ASCLD

The American Association of Crime Lab Directors.

aspect ratio

The width-to-height ratio of a pixel or the captured image.

BDB

Biometric Data Block used in CBEFF.

CBEFF

Common Biometric Exchange Formats Framework. It provides a set of definitions used to exchange biometric data in a standardized manner. It forms the basis for Type-99 records.

CDEFFS

Committee to Define an Extended Fingerprint Feature Set.

class resolution

The value of resolution (scanning or nominal) used to name (or identify) an acquisition process or image, where the resolution is within a specified tolerance around that value. Example: A scanner is referred to as “500 ppi” (class resolution) if the native scanning resolution is within 1% (5 ppi).

constraint schema

This is a NIEM schems that adds additional constraints and restrictions to components. A constraint schema was used in the 2008 version of the standard to add cardinality constraints to schemas that were automatically generated by a NIEM tool called SSGT (Subset Schema Generator Tool). The tool has been updated to directly specify cardinality constraints in the NIEM subset schema, so constraint schemas are no longer provided in the 2011 version of the standard. However, an implementer is permitted to define their own constraint schema to add further restrictions to the standard. An example is to only allow certain record types in a transaction.

context data

Additional related image, audio, or waveform data in support of a biometric record.

deprecated

The record type / field / subfield / information item / value / file shall not be used for applications claiming conformance to this version of the standard. This is different from '**legacy**'

derived representation

Biometric type record derived from a Type-20 source representation record, which may be another Type-20 record from which other biometric type records are derived.

distal segment

The segment of a finger or thumb farthest from the palm.

DNA

Deoxyribonucleic Acid. This is a chemical that forms a double helix that is unique to all but identical siblings.

domain

This term has two uses in this standard:

- *Implementation domain* refers to the group of organizations or agencies that have agreed to use a specified set of user-defined fields in a particular format. This is the domain encoded in **Field 1.013 Domain name / DOM.**
- *NIEM biometrics domain* refers to an XML namespace that conforms with the NIEM naming rules. It deals with biometric data. See **Annex C: NIEM-conformant encoding rules** for details.

EBTS

This stands for two separate application profiles of the ANSI/NIST-ITL standard:

a) Acronym for the FBI's application profile of the ANSI/NIST-ITL standard: Electronic Biometric Transmission Specification.

b) Acronym for the US Department of Defense's application profile of the ANSI/NIST-ITL standard: Electronic Biometric Transmission Specification.

EFTS

The FBI's earlier application profile of the ANSI/NIST-ITL standard: Electronic Fingerprint Transmission Specification. It has been superseded by EBTS.

EFS

Extended Feature Set for markup of friction ridge data.

exchange schema

Although NIEM contains more than 6000 elements it does not contain everything needed in an XML exchange. It contains the most common building blocks. This biometric standard requires an exchange schema called the “itl” schema. “itl” adds types and properties that are not in NIEM; they are unique to the standard. For example, the record structure (Types 1 through 99) is unique to the standard and is defined in the “itl” schema. In addition, implementers can define, in other exchange schemas, “user-defined” elements from the implementer’s domain.

EJI - entire joint image

An exemplar image containing all four full-finger views for a single finger.
(See **Figure 4**)

electropherogram

A plot of fluorescence units over time showing the measured peaks of a DNA molecule at various genetic locations.

element

In XML, an element is a building block delimited by a start-tag <CaptureDate> and an end-tag </CaptureDate>. Everything between the start-tag and the end-tag of the element (exclusive) is called the element's content. The “fields”, “subfields”, and “information items” used by traditional-encoding (non-XML) are all represented by XML elements in this encoding.

exemplar

The friction ridge prints of an individual, associated with a known or claimed identity, and deliberately recorded electronically, by ink, or by another medium (also called 'known prints').

fingerprint

An image or impression of the friction ridges of all or any part of a finger or thumb.

FAP

Acronym for Fingerprint Application Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to fingerprint acquisition. In the *Mobile ID Best Practices Recommendations*, face, finger and iris application profiles were all referred to as SAP. They are referred to separately in this standard.

FBI

The Federal Bureau of Investigation of the United States Department of Justice

forensic

Pertaining to the use of analytic / scientific techniques to establish or verify identity - in this standard, it applies to the examination and mark-up of images (sometimes manually).

Frankfurt horizon

This is the plane determined by the lowest point of the left eye socket and the tragions of the ears.

flat fingerprint

A fingerprint image resulting from the touching of a single finger to a livescan platen or paper fingerprint card without any rolling motion. Also known as a single-finger plain impression.

friction ridge image

An image of an impression from the palmar surfaces of the hands or fingers, or from the plantar (sole) surfaces of the feet or toes.

friction ridge skin

The volar skin surface of the surfaces of the hands and fingers, and the plantar surfaces of the feet and toes.

full finger view

A full finger view is a rolled or plain image of a full-length finger showing all segments. An entire joint image (cf.) includes four full finger view images: one rolled; left, center, and right plain.

genotype

The entire genetic constitution of an individual; also, the alleles present at one or more specific loci.

GLP

Good Laboratory Practice. The United States has rules for GLP in *21CFR58*. The Organization for Economic Co-operation and Development (OECD) has stated principles of GLP.

GMT

Greenwich Mean Time.

GPS

Global Positioning System.

AP

Acronym for Iris Application Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to iris acquisition. In the *Mobile ID Best Practices Recommendations*, face, finger and iris application profiles were all referred to as SAP. They are referred to separately in this standard.

IBIA

International Biometric Industry Association.

ICAO

The International Civil Aviation Organization.

ICC

International Color Consortium.

IEC

The International Electrotechnical Commission.

ILAC

International Laboratory Accreditation Cooperation.

impression

A friction ridge image containing friction ridge detail produced on a surface by pressure.

incipient ridge

A friction ridge not fully developed that may appear shorter and thinner in appearance than fully developed friction ridges.

INCITS

The InterNational Committee for Information Technology Standards.

instance document

An XML package described by a schema is called an instance document. If a document satisfies all the constraints specified by the schema, it is considered to be schema-valid.

interdigital area

The portion of the palm along the base of the fingers.

INTERPOL

International Criminal Police Organization.

INT-I

The INTERPOL application profile of the ANSI/NIST-ITL standard, developed by the INTERPOL AFIS Expert Group.

IREX

Iris Exchange Program. This is a program at NIST in support of iris-based applications based on standardized interoperable iris imagery.

iris

A thin, colored, approximately circular structure surrounding the pupil of the eye that contains features used for identification of individuals.

ISO

International Organization for Standardization.

ITL

Acronym for the Information Technology Laboratory of NIST.

IUPAC

International Union of Pure and Applied Chemistry.

JFIF

JPEG File Interchange Format.

JPEG

Image compression and storage format specified by the Joint Photographic Experts Group. It is discrete cosine transform-based.

JPEG 2000

Image compression and storage format specified by the Joint Photographic Experts Group. It is a wavelet-based method.

(allelic) ladder

A composition of DNA fragments that represents common alleles at a locus.

latent print

An impression or image of friction ridge skin left on a surface.

legacy

Indicates that the transaction element was valid in previous versions of the standard. Systems claiming conformance to this version of the standard shall only use the element when transmitting information stored prior to the adoption of this version of the standard.

locus (plural loci)

A unique physical location on the DNA molecule.

MAC address

Media Access Control address, a unique identifier assigned to network interfaces.

mark

The point where a needle has pierced the skin, usually associated with drug use.

medial segment

The middle segment of the finger. The thumb does not have a medial segment.

MGRS

Military Grid Reference System.

minutia

The point where a friction ridge begins, terminates, or splits into two or more ridges. Minutiae are friction ridge characteristics that are used to individualize a friction ridge image (fingerprint, palmprint, plantar). This is also known as Level 2 detail.

mitochondrial DNA

Small circular DNA molecules located in structures used to provide energy to the cell (mitochondria). Their small size and abundant nature make them particularly useful when examining small or much damaged biological material. It can be used to trace maternal lineages as it is only inherited from one's mother

modality

This is a type or class of biometric system. Any measurable biological or behavioral characteristic can be a biometric modality.

morphological conformance

Conformance with the form and structure of the internal content, and verification that the data structures exist and have correct values.

mugshot

Term used interchangeably with facial image.

native scanning resolution

The scanning resolution used by a specific AFIS, live-scan reader, or other image capture device and supported by the originator of the transmission.

NCIC

National Crime Information Center of the FBI.

NFIQ

NIST Fingerprint Image Quality.

NIEM

National Information Exchange Model. It is a partnership of the U.S. Department of Justice. the U.S. Department of Homeland Security, and the Department of Health and Human Services. It is designed to develop, disseminate and support enterprise-wide information exchange standards and processes that can enable jurisdictions to effectively share critical information in emergency situations, as well as support the day-to-day operations of agencies throughout the U.S.

NIEM subset schema

The portion of NIEM needed for a particular exchange.

NIST

National Institute of Standards and Technology.

nominal resolution

The number of pixels per unit distance (ppmm or ppi) of the image. The nominal resolution may be the same as the scanning resolution for a particular image. On the other hand, the nominal resolution may be less than the scanning resolution if the scanned image was subsampled, scaled, or interpolated down.

palmprint

A friction ridge image from the palm (side and underside) of the hand. A full *palmprint* includes the area from the wrist to the tips of the fingers.

pedigree

A family tree or a structure depicting relatedness and position of known and unknown persons.

PIV

Personal Identify Verification.

plain fingerprint

A fingerprint image resulting from the touching of one or more fingers to a livescan platen or paper fingerprint card without any rolling motion.

plantar

The friction ridge skin on the feet (soles and toes).

PNG

Portable Network Graphics.

ppi

Acronym for pixels per inch.

ppmm

Acronym for pixels per millimeter.

proximal segment

The segment of the finger or thumb closest to the palm.

RCMP

Acronym for the Royal Canadian Mounted Police.

record

A defined set of fields, which may be specified by the standard to be mandatory or optional, that contain data as defined in this standard.

RGB

Red, Green, Blue used to represent color pixels comprised of a specified number of bits to represent each of these primary color components.

ridge

A raised portion of the epidermis on the palmar or plantar skin, consisting of one or more connected ridge units of friction ridge skin.

ridge segment

A section of a ridge that connects two minutiae; a single non-intersecting portion of a skeletonized image.

ridge tracing

See skeletonized image.

ROI

Region of interest.

rolled fingerprint

A fingerprint image collected by rolling the finger across a livescan platen or paper fingerprint card from nail to nail. Rolls may be from livescan devices or scanned from paper fingerprint cards.

SAP

Subject Acquisition Profile. With the exception of mobile device SAP levels, they are a series of sets of progressively more stringent parameters and requirements relevant to face acquisition. Subject Acquisition profiles for iris are denoted as **Iris acquisition profiles (IAP)**, and those for fingerprints are denoted as **Fingerprint acquisition profiles (FAP).** The term SAP had been used exclusively for face acquisition in earlier versions of the standard. While the Mobile ID Best Practice Recommendations uses the term SAP to cover all three modalities, they are separately identified in this standard to avoid confusion with terminology already in use when referring to this standard.

scanning resolution

The number of pixels per unit distance at which an image is captured (ppmm or ppi).

scar

Healed fibrous tissue resulting from an injury to the skin.

(XML) schema

An XML schema declares the XML elements, their structure and order. A schema assigns data types, names, and attributes to the elements. A schema may be used to validate the structure and content of an XML package.

semantic conformance

Conformance to ensure that the biometric transaction is a faithful representation of the parent biometric data and thereby ensuring that the requirements are satisfied that are not merely syntactic or morphological.

simultaneous capture

The acquisition of images of a single biometric modality from a subject at the same time. Sequential capture over a time scale (< 1 second) that prevents confounding of body parts (e.g. substituting left iris for right iris) can also be considered simultaneous capture in this context.

skeletonized image

A representation of a friction skin image in which all pixels are white except for a 1-pixel-wide thinned black skeleton following the midpoint of each ridge. Also known as a ridge tracing.

slap image

Slap fingerprints (slaps) are taken by simultaneously pressing the fingers of one hand (i.e. without the thumb) onto a scanner or fingerprint card. Slaps are also known as four-finger simultaneous plain impressions (although if the person has more than four fingers on a hand, all of the fingers may be included in the slap image).

SMT

Scar, (needle) mark, and tattoo information.

source representation

The image, recording, or other signal from which a biometric type record (see derived representation) is derived. A source representation may be included as a Type-20 record in a transaction.

stitched image

A friction ridge image created by combining images that were separately captured.

substrate

Surface upon which a friction ridge impression is deposited.

STR - Short Tandem Repeat

Short sequences of DNA that are repeated numerous times in direct succession. The number of repeated units may vary widely between individuals and this high level of variation makes STRs particularly useful for discriminating between people.

SWGFAST

Scientific Working Group on Friction Ridge Analysis, Study, and Technology.

syntactic conformance

Conformance to the relationships between fields, subfields, or information items within a transaction to other values within the same transaction as specified in this standard.

tattoo

An indelible image on the skin that was applied to the skin. A common tattoo results from picking of the skin with a coloring matter. A subclass of tattoo is *chemical*, which indicates that the image was created by the use of chemicals to burn the image into the skin. Another subclass of tattoo is *branded*, which indicates that the pattern was caused by using a branding iron or other form of applied heat. A third subclass of tattoo is *cut*, which indicated that the image was caused by incision of the skin.

tolerance

The allowable range of deviation from the class resolution, symmetric around the class resolution value. For PIV single fingerprint scanners with the class resolution of 500 ppi, the tolerance is 2%. For all scanners other than PIV, the tolerance is 1%.

traditional encoding

The format of transactions used in all versions of this standard prior to, and including that of 2007. It is also included in this standard and is specified in **Annex B**.

transaction

A group of records with information and biometric data concerning a particular individual that is transmitted and / or stored as a complete unit.

transaction element

A record type / field / subfield / information item / value.

Unicode

A computing industry standard for the representation of most of the world's scripts (such as Latin letters, Cyrillic letters, Chinese characters, special symbols and others). See **Annex A**.

URI

Uniform Resource Identifier.

URL

Uniform Resource Locator.

UTC

Coordinated Universal Time.

UTF

Unicode Consortium Standard Transmission Format

valley

A lowered portion of the epidermis on the palmar or plantar skin, consisting of those areas between ridges.

WAV

Waveform Audio File Format.

WSQ

Acronym for Wavelet Scalar Quantization, a compression algorithm used for 500 ppi friction ridge prints.

W3C

World Wide Web Consortium. It is an international community that develops standards for web development.

WGS 84 (G873)

WGS 84 is the World Geodetic System of 1984. At 0000 GMT September 30, 1996 (the start of GPS Week 873), WGS 84 was redefined and was more closely aligned with International Earth Rotation Service (IERS) Terrestrial Reference Frame (ITRF) 94. It is now formally called WGS 84 (G873). WGS 84 (G873) was adopted as the reference frame for broadcast orbits on January 29, 1997.

XML

Extensible Markup Language. A convention for marking up and tagging data for electronic transmission. An XML package is built from text content marked up with text tags such as <FingerMissingCode>. In XML one can create as many tags as needed. These tags describe the type of content they contain rather than formatting or layout information. The types of tags allowed in an XML file are typically defined and constrained by a specification such as an XML Schema Definition (XSD).

5 Data conventions

5.1 Structure of a transaction

This standard defines the composition of the records comprising a transaction that may be transmitted to another site or agency. The receiving agency shall set the requirements for scanning resolution, number and type of records, and other user-specific data in order to consider the transaction valid. All records in a transaction shall pertain to a single subject. Biometric data used to identify another individual requires a separate transaction. Some records may include biometric data from another person if that data is used to corroborate the identity of the subject of the transaction. A transaction[4] is comprised of records. The Record types are listed in **Table 3**.

All of the records belonging to a single transaction shall be transmitted together. There may be multiple records in a transaction of each record type other than Type-1. The only required record is Type-1, which is used to describe the transaction. There shall be at least one other record type from **Table 3** accompanying a Record Type-1.

A record is comprised of fields. Within the standard, each field is assigned a number, a description and a mnemonic. An example is **Field 10.020: Subject pose / POS**. A field is used to transmit a particular datum or group of closely related data.

A single type of data that may have multiple entries in a field is shown as *Subfield: repeating values* in the record layout tables. Single or multiple types of data in a field that do not repeat are shown as *information items* in the record layout tables. Data with different formats that repeat as a set are shown as information items grouped under the heading: *Subfields: Repeating sets of information items*. The handling of subfields varies by encoding. See **Annex B: Traditional encoding** and **Annex C: NIEM-conformant encoding rules.**

[4] An ANSI/NIST-ITL transaction is called a file in Traditional Encoding and an Exchange Package in XML encoding.

5.2 Size of a transaction

Although the 2007 and 2008 versions of the standard stated "... there is no upper limit on the number of logical records that may be present in a file..." there was an effective upper limit due to the field size limits specified in the 2007 version (but not the 2008 version). This limit was 3 ASCII[5] characters for the information item holding the total number of records of type 2 through 99; thus an upper limit of 999 such records. With the addition of a Type-1 record, the maximum number of records in a transaction was thus restricted to 1000. This upper limit of 1000 records is maintained in this version of the standard to ensure backward compatibility with the 2007 version.

5.3 Record types

A transaction is comprised of records. The standard currently supports several different biometric modalities, and has reserved record identifiers for the possible future addition of other modalities.

[5] ASCII is defined in ANSI X3.4-1986 (R1992) (See **Section 3**)

Table 3 Record types

Record Identifier	Record Contents
1	Transaction information
2	User-defined descriptive text
3	Low-resolution grayscale fingerprint image (Deprecated)
4	High-resolution grayscale fingerprint image
5	Low-resolution binary fingerprint image (Deprecated)
6	High-resolution binary fingerprint image (Deprecated)
7	User-defined image
8	Signature image
9	Minutiae data
10	Face, other body part, or scar, mark tattoo (SMT) image
11	Voice data (future addition to the standard)
12	Dental record data (future addition to the standard)
13	Variable-resolution latent friction ridge image
14	Variable-resolution fingerprint image
15	Variable-resolution palmprint image
16	User-defined variable-resolution testing image
17	Iris image
18	DNA data
19	Variable-resolution plantar image
20	Source representation
21	Associated context
22-97	Reserved for future use
98	Information assurance
99	CBEFF biometric data record

5.3.1 Type-1 record

Transmissions to be exchanged are required to contain one and only one Type-1 record per transaction. The Type-1 record shall always be the first record within the transaction. At least one more record shall be present in the file. The Type-1 record shall provide information describing type and use or purpose for the transaction involved, a listing of each record included in the transaction, the originator or source of the physical record, and other useful and required information items.

5.3.2 Type-2 records

Type-2 records shall contain user-defined textual fields providing identification and descriptive information associated with the subject of the transaction. Each entry in a Type-2 record shall have a definition and format that is listed with the Domain owner. Data contained in this record shall conform in format and content to the specifications of the domain name(s) as listed in **Field 1.013 Domain name / DOM** found in the Type-1 record, if that field is in the transaction. The default domain is NORAM. **Field 1.016 Application profile specifications / APS** allows the user to indicate conformance to multiple specifications. If **Field 1.016** is specified, the Type-2 record must conform to each of the application profiles.

A **DOM** or **APS** reference uniquely identifies data contents and formats. Each domain and application profile shall have a point of contact responsible for maintaining this list. The contact shall serve as a registrar and maintain a repository including documentation for all of its common and user-specific Type-2 data fields. As additional fields are required by specific agencies for their own applications, new fields and definitions may be registered and reserved to have a specific meaning. When this occurs, the domain or application profile registrar is responsible for registering a single definition for each number used by different members of the domain or application profile . There may be more than one Type-2 record included in each transaction.

5.3.3 Type-3 records (deprecated)

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* version of this standard. Record Type-3 shall not be contained in transactions conforming to this version of the standard.

5.3.4 Type-4 records

Type-4 records were designed to convey fingerprint images captured by an Automated Fingerprint Identification System (AFIS) live-scan reader, or other image capture devices operating at a nominal scanning resolution of 500 pixels per inch (ppi). Many systems still use this record type and it will remain an integral part of the standard. Many implementation domains and application profiles specify that unless fingers are missing or non-recordable, there shall be 14 Type-4 records in a file: ten rolled impressions of the individual fingers, two plain impressions of each thumb, and two simultaneously obtained plain impressions of the four remaining fingers on each hand.

New users are encouraged to utilize record Type-14 to convey fingerprint images. Type-14 records may handle both 500 ppi images and those at greater resolutions that are now commonly exchanged.

5.3.5 Type-5 records (deprecated)

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* version of this standard. Record Type-5 shall not be contained in transactions conforming to this version of the standard.

5.3.6 Type-6 records (deprecated)

This record type is deprecated. For details concerning this record type, please refer to the *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* version of this standard. Record Type-6 shall not be contained in transactions conforming to this version of the standard.

5.3.7 Type-7 records

Type-7 was intended as a temporary measure to enable the exchange of image data that would be defined by specific record types in later versions of the standard. Since some older systems still use this record type, it is included in the standard.

5.3.8 Type-8 records

Type-8 records shall be used for scanned binary or vectored signature image data. Each Type-8 record shall contain data representing the signature of the subject from whom the biometric sample is being collected and/or the operator capturing biometric data.

5.3.9 Type-9 records

Type-9 records shall contain and be used to exchange minutiae or other friction ridge feature data. Each record shall represent the processed (automated and/or manual) image data from which the characteristics are stated. The primary use of this record type shall be for remote searching of latent prints. New to this version of the standard is the Extended Feature Set (EFS) for latent print markups. There is also a capability to have additional vendor-specified feature sets.

5.3.10 Type-10 records

Type-10 image records shall contain and be used to exchange image data from the face, scars, (needle) marks, and tattoos (SMT). New to this version of the standard is the extension of the record type to handle images of other body parts. See **Table 58** for a list of the images types possible in a Type-10 record. Textual and analytic information pertinent to the digitized image is also contained in this record type.

5.3.11 Type-11 records

Type-11 records are reserved for future use.

5.3.12 Type-12 records

Type-12 records are reserved for future use.

5.3.13 Type-13 records

Type-13 image records shall contain and be used to exchange variable-resolution latent friction ridge image data (fingerprint, palmprint and/or plantar) together with fixed and user-defined textual information fields pertinent to the digitized image. In all cases, the scanning resolution for latent images shall be at least 39.37 ppmm (1000 ppi). The variable-resolution latent image data contained in the Type-13 record shall be uncompressed or may be the output from a lossless compression algorithm. The number of latent records in a transaction is only constrained by the total number of records that may be contained in a transaction (See **Section 5.2**).

5.3.14 Type-14 records

Type-14 image records shall contain fingerprint image data. Fixed and user-defined textual information fields pertinent to the digitized image may also be included. While the Type-14 record may be used for the exchange of 19.69 ppmm (500 ppi) images, it is strongly recommended that the resolution for fingerprint images be 39.37 ppmm (1000 ppi). It should be noted that as the class resolution is increased, more detailed ridge and structure information becomes available in the fingerprint image. However, in all cases the class resolution shall be at least 19.69 ppmm (500 ppi).

The variable-resolution fingerprint image data contained in the Type-14 record may be in a compressed form.

Some domains specify a set number of Type-14 records for an enrollment. An example is ten rolled impressions of the individual fingers, two plain impressions of the thumbs or one plain impression of the thumbs simultaneously, and two plain impressions of the remaining fingers of each hand. Some transactions may also include rolled tip images and either one entire joint image or one full finger rolled image and left, center and right full finger plain impressions. Most domains and application profiles require information if fewer than 10 fingers were printed. Type-14 now contains a field to specifically convey this information (**Field 14.018: Amputated or bandaged / AMP**).

5.3.15 Type-15 records

Type-15 image records shall contain and be used to exchange palm print image data together with fixed and user-defined textual information fields pertinent to the digitized image. While the Type-15 record may be used for the exchange of 19.69 ppmm (500 ppi) images, it is strongly recommended that the class resolution for Type-15 images be 39.37 ppmm (1000 ppi). It should be noted that as the resolution is increased, more detailed ridge and structure information becomes available in the image. However, in all cases the class resolution shall be at least 19.69 ppmm (500 ppi).

The variable-resolution palm print image data contained in the Type-15 record may be in a compressed form. A typical transaction for some agencies includes: a writer's palm with an upper and lower palm from each hand and two full palmprints.

5.3.16 Type-16 records

The Type-16 image record is designed for developmental purposes and for the exchange of miscellaneous images. This record shall contain and be used to exchange image data together with textual information fields pertinent to the digitized image. Such an image is usually not elsewhere specified or described in this standard. With the exception of the fields at the start of the record and the descriptors for the image data, the remaining details of the Type-16 record are undefined by this standard and shall be agreed upon between the sender and recipient.

5.3.17 Type-17 records

Type-17 image records shall contain iris image data. This record type was developed to provide a basic level of interoperability and harmonization with the *ANSI INCITS 379-2004 Iris image interchange format* and the *ISO/IEC 19794-6 Iris image data interchange format.* It also contains optional descriptive data fields and (new to this version of the standard) image markup fields. Generic iris images may be exchanged using the mandatory fields of this record type. Field **17.018 (Global unique identifier)** from the 2007 and 2008 version of the standard has been deprecated in this version.

5.3.18 Type-18 records

The Type-18 record (new to this version of the standard) shall contain and be used to exchange DNA and related data. It was developed to provide a basic level of interoperability with the draft format of the *ISO/IEC 19794-14 DNA data interchange format*.

With full consideration to privacy, this standard only uses the non-coding regions of DNA. The regions of the DNA that encode phenotypic information are deliberately avoided.

5.3.19 Type-19 records

Type-19 image records (new to this version of the standard) shall contain and be used to exchange variable-resolution plantar print image data together with fixed and user-defined textual information fields pertinent to the digitized image. While the Type-19 record may be used for the exchange of 19.69 ppmm (500 ppi) images, it is strongly recommended that the class resolution for plantar images be 39.37 ppmm (1000 ppi). It should be noted that as the resolution is increased, more detailed ridge and structure information becomes available in the image. However, in all cases the scanning resolution used to capture a plantar image shall be at least as great as the minimum scanning resolution of 19.69 ppmm (500 ppi). The variable-resolution plantar image data contained in the Type-19 record may be in a compressed form.

5.3.20 Type-20 records

The Type-20 record (new to this version of the standard) shall contain the source representation(s) from which other Record Types were derived. Typically, one Type-20 source representation is used to generate one or more representations for use in other record types. When a source representation (in a Type-20 record) is processed and the derived representation is to be used as the source for further derivations, then the derived representation is contained in a Type-20 record.

In some cases, several Type-20 records may be processed to derive a single Type-20 record.. Some possible uses of the Type-20 record are shown here.

- From a group photo stored in a Type-20 record, a subject's face is segmented and stored in a Type-10 record.
- From a high-resolution color image in a Type-20 record, two latent fingerprint images are segmented, rescaled and gray-scaled for storage in separate Type-13 records.
- From a series of off-angle face images stored in separate Type-20 records, a single 2D face image is generated (using fusion) that is stored in a Type-10 record.

5.3.21 Type-21 records

The Type-21 record shall contain an associated context image, audio / visual recording or other related data. This record type does NOT contain information used to derive biometric information contained in other records. Record Type-20 serves that function. Record Type-21 may be used to convey contextual information, such as an image of the area where latent fingerprints were captured.

5.3.22 Type-98 records

The Type-98 record shall contain security information that allows for the assurance of the authenticity and/or integrity of the transaction, including such information as binary data hashes, attributes for audit or identification purposes, and digital signatures.

5.3.23 Type-99 records

Type-99 records shall contain and be used to exchange biometric data that is not supported by other ANSI/NIST-ITL record types. This provides a basic level of interoperability and harmonization with other biometric interchange formats. This is accomplished by using a basic record structure that is conformant with *ANSI INCITS 398-2005, the Common Biometric Exchange Formats Framework (CBEFF)* and a biometric data block specification registered with the International Biometrics Industry Association (IBIA)[6].

5.4 Backward compatibility

Backward compatibility is important, since organizations adhering to earlier versions of the standard may create transactions according to that version, and these transactions may still be received by organizations that have updated tto a newer version of the standard.

[6] For more information, go to http://www.ibia.org .

The fields and format of Type-4 (fingerprint images) and Type-8 (signature) records cannot change between versions of the standard due to restrictions in the Traditional encoding format. (In Traditional encoding, they are 'binary' data with a fixed structure.) Since the time when these record types were defined, users have needed more flexibility in defining the metadata associated with the fingerprint image data. Thus, Type-14 was developed to replace Type-4 fingerprint image records. However, since several systems exist that use Type-4 to transmit fingerprint images, that record type is retained in the standard. Type-2 (user-defined descriptive text entries), Type-7 (user-defined image) and Type-16 (user-defined testing image) records are further defined in application profile-specific documentation (See **Section 6 Implementation domain and application profiles).**

Record types 9 through 99 may be updated, expanded or introduced with new versions of the standard. New fields in existing records may be added, as well as new data record types.

If it is determined by the canvassees that a record type, field, subfield, information item or value is not used or needed, it may be declared '***deprecated***.' In this version of the standard, the deprecated record type, field, or information item is not included in the description. Deprecated records for this version are Record Types 3, 5 and 6. **Field 17.018** is deprecated. There are two deprecated values in **Field 17.016: Image property code / IPC** (2: for interlace frame, and 3: for interlace field).

There are also certain items that are noted in the standard as being discouraged for use in new applications, but that have not yet been agreed upon by the canvassees to be deprecated.

There is a special category called '***legacy***' for a record type, field, subfield, information item or value that was valid in previous versions of the standard, but shall not be used for new data. '***Legacy***' indicates that if there is existing data using this record type, field, information item or value it may still be transmitted in a transaction conformant to this version of the standard. In this version '***legacy***' applies to **Fields 9.005** through **9.012**, **Field 10.022** and to the value '1' in **Table 4 Character encoding**.

When a data definition is introduced that causes potential problems with backward compatibility, it is noted in the standard. An example is the definition of 'color space.' See **Section 7.7.10.3.** NIEM-conformant XML encoding has inherent backward compatibility issues due to the need to develop new schemas. See **Annex C: NIEM-conformant encoding rules** for details.

Some fields and information items are optional in this version of the standard that were mandatory in previous versions. Examples are the second and third information items of **Field 9.135: M1 friction ridge quality data / FQD.** A significant change is that **Field 999** in Record Types 14,15, and 17 are now optional if it is indicated that the body part is amputated or unable to be captured.

5.5 Character types

The data contained in an information item may be of the following types:

- A — Alphabetic: 26 English letters (both upper and lower case) or spaces
- AN — Alphanumeric: Alphabetic and numeric 1 2 3 4 5 6 7 8 9 0
- ANS — Alphanumeric and special characters that are specifically stated in the description of the data (such as period or comma)
- AS — Alphabetic and special characters that are specifically stated in the description of the data (such as period or comma)
- B — Binary for Traditional encoding (See **Annex B: Traditional encoding**) or Base64 for XML (See **Annex C: NIEM-conformant encoding rules**)
- Base64 — Base-64 encoded (exclusively)
- H — Hexadecimal representation: 0 1 2 3 4 5 6 7 8 9 A B C D E F
- N — Numeric: 1 2 3 4 5 6 7 8 9 0
- NS — Numeric with special characters that are specifically stated in the description of the data (such as period or comma)
- U — Unicode characters: Latin and extended Latin characters like ü, Ñ, ç, Þ, ß, ł, ặ, and special characters like ₤, €, ™, +, * , ‡, and non-Latin characters like ᆄ, oҕ, Å, Ⴗ, ж, ઍ, 句, ע , ث , and の.

At the beginning of each Section describing the contents of a record type, there is a table listing the layout for that record type. Each data location in the tables lists the character type, the minimum and maximum number of characters, the data constraints, and the number of times that it may appear.

5.6 Character encoding

In order to ensure that the transaction description information can be read by all systems, data for all fields in Record Type-1 shall always be recorded in all encodings using the characters that can be represented by the 7-bit American National Standard Code for Information Interchange (ASCII) found in **Table 93** with the exception of the reserved values.

The control characters “$^{F}{}_{S}$”, “$^{G}{}_{S}$”, “$^{R}{}_{S}$”, “$^{U}{}_{S}$”, “$_{STX}$” and “$_{ETX}$” are reserved characters in all encodings. Base-64 shall be used for converting non-ASCII text into ASCII form, where required and noted in the standard. (See **Annex A: Character encoding information** for a description of Base-64).

Table 4 Character encoding

Character encoding index	Character encoding name	Description
0	ASCII	7-bit (Default) with zero added in high bit position (See **Annex A: Character encoding information**)
2	UTF-16 [7]	16 bit (See *ISO/IEC 10646-1* and *The Unicode standard*)
3	UTF-8	8-bit (See *NWG 3629* and *The Unicode standard*)
4	UTF-32	32-bit (See *The Unicode standard*)
5-127	-------------	Reserved for future use
128-999	-------------	User-defined character encoding sets

Field 1.015 Character encoding / DCS is an optional field that allows the user to specify an alternate character encoding. The default character encoding for Traditional encoding is 7-bit ASCII. For XML, the default is UTF-8. **Field 1.015 Character encoding / DCS** contains three information items: the **character encoding set index / CSI**, the **character encoding set name / CSN**, and the **character encoding set version / CSV.** The first two items (**CSI** and **CSN**) are selected from the appropriate columns of **Table 4. CSV** specifies the specific version of the character encoding set used , such as UTF-8 version **1.0**. Note that the value "1" does not appear in the table. It is a legacy value, which should not be used for newly generated transactions. The 2007 and 2008 versions of this standard referred to it as "8-bit ASCII" and it was used to indicate the Latin-1 character set (*ISO/IEC 8859-1*).

The 2007 version of the standard allowed users to switch any data (except that contained in the Type-1 record) to an alternative character encoding using a mechanism employing special control characters. This capability is retained in this version of the standard for Traditional encoding to ensure backward compatibility. See **Annex B: Traditional encoding**. However, the 2007 version stated that for certain fields, UTF-8 could be used for the data without having to include the special control characters. Fields where this is possible in this version of the standard are marked with 'U' or 'user-defined' in the 'character type' column of the record layout tables for each record type. Users are encouraged to choose the option of UTF-8 for 'U' and 'user-defined' character types that does not require the use special control characters in Traditional Encoding. It is not possible to switch character encodings in XML, but users are encouraged to state the character encoding (normally UTF-8) and version (1.0) in **Field 1.015**. See **Annex C**.

[7] In the 2007 and 2008 versions of the standard, this was called Unicode. It has been changed here for clarity, since Unicode can be expressed in UTF-8, UTF-16 and UTF-32 and code 2 only referred to UTF-16.

6 Implementation domain and application profiles

An implementation domain, coded in **Field 1.013 Domain name / DOM** of a Type-1 record as an optional field, is a group of agencies or organizations that have agreed to use pre-assigned data fields with specific meanings (typically in Record Type-2) for exchanging information unique to their installations. The implementation domain is usually understood to be the primary application profile of the standard. New to this version of the standard, **Field 1.016 Application profile specifications / APS** allows multiple application profiles to be referenced. The organization responsible for the profile, the profile name and its version are all mandatory for each application profile specified. A transaction must conform to each profile that is included in this field. It is possible to use **Field 1.016** and / or **Field 1.013.** It is recommended that when only one profile is applicable, that **Field 1.013** be used and it be called the implementation domain.

An example of an implementation domain is the one maintained by the Criminal Justice Information Services (CJIS) Division of the Federal Bureau of Investigation (FBI). It is the North American Domain subscribed to by the Royal Canadian Mounted Police (RCMP), the FBI, and several state and Federal agencies in North America. The default value for this field shall be the North American Domain implementation and shall appear as "NORAM".

The transaction may include user-defined fields that are not described in any specified application profile or the specified domain. However, when any part of a transaction is defined by one or more application profiles, it must conform to the requirements of all of the relevant application profiles.

7 Information associated with several records

7.1 Record header

The record header appears as the first field (**xx.001**) in each Record Type. It contains information particular to the encoding format chosen, in order to enable proper reading of the record. In Traditional encoding, this field contains the record length in bytes (including all information separators). In NIEM-conformant XML encoding, this field contains the *RecordCategoryCode*, which is the numeric representation of the Record Type.

In the 2007 version of the standard, the record length was unrestricted for Record Type-1. It was a maximum value having up to 4-bytes in ASCII representation for Record Types 4 and 7 and 8. For Record Types 9 and above it was restricted to 8 characters (99,999,999). These values are retained in this version for Traditional encoding.

In Traditional encoding, the mnemonic for the record header is **LEN**. This is to allow a change to the value contained in the record header to be recorded in a Type-98 record. See **Annex B: Traditional encoding** and **Field 98.900: Audit log / ALF** .

7.2 Data

Field xx.999 is reserved in Record Types 10 and above for data associated with the record that is described in the other fields of the record. It is mandatory in most of these record types. (It does not appear in Type-18 or Type-98). Only in Record Types 14, 15, 17 and 19 is it possible for **Field xx.999** to be optional - when an amputated or missing body part is noted in the appropriate field in those record types. In those cases, it is optional, depending upon the specifications of the domain or implementation profile.

7.3 Indexes used to link records

In order to track relationships among instances of records in a transaction, some special pointer indexes are used within the Record Types. The **information designation character / IDC** (called **image designation character** in previous versions of the standard) occurs in each instance of a record, except Record Type-1. It occurs as **Field xx.002** in those records. If two records have the same **IDC** value, they are closely linked, as explained in **Section 7.3.1.** There are restrictions on the use of the **IDC**. Historically, it has been principally used to link a fingerprint image record to the minutiae record with data derived from that fingerprint image. There is an upper limit of 100 **IDC** values, since they are numbered from 0 to 99. This restriction is based upon limiting the **IDC** to 2 ASCII characters (resulting in a maximum value of 99) in **Field 1.003** of the 2007 version of the standard. There was no restriction in the 2008 version. The upper limit of 99 is retained in this version to preserve backward compatibility with the 2007 version of the standard. **Field 1.003 Transaction content / CNT** therefore has the same character counts for **IDC** as the 2007 version.

New to this version of the standard are pointer indexes to a Source Representation record (Type-20) and another index to one or more Associated Context records (Type-21).

- The first index (to a Type-20 record) is described in **Section 7.3.2.** It is stored in **Field xx.997,** which is an optional field. Type-20 records (if in the transaction) contain the source from which the biometric sample in another record or records was obtained. An example is a photograph of many people, with the image of the subject of the transaction segmented out of the original photo and placed in a Type-10 record. The **source representation number/ SRN** (See **Section 7.3.2.1)** information item is this index to the particular Type-20 record containing the source representation from which the biometric data was derived that is included in the particular instance of Record Type **xx**. Also in the **Field xx.997** is an optional second information item **reference segment position / RSP,** described in **Section 7.3.2.2.** It contains the index to a particular set of segmentation coordinates of the source representation.

- The second index (to a Type-21 record) is described in **Section 7.3.3.** It is stored in **Field xx.995**, which is an optional field. Type-21 records (in the transaction) contain images, or audio / visual recordings that may be associated with the collection of the biometric sample, but are NOT the actual source of the sample. An example might be a general picture of where the latent prints were captured. The index to Record Type-21, **associated context number / ACN,** (See **Section 7.3.3.1**) is contained in an information item in **Field xx.995**. There may be multiple subfields in **Field xx.995** for a particular instance of a record, with each containing a different **ACN**. A second information item is the **associated segment position / ASP** described in **Section 7.3.3.2**. It contains the index to a particular set of segmentation coordinates of the associated context data.

Also new to this version of the standard are two fields that contain indexes to allow linking instances of a particular Record Type.

- **Field 10.039: Type-10 reference number / T10** explicitly handles Type-10 images that are of the same body part, such as a larger image and zoomed-in images. (See **Section 7.3.4).**

- **Field 14.026: Simultaneous capture / SCF** explicitly links finger images that were captured simultaneously on non-contiguous platens or other image capture technologies that do not capture the finger images in a manner preserving full relative position of the finger tips to each other, if placed in a single image. (See **Section 7.3.5).**

7.3.1 Information designation character / IDC

Each of the records present in a transaction, with the exception of the Type-1 record, shall include a field (**xx.002**) containing the **information designation character / IDC**[8]. The value of the **IDC** shall be a sequentially assigned positive integer starting from zero and incremented by one up to a maximum of 99. **IDC** references are stated in Type-1 **Field 1.003 Transaction content / CNT** and shall be used to relate information items in the **CNT** field of the Type-1 record to the other records in the transaction. Two or more records may share a single **IDC** solely to identify and link together records that pertain to different representations of the same biometric trait.

- Most frequently, **IDC**s are used to link a particular finger/palm/plantar image (in a Type - 4, 13, 14, 15, 19 record) with the corresponding Type-9 minutiae record. When different images of a single finger/palm/plantar are captured, each is given a separate **IDC**, to ensure that the minutiae records correspond to a specific image record.

- Two or more **image** records may share a single **IDC** only when they are enhancements of a single image; such transformations shall have identical dimensions, and shall not be distorted with respect to each other (i.e., a feature at a given position in one image shall be in the same position in the other image). This means that if a friction-ridge image is captured at 1000 ppi (saved in Type 13, 14, 15, or 19) and down-sampled to 500 ppi (for transmission in a Type-4 record), then each would have different **IDC**s. Multiple images of a face, encoded in Record Type-10,

[8] This was called the **image designation character** in earlier versions of the standard. The mnemonic is the same.

shall each have a unique **IDC**. SMT images also each have a unique **IDC**. In the case when one is a different image of the same SMT, **Field 10.039: Type-10 reference number / T10** is used to link those SMT images.

Some examples of the use of **IDC** are:

- A criminal arrest transaction that might, for some agencies, include fingerprints, palmprints, and a mugshot would include distinct records with **IDC**s ranging from "0" to "21": a Type-1 record, a Type-2 record (**IDC** 0), 14 Type-14 fingerprint image records (**IDC**s 1-14), six Type-15 palmprint records (**IDC**s 15-20), and a Type-10 facial image (**IDC** 21).

- A latent print search transaction, which for some agencies could include two latent images with minutiae markup, the original source image from which the latent prints were derived, and a crime scene image would include distinct records with **IDC**s ranging from "0" to "4": a Type-1 record, a Type-2 record (**IDC** 0), 2 Type-13 latent image records (**IDC**s 1-2), two Type-9 minutiae records (**IDC**s 1-2, referring to the Type-13 latent image records), a Type-20 source representation image record (**IDC** 3), and a Type-21 associated context record (**IDC** 4).

- A 'raw' image and the same image stored with WSQ compression would have the same **IDC**. Both share the same image dimension and the features would occur at the same location.

New to this version of the standard, three fields, **Field 9.360: EFS area of correspondence / AOC**, **Field 9.362: EFS examiner comparison determination / ECD** and **Field 9.362: EFS examiner comparison determination / ECD** use **IDC**s as references to define the relationship between two different prints.

7.3.2 Source representation / SOR

New to this version of the standard, optional field **xx.997** is allowed in biometric data sample Record Types 10 and above that have the biometric sample derived from a source representation in Record Type-20. The biometric data is stored in **Field xx.999** (See **Section 7.2 Data**). Record Type-18 (DNA) does not contain a field xx.997, since it does not contain a field 18.999**.** Record Type-98 does not contain this field, since that is not a biometric data record type. Record Type-21 does not contain biometric data and thus does not include field **xx.997**. This field is comprised of one mandatory and one optional information item, as described below. An example of the use of this field would be when data is extracted from a representation, such as a group photograph, which is stored in a Type-20 record. The facial image of the subject of the transaction may be segmented and placed in a Type-10 record.

Figure 1 illustrate the relationship between a data record and the source representation contained in a Record Type-20.

7.3.2.1 Source representation number / SRN

The first information item contains the **source representation number / SRN**. This is mandatory for each **Field xx.997**. It contains an index to a particular instance of a Type-20 record in the transaction. This same index value appears in the appropriate instance of Record Type-20 as **Field 20.021: Source representation number / SRN**. The value of the **SRN** shall be a sequentially assigned a positive integer starting from one and incremented by one, not to exceed 255.

7.3.2.2 Reference segment position / RSP

The second information item in **Field xx.997** is optional. It is the **reference segment position / RSP**. It contains the index to a particular set of segmentation coordinates of the source representation. (There may be more than one segment, such as from an audio / visual recording, with different frames yielding input for separate biometric data record instances in the same transaction)**.** This same segmentation index value appears in Record Type-20 as the **reference segment position / RSP** in **Field 20.016: Segments / SEG**. There may be up to 99 segments listed in **Field 20.016,** but only the segment used to produce the biometric data contained in **Field xx.999** of the particular instance of Record Type-xx is identified in **Field xx.997.**

Figure 1: Source Representation Indices

DATA RECORD		RECORD TYPE-20 WITH THE APPROPRIATE SOURCE REPRESENTATION
Field xx.997 / SOR		
Subfield k (there can be multiple source representations)		
information item SRN value = a	←	**Field 20.021 / SRN** value = a
information item RSP value = z	←	**Field 20.016 / SEG**
		Subfield j (for the proper segment)
		information item RSP value = z

7.3.3 Associated context / ASC

New to this version of the standard, optional field **xx.995** is contained in biometric data sample Record Types 10 and above that may have instances of Record Type-21 linked to it. Record Type-21 stores images and/or recordings that are not the actual source of the biometric data contained in another Record Type, but do show the context of the biometric data. An example would be a crime scene photograph showing the location of a glass that had latent prints on it. However, the close-up image of the latent prints could appear in a Type-20 record (since that is the image that the individual fingerprint images are derived from), with the segmented individual images appearing in Type-13 records. This field consists of a maximum of 255 repeating subfields, each of which contains two information items, as described below. This is because there may be multiple instances of associated context records associated with a single biometric sample. **Figure 2** illustrates the relationship of the fields and information items.

7.3.3.1 Associated context number / ACN

The first information item contains the **associated context number / ACN** for a particular Record Type-21. This is mandatory for each **Field xx.995,** when the field is used. It contains an index to a particular instance of a Type-21 record in the transaction. This same index value appears in the appropriate instance of Record Type-21 as **Field 21.021: Associated context number / ACN**. The value of the ACN shall be a sequentially assigned a positive integer starting from one and incremented by one, not to exceed 255.

7.3.3.2 Associated segment position / ASP

The second information item in **Field xx.995** is optional. It is the **associated segment position / ASP.** It contains the index to a particular set of segmentation coordinates of the associated context data. This same segmentation index value appears in Record Type-21 as the **associated segment position / ASP** in **Field 21.016: Segments / SEG**. There may be up to 99 segments listed in **Field 21.016,** but only the relevant segment is contained in **Field xx.995.**

Figure 2: Associated Context Indices

DATA RECORD		RECORD TYPE-21 WITH THE APPROPRIATE SOURCE REPRESENTATION
Field xx.995 / ASC		
Subfield k (there can be multiple source representations)		
information item ACN value = a	←	**Field 21.021 / ACN** value = a
information item ASP value = z	←	**Field 21.016 / SEG**
		Subfield j (for the proper segment)
		information item ASP value = z

7.3.4 Type-10 reference

There may be several Type-10 images of a particular part of the body. For instance, a photograph of a tattoo may cover the entire tattoo. Another may be a zoom-in shot of a portion of the tattoo. In order to link these two images, the same index number is assigned to **Field 10.039: Type-10 reference number / T10,** which is new to this version of the standard. Note that these images would have different **IDC** values.

7.3.5 Simultaneous capture

In order to accommodate the emergence of technology that can simultaneously capture fingerprint images on separate platens or other technology that does not preserve the full relative position of the fingers to each other, **Field 14.026: Simultaneous capture / SCF** allows the user to specify the same reference number for all images that were simultaneously captured. With this field included in a record, the transmitter states that sequencing errors definitely did not occur on the finger images. **Field 14.026** is new to this version of the standard. Multi-finger images generated within a single device based upon adjacent platens are considered a single capture and thus are not marked as simultaneous capture in this field.

7.4 Data Processing Logs

This version of the standard introduces several capabilities to record operations performed to process the biometric sample.

7.4.1 Annotation information / ANN

New for this version of the standard, optional field **xx.902** is used to store annotation, logging, or processing information associated with one or more processing algorithms or workstations. If present, this text field shall consist of one or more subfields comprised of a set of information items. Four mandatory information items comprise a subfield:

- The first information item is the **Greenwich mean time / GMT** when the processing occurred. (See **Section** 7.7.2.2)

- The second information item (**processing algorithm name/version / NAV)** shall contain text of up to 64 characters identifying the name and version of the processing algorithm / application or workstation.

- The third information item (**algorithm owner / OWN**) shall contain text of up to 64 characters with the contact information for the organization that developed / maintains the processing algorithm / application or latent workstation.

- The fourth information item (**process description / PRO)** shall contain text of up to 255 characters describing a process or procedure applied to the sample in this Type-XX record.

7.4.2 Universal latent workstation (ULW) annotation information / LAI

This optional field, which is new to this version of the standard, exists only in Record Type-9. The ULW has been extensively used and logs generated from it were routinely transmitted in user-defined **Field 9.901** in previous versions of this standard. Thus, this version of the standard formally includes **Field 9.901: Universal latent workstation annotation information / ULA** to record latent processing logs formatted according to the ULW.

7.4.3 Information assurance audit logs

If a user wishes to maintain a log of differences between transmissions, **Field 98.900: Audit log / ALF** may be used to indicate how and why a transaction was modified. Record Type-98 is new to this version of the standard. The **ALF** is of particular use when a transaction is sent from one location to a second, where additional information is included, before sending to a final destination.

7.4.4 Comment

The optional Comment field appears in many record types and may be used to insert free text information. It is not reserved exclusively for log-related information but has historically often been used for this purpose. It is limited to a maximum of 126 characters. This maximum size was established in order to maintain consistency across encodings. The maximum size differed in the 2007 and 2008 versions of the standard. The comment fields are:

Field 10.038: Comment / COM
Field 13.020: Comment / COM
Field 14.020: Comment / COM
Field 15.020: Comment / COM
Field 16.020: Comment / COM
Field 17.021: Comment / COM
Field 18.022: Comment / COM
Field 19.020: Comment / COM
Field 20.020: Comment / COM
Field 21.020: Comment / COM

The EFS comment field in Record Type-9 is limited to 200 characters. It is:

Field 9.351: EFS comments / COM

7.5 Data Protection

7.5.1 Information assurance

The **Record Type-98: Information assurance record**, which is new to this version of the standard, allows special data protection procedures to ensure the integrity of the transmitted data. **Field 98.003: IA data format owner / DFO** and **Field 98.005: IA data format type / DFT** define the information assurance regime that is employed to store data in **Fields 98.200-899: User-defined fields / UDF** .

7.5.2 Data hash / HAS

Optional field **xx.996**, which is new to this version of the standard, is designed for use in Record types 10 and above that have a **Field xx.999** storing the biometric data. **Field xx.996** is comprised of 64 characters representing hexadecimal values. Thus, each character may be a digit from “0” to “9” or a letter “A” through “F”. See the latest version of the *Federal Information Processing Standard 180, Secure Hash Standard* for information on computing SHA-256 hashes. At the time of this standard's publication, *FIPS 180-3*[9] had been published.

It is also possible to use **Field xx.996** to contain the hash for data stored externally, which is referenced in **Field 20.994: External file reference / EFR** and /or **Field 21.994: External file reference / EFR** . The ability to store files externally is new to this version of the standard, and is only implemented for the two new record types referred to here.

Use of the hash enables the receiver of the data to perform quick searches of large databases to determine if the data already exist in the database. It is not intended as an information assurance check. That is handled by **Record Type-98: Information assurance record**.

7.6 Agency codes

In the 2007 version of the standard, Record Type-1 fields for agency identification were comprised of one information item **{destination}{originating} agency identifier / DAI or ORI**. The 2008 version of the standard added a second optional information item **{destination}{originating} agency name / DAN or OAN**, and is a text description of the organization name. In this version of the standard, the agency names (**DAN** and **OAN**) are contained in a new field (**Field 1.017 Agency names / ANM**) since information items cannot be added to existing fields in Traditional encoding and still preserve backward compatibility. **DAN** and **OAN** have an unlimited maximum number of characters in this version. XML encoding is not dependent upon the field number, so there is no change required for compatibility with the 2008 version. Both information items in **ANM** are optional and may be encoded using alphanumeric characters with any special characters allowed in ASCII.

The affected fields are:

- **Field 1.007 Destination agency identifier / DAI**
- **Field 1.008 Originating agency identifier / ORI**
- **Field 1.017 Agency names / ANM**

In many Record types, **Field xx.004** contains the **SRC.** This is the identifier of the agency that actually created the record and supplied the information contained in it. (The **ORI** specified in **Field 1.008 Originating agency identifier / ORI** is the organization that created the transaction, which may be assembled from record(s) received from another agency or agencies). **SRC** is unlimited in size and is "U" character type.

In order to maintain backward compatibility with the 2007 version while maintaining backward compatibility with the 2008 version, a new optional **Field xx.993** has been added for the **Source agency name / SAN**. **SAN** is up to 125 characters and in "U" character type (unlike the information items in **Field 1.017 Agency names / ANM** which only allow the characters that can be represented in ASCII).

For example, in Record Type-13, there are two fields:

[9] FIPS 180-3 is available at **http://csrc.nist.gov/publications/fips/fips180-3/fips180-3_final.pdf**

- **Field 13.004: Source agency/ SRC**
- **Field 13.993: Source agency name / SAN**

In Record Type-18 there is an information item, the **name of the organization / NOO** (in **Field 18.003: DNA laboratory setting / DLS)** that processed the DNA data. This may be different from the agency in **Field 18.004: Source agency / SRC** and from the agency listed in **Field 1.008 Originating agency identifier / ORI**.

7.7 Metadata describing the biometric sample

7.7.1 Biometric acquisition device identification

Several record types contain fields describing the biometric acquisition device[10]:

7.7.1.1 Device unique identifier / DUI

The **DUI** shall contain a string uniquely identifying the device or source of the data[11]. This field shall be one of:

- Host MAC address, identified by the first character "M"[12], or
- Host processor ID, identified by the first character "P".

Fields containing the **DUI** are:

Field 9.903: Device unique identifier / DUI
Field 10.903: Device unique identifier / DUI
Field 13.903: Device unique identifier / DUI
Field 14.903: Device unique identifier / DUI
Field 15.903: Device unique identifier / DUI
Field 16.903: Device unique identifier / DUI
Field 17.017: Device unique identifier / DUI
Field 19.903: Device unique identifier / DUI
Field 20.903: Device unique identifier / DUI
Field 99.903: Device unique identifier / DUI

[10] Notice that **Field 17.018 (Global unique identifier / GUI)** is deprecated in this version of the standard. It did not conform to the standard **GUI** usage in information technology.
[11] This version of the standard deletes the options for "Serial number or No serial number" from **Field 17.017**, since it is available in the **Make / Model / Serial Number** field.
[12] The MAC address takes the form of six pairs of hexadecimal values (0 through 9 and A through F). They are represented without separators in this standard for a total of 13 characters. The processor ID may be up to 16 characters.

7.7.1.2 Make/model/serial number / MMS

The **MMS** contains the make, model and serial number for the capture device. It shall consist of three information items. The information items are:

make / MAK,
model / MOD, and
serial number / SER.

Each information item shall be 1 to 50 characters. Any or all information items may indicate that information is unknown with the value "0".Fields containing the **MMS** are:

Field 9.904: Make/model/serial number / MMS
Field 10.904: Make/model/serial number / MMS
Field 13.904: Make/model/serial number / MMS
Field 14.904: Make/model/serial number / MMS
Field 15.904: Make/model/serial number / MMS
Field 16.904: Make/model/serial number / MMS
Field 17.019: Make/model/serial number / MMS
Field 19.904: Make/model/serial number / MMS
Field 20.904: Make/model/serial number / MMS
Field 99.904: Make/model/serial number / MMS

7.7.1.3 Device monitoring mode / DMM

This field describes the level of human monitoring that was associated with the biometric sample capture. Alphabetic values are selected from **Table 5.** These are the corresponding fields in the standard:

Field 10.030: Device monitoring mode / DMM
Field 14.030: Device monitoring mode / DMM
Field 15.030: Device monitoring mode / DMM
Field 16.030: Device monitoring mode / DMM
Field 17.030: Device monitoring mode / DMM
Field 19.030: Device monitoring mode / DMM

Table 5 Device monitoring mode

Condition	Description
CONTROLLED	Operator physically controls the subject to acquire the biometric sample
ASSISTED	Person available to provide assistance to subject submitting the biometric
OBSERVED	Person present to observe operation of the device but provides no assistance
UNATTENDED	No one is present to observe or provide assistance
UNKNOWN	No information is known

7.7.2 Date and time

Date and time are used in several fields and information items throughout the standard. They are handled differently for each encoding (See **Annex B** and **Annex C**).

7.7.2.1 General

YYYY designates the four-digit year; MM designates the month (01 through 12); DD represents the day of the month (01 through 31); hh represents the hour (00 through 23); mm represents the minute (0 through 59); and ss represents the seconds (0 through 59). Midnight is expressed as all zeros in the time portion of the date and time.

The time and date fields are handled differently for each encoding. The Traditional encoding represents the time and date as a numeric value (such as "20110308" representing March 8, 2011). NIEM-conformant encoding places the date in an element formatted as "2011-03-08". The value is shown as "2011-03-08T05:25:00Z" in the case of Greenwich mean time (See **Section 7.7.2.2**). The "T" is a fixed character that indicates the separation of the date and the time in the alphanumeric string. In all cases, the content shall be identical, regardless of the encoding. See **Annex B: Traditional encoding** and **Annex C: NIEM-conformant encoding rules** for details.

7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT

UTC has replaced GMT as the main reference time scale terminology, but the older terminology is retained in this standard for existing record types. In this standard, **Field 1.014 Greenwich mean time / GMT** shall be taken to mean the UTC value. Some newer record types using this format refer to the data as UTC (such as in **Field 18.013: Sample collection date / SCD**). This time is independent of the actual time zone where the time and date is recorded. The data is YYYYMMDDhhmmssZ, where the Z is indicates the zone description of 0 hours. This data is handled differently for each encoding.

7.7.2.3 Local date

The local date is recorded as YYYYMMDD. It may be a different date than the GMT, due to time zone differences. It is handled differently for each encoding.

7.7.2.4 Local date & time

The local date and time is recorded as YYYYMMDDhhmm. Note that this may be a different date than the corresponding GMT, due to time zone differences. It is reflective of the local time, such as Daylight Savings Time. This data is handled differently for each encoding.

7.7.2.5 Time index / TIX

For Type-20 or Type-21 records containing video or audio, this field shall contain two information items, **time index start /TIS** and **time index end / TIE** for the start and end times of segments within a video or audio file, measured in hh:mm:ss.$_{sss}$ where ss.$_{sss}$ refers to the seconds and milliseconds. Thus, the allowed special characters are the colon and the period. **TIX** is comprised of one or more subfields. Each subfield corresponds to a single segment, with a starting and end time as separate information items. This data is handled differently for each encoding. The zero time index shall be clearly indicated on the source, unless it is the absolute beginning of the file.

7.7.3 Geographic sample acquisition location / GEO

New to this version of the standard, this optional field (**xx.998**) is used in most Record Types 10 and above. It specifies the coordinated universal time (UTC) and the location where the biometric sample was collected. All of this information is contained in up to fifteen information items.

There are multiple possible formats for specifying the geographic location in this field (longitude and latitude, geographic coordinate universal transverse Mercator, and alternate coordinate systems).

- The first information item is optional. It is the coordinated **universal time entry / UTE**. See **Section 7.7.2.2.**

The next eight information items (information items 2 through 9) comprise the Geographic Coordinate Latitude/Longitude. As a group, they are optional. However, **latitude degree value / LTD** and **longitude degree value / LGD** are co-conditional, so they shall both be present if either is present. Further, “minutes” values **LTM** and **LGM** can only be present if their corresponding “degrees” values are present. **LTS** and **LGS** can only be present if their corresponding “minutes” value is present. The other entries are optional.

Geographic coordinate latitude is measurement of the angular distance between a point on the earth and the equator. Geographic coordinate longitude is a measurement of the angular distance between a point on the earth and the prime meridian. If a decimal value is used in a particular information item, the more granular information item shall be empty (e.g., if Longitude minutes equals 45.27, Longitude seconds shall be empty).

- The second information item is **latitude degree value / LTD**. This is a value that specifies the degree of latitude. The value shall be between -90 (inclusive) and +90 (inclusive). The degrees may be expressed as an integer (without a decimal) or a real number including decimals. If decimals are present, then minutes and seconds shall be empty. The allowed special characters are the negative sign and the period. Examples:
    - Buenos Aires, Argentina: -34 (with minutes **LTM** = 36)
    - NIST, Gaithersburg, Maryland: 39.137627 (no **LTM** or **LTS**)
- The third information item is **latitude minute value / LTM**. This is a value that specifies a minute of a degree. The value shall be between 0 (inclusive) to 60 (exclusive). The minute value may be expressed as an integer (without a decimal) or as a real number including decimals. If decimals are present then seconds shall be empty. Thus, the allowed special character is a period. The minute value can be

empty, even if the degree value is an integer. **LTM** and **LGM** are co-conditional, so they shall both be present if either is present.

- The fourth information item is the **latitude second value / LTS**. This is a value that specifies a second of a minute. The value shall be 0 (inclusive) to 60 (exclusive). Thus, the allowed special character is a period. The second value can be empty, even if the minute value is an integer. **LTS** and **LGS** are co-conditional, so they shall both be present if either is present.

- The fifth information item is the **longitude degree value / LGD**. It is a value that specifies the degree of a longitude. The value shall be between -180 (inclusive) and +180 (inclusive). If **LTD** is present, then **LGD** shall be present.The degrees may be expressed as whole numbers (without a decimal) or real numbers including decimals. The allowed special characters are the negative sign and the period. If decimals are present, then minutes and seconds are empty. Examples:

    - Buenos Aires, Argentina: -58 (with minutes **LGM** = 22)
    - NIST, Gaithersburg, Maryland: -77.216032 (no **LGM** or **LGS**)

- The sixth information item is the **longitude minute value / LGM**. It is a value that specifies a minute of a degree. The value shall be from 0 (inclusive) to 60 (exclusive).The minute value may be expressed as an integer (without a decimal) or as a real number including decimals. If decimals are present then seconds shall not appear. The minute value can be empty, even if the degree value is an integer.Thus, the allowed special character is a period. **LTM** and **LGM** are co-conditional, so they shall both be present if either is present.

- The seventh information item is the **longitude second value / LGS**. This is a value that specifies a second of a minute. The value shall be 0 (inclusive) to 60 (exclusive). Thus, the allowed special character is a period. The second value can be empty, even if the minute value is an integer. **LTS** and **LGS** are co-conditional, so they shall both be present if either is present.

- The eighth information item is **elevation / ELE**. It is expressed in meters. It is a numeric value. It is between -422 meters (Dead Sea) and 8848 meters (Mount Everest). Allowed special characters are the negative sign and the period.

- The ninth information item is the **geodetic datum code / GDC**[13]. It is an alphanumeric value of 3 to 6 characters in length. This information item is used to indicate which coordinate system was used to represent the values in information items 2 through 7. If no entry is made in this information item, then the basis for the values entered in the first eight information items shall be WGS84, the code for the *World Geodetic Survey 1984 version - WGS 84 (G873)*. See **Table 6** for values.

[13] See the Glossary maintained by the National Oceanic and Atmospheric Administration for information on commonly used terms. http://www.ngs.noaa.gov/CORS-Proxy/Glossary/xml/NGS_Glossary.xml

The tenth, eleventh and twelfth information items are treated as a group and are optional. These three information items together are a coordinate which represents a location with a Universal Transverse Mercator (UTM) coordinate. If any of these three information items is present, all shall be present.

- The tenth information item is the **geographic coordinate universal transverse Mercator zone / GCM**[14]. It is an alphanumeric value of 2 to 3 characters. This is a one or two digit UTM zone number followed by the 8 degree latitudinal band designator (which is a single letter). Valid latitudinal band designators include C through X, omitting I and O.

- The eleventh information item is the **geographic coordinate universal transverse Mercator easting / GCE.** It is an integer of 1 to 6 digits.

- The twelfth information item is the **geographic coordinate universal transverse Mercator northing / GCN**. It is an integer of 1 to 8 digits.

The following item is used for instances when GPS or other coordinate systems may not be readily available:

- The thirteenth information item is optional. It is the **geographic reference text / GRT**. This information item is an alphanumeric entry of up to 150 characters. It is a free form text describing a street address or other physical location (such as 'Corner of Washington and Madison, Geneva, NY').

The following two information items should be used when an alternate system had been utilized for recording position:

- A fourteenth optional information item **geographic coordinate other system identifier / OSI** allows for other coordinate systems. This information item specifies the system identifier. It is up to 10 characters in length. Examples are:

  - MGRS[15] (Military Grid Reference System)
  - USNG[15] (United States National Grid)
  - GARS[15] (Global Area Reference System)
  - GEOREF[15] (World Geographic Reference)
  - LANDMARK landmark and position relative to the landmark, for example: Landmark: hydrant 143 sector 5 Position: 5.2 meters directly E

- A fifteenth optional information item is the **geographic coordinate other system value / OCV.** It shall only be present if **OSI** is present in the record**.** It can be up to 126 characters in length. If **OSI** is LANDMARK, **OCV** is free text and may be up to 126 characters. For details on the formatting of **OCV** for the other coordinate systems shown in **OSI** as examples, see

[14] The UTM zone numbers and designators are described at http://earth-info.nga.mil/GandG/coordsys/grids/utm.html

[15] For a description, see http://earth-info.nga.mil/GandG/coordsys/grids/referencesys.html

Table 6 Geographic coordinate datum code values

Geodetic Datum Code	Value
Airy	AIRY
Australian National	AUST
Bessel 1841	BES
Bessel 1841 (Namibia)	BESN
Clarke 1866	CLK66
e 1880	CLK80
Everest	EVER
Fischer 1960 (Mercury)	FIS60
Fischer 1968	FIS68
GRS 1967	GRS67
Helmert 1906	HELM
Hough	HOUG
International	INT
Krassovsky	KRAS
Modified Airy	AIRYM
Modified Everest	EVERM
Modified Fischer 1960	FIS60M
South American 1969	SA69
WGS-60	WGS60
WGS-66	WGS66
WGS-72	WGS72
WGS-84 / NAD-83	WGS84
Other	<entry up to 6 characters>

7.7.4 Metadata specific to friction ridge records

7.7.4.1 Impression type / IMP

This field contains a code from **Table 7** for how the friction ridge sample was collected. It has been expanded in this version of the standard to include plantars and unknowns.
A latent impression is the digital image of the latent impression that was acquired directly from a latent impression, using a flatbed scanner or digital camera.

Latent tracing is when the digital image is of a drawn tracing of the impression, not the impression itself. The tracing may have been hand- or computer-drawn.

A latent photo means that the digital image was acquired from a paper photograph that had been taken of a latent impression; the paper photograph was then digitized using a flatbed scanner or digital camera.

A latent lift is a digital image that was acquired from a lift of the latent impression, using a flatbed scanner or digital camera.

Table 7 Friction ridge impression types

<table>
<tr><th colspan="2" rowspan="3">Description</th><th colspan="5">Code</th></tr>
<tr><th colspan="2">Fingerprint</th><th rowspan="2">Palm</th><th rowspan="2">Plantar</th><th rowspan="2">Unknown Friction Ridge</th></tr>
<tr><th>Plain</th><th>Rolled</th></tr>
<tr><td rowspan="6">Livescan</td><td>Livescan (type unknown or unspecified)</td><td>0</td><td>1</td><td>10</td><td>30</td><td rowspan="7"></td></tr>
<tr><td>Vertical swipe</td><td>8</td><td></td><td colspan="2" rowspan="5">N/A</td></tr>
<tr><td>Optical contact</td><td>20</td><td>21</td></tr>
<tr><td>Non-optical contact</td><td>22</td><td>23</td></tr>
<tr><td>Optical contactless</td><td>24</td><td>25</td></tr>
<tr><td>Non-optical contactless</td><td>26</td><td>27</td></tr>
<tr><td colspan="2">Non-livescan (e.g. inked)</td><td>2</td><td>3</td><td>11</td><td>31</td></tr>
<tr><td rowspan="4">Latent</td><td>Impression</td><td colspan="2">4</td><td>12</td><td>32</td><td>36</td></tr>
<tr><td>Tracing</td><td colspan="2">5</td><td>13</td><td>33</td><td>37</td></tr>
<tr><td>Photo</td><td colspan="2">6</td><td>14</td><td>34</td><td>38</td></tr>
<tr><td>Lift</td><td colspan="2">7</td><td>15</td><td>35</td><td>39</td></tr>
<tr><td colspan="2">Other</td><td colspan="5">28</td></tr>
<tr><td colspan="2">Unknown</td><td colspan="5">29</td></tr>
</table>

7.7.4.2 Friction ridge generalized position / FGP

FGP is used in Record types dealing with friction ridges**.** It specifies which friction ridge biometric sample was collected. Note that for codes 1 - 40 and 60 - 84, the **Table 8** specifies recommended MAXIMUM width and height. (Individual implementation domains and application profiles may use different values.)

In previous versions of this standard, **FGP** was used for finger position, and **PLP** for palmprint position. They are now in one table, along with the codes added in the ANSI/NIST-ITL 1a-2009 amendment. New to this version, plantar codes are included in the table. In order to cover all of these cases, the name was changed to **friction ridge generalized position / FGP.**

If the image is from a distal segment of the finger but the finger position is unknown, the code “0” (unknown fingerprint) shall be used. If the image is from the proximal or medial segment of the finger but the finger position is unknown, the code “19” shall be used with print position descriptors.

If the image is from a palm but the location cannot be determined, the code "20" (Unknown palm) shall be used.

If the type of friction skin is unknown, each of the possible positions shall be included as separate data entries. Codes "0" (Unknown fingerprint) and "20" (Unknown palm) together address all friction ridge areas on the hands; codes "60" (Unknown sole of foot) and "63" (Unknown toe) together address all friction ridge areas on the feet. Code "18" denotes an unknown friction ridge, from hand or foot. Code 18 is new to this version of the standard.

The codes for extra digits, palm carpal delta areas (at the base of the hand) and palm grasp are also new for this version of the standard.

Table 8 Friction ridge position code & recommended image dimensions

Finger Position Codes

Finger position	Finger code	Max Width (mm)	Max Width (in)	Max Height (mm)	Max Height (in)
Unknown fingerprint	0	40.6	1.6	38.1	1.5
Right thumb	1	40.6	1.6	38.1	1.5
Right index finger	2	40.6	1.6	38.1	1.5
Right middle finger	3	40.6	1.6	38.1	1.5
Right ring finger	4	40.6	1.6	38.1	1.5
Right little finger	5	40.6	1.6	38.1	1.5
Left thumb	6	40.6	1.6	38.1	1.5
Left index finger	7	40.6	1.6	38.1	1.5
Left middle finger	8	40.6	1.6	38.1	1.5
Left ring finger	9	40.6	1.6	38.1	1.5
Left little finger	10	40.6	1.6	38.1	1.5
Plain right thumb	11	25.4	1.0	76.2	3.0
Plain left thumb	12	25.4	1.0	76.2	3.0
Plain right four fingers (may include extra digits)	13	81.3	3.2	76.2	3.0
Plain left four fingers (may include extra digits)	14	81.3	3.2	76.2	3.0
Left & right thumbs	15	81.3	3.2	76.2	3.0
Right extra digit[16]	16	40.6	1.6	38.1	1.5

[16] These rules shall be used in dealing with subjects with extra fingers or thumbs: the four fingers closest to the thumb shall be labeled with the index/middle/ring/little position codes; the thumb closest to the fingers

Finger position	Finger code	Max Width (mm)	(in)	Max Height (mm)	(in)
Left extra digit[16]	17	40.6	1.6	38.1	1.5
Unknown friction ridge	18	139.7	5.5	213.0	8.5
EJI or tip	19	114.3	4.5	127.0	5.0

Palm Position Codes

Palm Position	Palm code	Max Width (mm)	(in)	Max Height (mm)	(in)
Unknown palm	20	139.7	5.5	213.0	8.5
Right full palm	21	139.7	5.5	213.0	8.5
Right writer's palm	22	44.5	1.8	127.0	5.0
Left full palm	23	139.7	5.5	213.0	8.5
Left writer's palm	24	44.5	1.8	127.0	5.0
Right lower palm	25	139.7	5.5	139.7	5.5
Right upper palm	26	139.7	5.5	139.7	5.5
Left lower palm	27	139.7	5.5	139.7	5.5
Left upper palm	28	139.7	5.5	139.7	5.5
Right other	29	139.7	5.5	213.0	8.5
Left other	30	139.7	5.5	213.0	8.5
Right interdigital	31	139.7	5.5	76.2	3.0
Right thenar	32	76.2	3.0	114.3	4.5
Right hypothenar	33	76.2	3.0	114.3	4.5
Left interdigital	34	139.7	5.5	76.2	3.0
Left thenar	35	76.2	3.0	114.3	4.5
Left hypothenar	36	76.2	3.0	114.3	4.5
Right grasp	37	139.7	5.5	213.0	8.5
Left grasp	38	139.7	5.5	213.0	8.5
Right carpal delta area	81	139.7	5.5	114.3	4.5
Left carpal delta area	82	139.7	5.5	114.3	4.5

shall be labeled with the thumb position code; additional fingers shall be labeled with the extra finger position code for the appropriate hand. The comment field (**Field 13.020: Comment / COM** or **Field 14.020: Comment / COM)** should be used to describe specifics for the finger location. In the case of conjoined fingers, the image of the entire conjoined finger shall be included using the finger position closest to the thumb, and the next finger position shall be used for the next fully separable finger. The comment field (**Field 13.020: Comment / COM** or **Field 14.020: Comment / COM)** should be used to describe specifics of the conjoined fingers.

Palm Position	Palm code	Max Width (mm)	(in)	Max Height (mm)	(in)
Right full palm, including writer's palm[17]	83	139.7	6.5	114.3	8.5
Left full palm, including writer's palm	84	139.7	6.5	114.3	8.5

Plantar Position Codes

Plantar Position	Plantar code	Max Width (mm)	(in)	Max Height (mm)	(in)
Unknown sole	60	139.7	5.5	330.2	13.0
Sole – right foot	61	139.7	5.5	330.2	13.0
Sole – left foot	62	139.7	5.5	330.2	13.0
Unknown toe	63	44.5	1.8	76.2	3.0
Right big toe	64	44.5	1.8	76.2	3.0
Right second toe	65	44.5	1.8	76.2	3.0
Right middle toe	66	44.5	1.8	76.2	3.0
Right fourth toe	67	44.5	1.8	76.2	3.0
Right little toe	68	44.5	1.8	76.2	3.0
Left big toe	69	44.5	1.8	76.2	3.0
Left second toe	70	44.5	1.8	76.2	3.0
Left middle toe	71	44.5	1.8	76.2	3.0
Left fourth toe	72	44.5	1.8	76.2	3.0
Left little toe	73	44.5	1.8	76.2	3.0
Front / ball of right foot	74	139.7	5.5	139.7	5.5
Back / heel of right foot	75	139.7	5.5	139.7	5.5
Front / ball of left foot	76	139.7	5.5	152.4	6.0
Back / heel of left foot	77	139.7	5.5	152.4	6.0
Right middle of foot[18]	78	139.7	5.5	152.4	6.0
Left middle of foot[18]	79	139.7	5.5	152.4	6.0

Table 8 is extended with recommended minimum dimensions for common 2 finger and 3 finger combinations. Note that mobile devices may use the codes defined in the above table, as well as those presented below. No maximum dimensions are included, but there are

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[17] The subject's hand is rolled so that the full palm and writer's palm are captured in a single impression.
[18] The codes for the middle of the feet correspond to the arch and/or outside (fibular hypothenar) areas of the feet.

practical maximum upper limits to the image size. The minimum areas for codes 42, 45, 48 and 50 may not be sufficient for practical use. The actual size will depend upon the equipment used. It should be noted that codes 13-15 and 40-50 are for simultaneous 2 and 3 and 4 – finger combinations. The titles of the finger combinations are given from the thumb outwards (that is, left to right for the right hand and right to left for the left hand). Code 46 "Right index / Left index" means that the right index placed on the right portion of the imaging area and the left index on the left portion of that same imaging area.

Multiple Finger Position Codes

Finger position	Finger code	Min Width (mm)	(in)	Min Height (mm)	(in)
2-Finger Combinations					
Right index/middle	40	40.6	1.6	38.1	1.5
Right middle/ring	41	40.6	1.6	38.1	1.5
Right ring/little	42	40.6	1.6	38.1	1.5
Left index/middle	43	40.6	1.6	38.1	1.5
Left middle/ring	44	40.6	1.6	38.1	1.5
Left ring/little	45	40.6	1.6	38.1	1.5
Right index / left index	46	40.6	1.6	38.1	1.5
3-Finger Combinations					
Right index/middle/ring	47	63.5	2.5	38.1	1.5
Right middle/ring/little	48	63.5	2.5	38.1	1.5
Left index/middle/ring	49	63.5	2.5	38.1	1.5
Left middle/ring/little	50	63.5	2.5	38.1	1.5

7.7.4.3 Print (or search) position descriptors / PPD or SPD

These fields are used to define fingerprints that include all or part of the lower joints (medial or proximal segments), or extreme tips.

For exemplar fingerprints contained in Type-14 records, if the impression is known to be an entire joint image (EJI), full finger view (FFV), or extreme tip (TIP), then **Field 14.013: Friction ridge generalized position / FGP** shall be set to 19, and **Field 14.014: Print position descriptors / PPD** shall be specified; **Field 14.015: Print position coordinates / PPC** may be (optionally) specified.

For latent prints contained in Type-13 records, if all or part of the impression should be compared against the medial or proximal segments or the extreme tips, then **Field 13.013: Friction ridge generalized position / FGP** shall be set to 19, and **Field 13.014: Search position descriptors / SPD** shall be specified; **Field 13.015: Print position coordinates / PPC** may be (optionally) specified.

Figure 3 and **Figure 4** illustrate the positions of the distal, medial and proximal portions of a finger. **Table 9** lists the finger views (FV1 through FV4) shown in **Figure 4.** The position descriptor, in **Field 13.014: Search position descriptors / SPD** or **Field 14.014: Print position descriptors / PPD** contains two mandatory information items:

- For a Type-13 record (latent prints), the first information item **(probable decimal finger position code / PDF)** (0-10, 16 or 17) is taken from **Table 8**. A "0" indicates that all the fingers of a possible candidate should be searched. For a Type-14 record (known exemplars), the first information item is the **decimal finger position code / DFP.** It is also taken from **Table 8** with a value of 1 to 10, inclusive or 16 or 17.

- The second information item **(finger image code / FIC**) is the code taken from **Table 9** to indicate the portion of the database to search. Full-length finger joint images use codes FV1 through FV4. **Figure 4** is an illustration of the Entire Joint Image for a middle finger with each of the full finger views and constituent parts identified. Multiple portions of the EJI may be listed in a separate subfield.

Field 13.014: Search position descriptors / SPD, Field 14.014: Print position descriptors / PPD, Field 13.015: Print position coordinates / PPC and **Field 14.015: Print position coordinates / PPC** are included to make the standard flexible enough to accommodate many different scenarios and applications. These fields facilitate searching of latents formatted within Type-13 records against Type-14 records contained in the various databases. The search of a database by a latent can be narrowed with the use of additional information such as finger position, finger segment, or full finger view. It is unlikely that an entire EJI will ever be left at the scene of a crime. But a latent may be searched against the EJIs based on a specific finger segment or full finger view. This may be accomplished for a portion of the latent described by the X and Y coordinates.

Multiple portions of the EJI may be listed, each as a subfield with the same value for **PDF** and a different value for **FIC**, such as one subfield with **PDF** of 2 and **FIC** of DST and another subfield with **PDF** of 2 and **FIC** of MED. There need not be more than one subfield. For latents in Type-13 records, **Field 13.014: Search position descriptors / SPD** defines the set of all areas against which the latent should be compared. To indicate that the latent may have come from any part of the finger, **FIC** should include both EJI and TIP (in different subfields). Since EJI is a superset of FV1-FV4, DST, MED and PRX, it is therefore redundant to specify any of the latter if EJI is included in **FIC**. If a latent in a Type-13 record is to be compared against different segments of a finger but can be specified more precisely than simply listing EJI, multiple portions of the EJI may be listed – in which the information item **FIC** indicates the appropriate area of the field. One subfield may, for example, have a **PDF** of 0 and **FIC** of DST and another subfield with **PDF** of 0 and **FIC** of MED. It is possible to include any combination of **PDF** and **FIC**s, such as: **PDF** = 2 and **FIC** = MED; **PDF** = 2 and **FIC** = DST; **PDF** = 3 and **FIC** = MED; and **PDF** = 3 and **FIC** = DST.

7.7.4.4 Print position coordinates / PPC

If **Field 13.013: Friction ridge generalized position / FGP** or **Field 14.013: Friction ridge generalized position / FGP** is set to 19 then **Field 13.015: Print position**

coordinates / PPC or **Field 14.015: Print position coordinates / PPC** may optionally contain offsets to the locations for the bounding box of the EJI, each of the full finger views, or segments within the EJI. When used, this field shall consist of six (6) mandatory information items describing the type or portion of the image contained in this record and its location within an EJI. This information will describe either the location of the entire joint image, one full finger view, or segment. Individual full finger or segment definitions may be repeated as repeating sets of information items:

- The first information item is the **full finger view / FVC** with values of "FV1" through "FV4". Values of "FV1" to "FV4" specify the perspective for each full finger view. For a fingertip, the first information item shall be "TIP". **FVC** will contain the code "NA" if only a proximal, distal or medial segment is available.

- The second information item is used to identify the **location of a segment / LOS** within a full finger view. **LOS** will contain the *not applicable* code "NA" if the image portion refers to a full finger view, tip or to the entire joint image locations**.** Otherwise, it shall contain "PRX", "DST", "MED" for a proximal, distal, or medial segment, respectively.

- The third information item is the **left horizontal coordinate / LHC**. It is the horizontal offset in pixels to the left edge of the bounding box relative to the origin positioned in the upper left corner of the image.

- The fourth information item is the **right horizontal coordinate / RHC.** It is the horizontal offset in pixels to the right edge of the bounding box relative to the origin positioned in the upper left corner of the image.

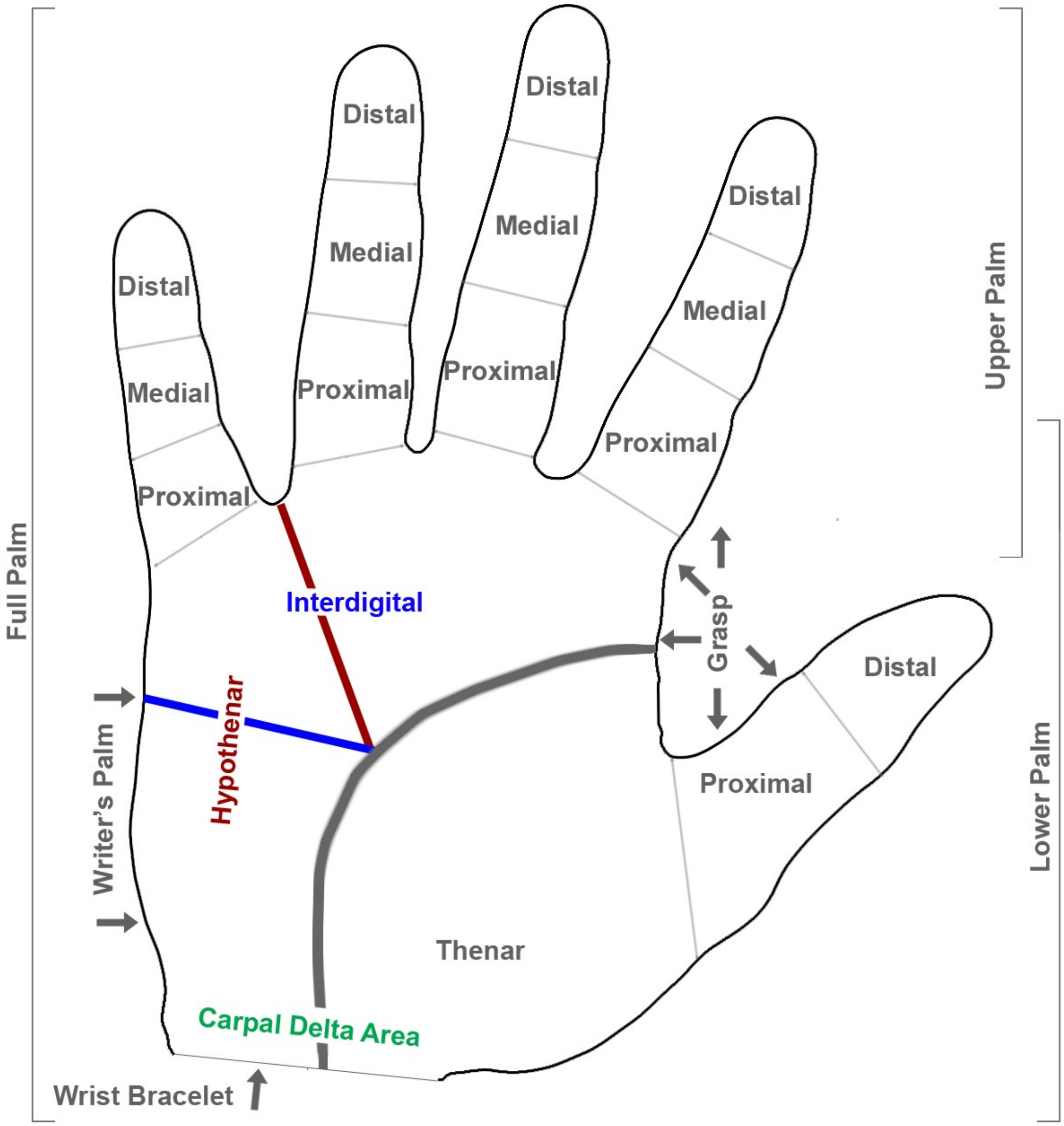
- The fifth information item is the **top vertical coordinate / TVC** is the vertical offset (pixel counts down) to the top of the bounding box.

- The sixth information item is the **bottom vertical coordinate / BVC**. It is the vertical offset from the upper left corner of the image down to the bottom of the bounding box. It is counted in pixels.

Table 9 Joint image segments, tip code and finger view codes

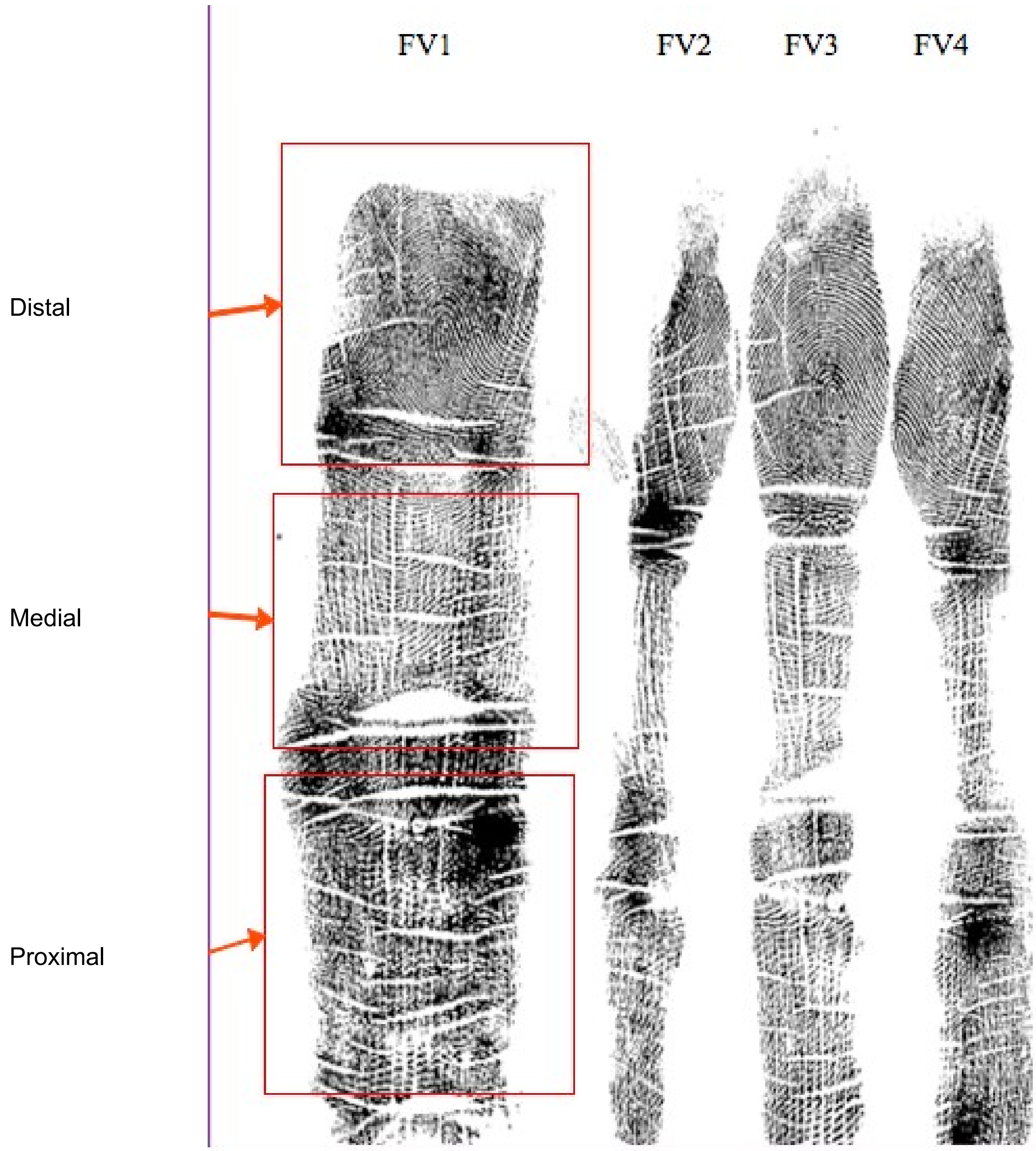
Type of Image	Image Code
Entry allowed for FIC only	
Entire joint image	EJI
Entries for FVC or FIC	
Rolled tip	TIP
Full finger rolled image	FV1
Full finger plain image – left side	FV2
Full finger plain image – center	FV3
Full finger plain image – right side	FV4
Entry for FVC only	
Only a proximal, distal or medial segment is available	NA
Entries for LOS or FIC	
Proximal segment	PRX
Distal segment	DST
Medial segment	MED
Entry for LOS only	
Image portion refers to a full finger view, tip or to the entire joint image locations	NA

Figure 3: Palm and finger segment positions



Note: Upper palm and lower palm images shall include the interdigital area as overlap for verification. Therefore, the lower and upper palm locations have approximate boundaries in this illustration. It is described in **Section 8.15**. The carpal delta area is at the base of the palm, at the wrist. The wrist bracelet is the series of lines/creases below and parallel to the carpal delta and thenar /hyperthenar areas of the palm.

Figure 4: Entire joint image



7.7.5 Subject acquisition profile / SAP/ FAP / IAP

A subject acquisition profile is used to describe a set of characteristics concerning the capture of the biometric sample. These profiles have mnemonics **SAP** for face, **FAP** for fingerprints and **IAP** for iris records. **SAP** codes are mandatory in Type-10 records with a face image. **FAP** is optional in Type-14. **IAP** is optional in Type-17 records. The values do not have the same meaning for different modalities. As is explained in the *Mobile ID Best Practice Recommendation*[19], a multi-biometric capture device could, for example, have a **SAP** level of 42, **FAP** level of 45, and an **IAP** level of 40. With the exception of mobile device SAP levels, the higher the value, the stronger the acquisition requirements.

7.7.5.1 Subject acquisition profile for face / SAP

Field 10.013: Subject acquisition profile / SAP has the **SAP** level code for face in **Table 10.** The **SAP** codes 32, 42 and 52 are new to this version of the standard.

Table 10 Subject acquisition profiles for face

Subject Acquisition Profile	SAP Level
Unknown acquisition profile	0
Surveillance facial image	1
Driver's license image (AAMVA)	10
ANSI Full Frontal facial image (*ANSI 385*)	11
ANSI Token facial image (*ANSI 385*)	12
ISO Full Frontal facial image (*ISO/IEC 19794-5*)	13
ISO Token facial image (*ISO/IEC 19794-5*)	14
PIV facial image (*NIST SP 800-76*)	15
Legacy Mugshot	20
Best Practice Application – Level 30	30
Mobile ID Best Practice - Level 32	32
Best Practice Application – Level 40	40
Mobile ID Best Practice - Level 42	42
Best Practice Application – Level 50	50
Best Practice Application – Level 51	51
Mobile ID Best Practice - Level 52	52

[19] It is available at http://www.nist.gov/customcf/get_pdf.cfm?pub_id=903169

7.7.5.1.1 Level 0 (Unknown profile)

This level denotes any case when the **SAP** is unknown. This value may be used to alert systems that the profile of the face image needs to be determined manually or via advanced face image quality evaluation techniques.

7.7.5.1.2 Level 1 (Surveillance facial image)

This **SAP** value denotes a surveillance facial image: a face image captured without specific regard to scene, photographic, or digital requirements. For example, an image of a face from commonly available surveillance video equipment is generally considered a surveillance facial image. Typically surveillance facial images are of relatively poor quality compared to mugshots, including significant pose angle used for the frontal view, poor image resolution, poor image contrast, etc.

7.7.5.1.3 Levels 10-15 (Other application profiles)

Levels 10-15 shall denote transaction associated with capture under the guidance of other facial standards or application profiles as defined below. Note that the facial images of Level-13 and Level-14 may come from travel documents as described in "*Deployment of Machine Readable Travel Documents", ICAO Technical Report, version 2.0*.

- Level-10 denotes a driver license facial portrait described in the *AAMVA International Specification – DL/ID Card Design*.
- Level-11 denotes an ANSI facial image that meets requirements of the Full Frontal Image type defined in *ANSI INCITS 385-2004.*
- Level-13 denotes an ISO facial image that meets the requirements of the *Full Frontal Image defined in International standard ISO/IEC 19794-5*
- Level-14 denotes an ISO facial image that meets the requirements of the *Token Face Image type defined in International standard ISO/IEC 19794-5.*
- Level-15 denotes a PIV facial image that meets requirements of Biometric Data Specification for Personal Identity Verification defined in *NIST SP 800-76*.

See **Section 3 Normative references** for information about the references cited above.

7.7.5.1.4 Level 20 (Legacy mugshot)

A facial image conforming to this application profile level shall be a mugshot formatted according to *ANSI/NIST-ITL 1-2000*, but not necessarily conforming to the best practice requirements given in level-30. The subject pose(s) may be Frontal, Profile, or Angled.

7.7.5.1.5 Level 30 (Basic mugshot)

These mugshots shall adhere to strict background, lighting, and resolution requirements. In particular, the background is 18% gray, the lighting is three-point, and the image size is at least 480 x 600 pixels with an aspect ratio of 1:1.25. **Annex E: Facial Capture – SAPs 30 and above** for more information about Level 30.

7.7.5.1.6 Level 32 (Mobile device basic mugshot)

The requirements for level 32 are based on those of level 30, but not fully inclusive of all of those requirements. For instance, relative centering error and 18% grayscale with appropriate lighting may not be realistic for a mobile application. Use of this **SAP** number indicates that the image was captured with a mobile device. See **Table 11** for the complete requirements for **SAP** level 32.

7.7.5.1.7 Level 40 (Higher resolution mugshot)

A facial image conforming to the level-40 application profile can be captured with an off-the-shelf 1-megapixel camera. Requirements for conformance with level-40 facial image capture include the following (See **Annex E: Facial Capture – SAPs 30 and above)**:

- The image shall conform to the minimum requirements for the capture of level-30 facial images
- At least one full frontal face image shall be captured.
- The minimum number of pixels in the digital image shall be 768 x 1024 pixels, and
- Facial images shall conform to the "head and shoulders" composition detailed requirements shown in **Annex E: Facial Capture – SAPs 30 and above**.

It should be noted that the resolution aspect of the captured facial images are improved as the number of pixels in both directions are increased. As images are captured with an increased number of pixels, the 3:4 (Width : Height) aspect ratio shall be maintained.

7.7.5.1.8 Level 42 (Mobile device higher resolution mugshot)

The requirements for level 42 are based on those of level 40, but not fully inclusive of those requirements. For instance, relative centering error and 18% grayscale with appropriate lighting may not be realistic for a mobile application. Use of this **SAP** number indicates that the image was captured with a mobile device. See **Table 11** for the complete requirements for **SAP** level 42.

7.7.5.1.9 Levels 50 and 51 (Best practice mugshots)

A facial image conforming to the level 50 and level 51 application profiles shall include "face image capture requirements". See **Annex E: Facial Capture – SAPs 30 and above.** These profile levels are intended to allow for examination of up to forensic-level

(10 ppmm) detail on a subject's face. The only difference between level-50 and level-51 is that level-50 specifies the "head and shoulders" composition requirements while level-51 specifies the "head only" composition requirements.

For a level-50 image capture profile, the minimum number of pixels in the digital image shall be 3300 pixels in the horizontal direction by 4400 pixels in the vertical direction.[20] Off-the-shelf 15 (or more) megapixel digital cameras satisfy this requirement. As an alternative, allocating 70% of the image width for the head requires approximately 2400 pixels for the "head only" facial capture. For a level-51 image capture profile, the minimum number of pixels in the digital image shall be 2400 pixels in the horizontal direction by 3200 pixels in the vertical direction. Off-the-shelf 8 megapixel digital cameras satisfy this requirement.

The levels-50 and 51 **SAP**s allow for the encoding of face images that are consistent with the discussion above and with the "face image capture requirements". It should be noted that the resolution aspect of the captured facial images might be improved as the number of pixels in both directions are increased. **Figure 5** illustrates the improvement in image quality from levels 30 to 50/51. As images are captured with an increased number of pixels, the 3:4 (Width : Height) aspect ratio shall be maintained.

7.7.5.1.10 Level 52 (Mobile device best practice mugshots)

The requirements for level 52 are based upon those of level 50, but are not fully inclusive of all of those requirements. For instance, relative centering error and 18% grayscale with appropriate lighting may not be realistic for a mobile application. Specific roll, pitch and yaw requirements are not included in Level 52. See **Table 11** for the complete requirements for **SAP** level 52.

Figure 5: Examples of resolution for face SAP levels 30/32, 40/42, & 50/51/52

[20] Identification applications require approximately 1700 pixels wide by 2515 pixels high on the face for the 99th percentile male in the U.S. population. Allocating 50% of the image width for the head requires approximately 3400 pixels for a "head and shoulders photo" image width.

Table 11 Mobile device face SAP levels

Capture	Comments	Levels		
		32	42	52
Image resolution (size)	Lower resolution may reduce accuracy	≥ 480 x 600	≥ 786 x 1024	≥ 2400 x 3200
Capture device sensor		Progressive scan (no interlace)	Progressive scan (no interlace)	Progressive scan (no interlace)
Capture device color space		Minimum of 24-bit RGB color space or a minimum of 8-bit monochrome color space	Minimum of 24-bit RGB color space or a minimum of 8-bit monochrome color space	Minimum of 36-bit RGB color space or a minimum of 12-bit monochrome color space
Capture device controls		Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed / flash intensity) based on face area on-board	Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed / flash intensity) based on face area on-board (requires continuous face detection)	Auto gain and auto shutter, optional: control loop for camera parameter (shutter speed / flash intensity) based on face area on-board (requires continuous face detection)
Capture distance in cm	Lower distance may reduce accuracy	60-200 cm (~ 2 – 6 feet), the longer distance is preferred	60-200 cm (~ 2 – 6 feet), the longer distance is preferred	60-200 cm (~ 2 – 6 feet), the longer distance is preferred
Illuminator type – optional feature		Xenon flash or LED / fill-in flash	Xenon flash or LED / fill-in flash	Xenon flash or LED / fill-in flash
Ambient light	Minimum light level at which flash becomes required	4 lux	4 lux	4 lux
Wavelength range		Visible light. 380-780 nm	Visible light. 380-780 nm	Visible light. 380-780 nm
Exposure time	Capability to freeze motion	≤ 1/100s (10 ms)	≤ 1/100s (10 ms)	≤ 1/100s (10 ms)
Inter-eye distance	Lower resolution may reduce accuracy	≥ 90 pixels	≥ 150 pixels	≥ 300 pixels
Frame rate	For positioning (live view)	≥ 12 fps	≥ 12 fps	≥ 12 fps

7.7.5.2 Subject acquisition profile for fingerprint / FAP

The profile levels for fingerprint acquisition are optional and are based upon those listed in the *Mobile ID Best Practice Recommendation.* They are entered in **Field 14.031: Subject acquisition profile – fingerprint / FAP**, which is new to this version of the standard.

Table 12 Subject acquisition profiles for fingerprint

CAPTURE	FAP 10	FAP 20	FAP 30	FAP 40	FAP 45	FAP 50	FAP 60
Acquire flat images	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acquire rolled images	No	No	No	Optional	Optional	Optional	Optional
Minimum scanning resolution	490 ppi – 510 ppi	490 ppi – 510 ppi	490 ppi – 510 ppi	490 ppi – 510 ppi	495 ppi – 505 ppi	495 ppi – 505 ppi	495 ppi – 505 ppi
Minimum gray levels	256	256	256	256	256	256	256
Minimum image dimensions (w x h)	.5” x .65”	.6” x .8”	.8” x .1.0”	1.6” x 1.5”	1.6” x 1.5”	2.5” x 1.5”	3.2” x 3.0”
Maximum Compression Ratio	10:1	10:1	10:1	15:1	15:1	15:1	15:1
Compression algorithm	WSQ Version 2.0 or above	WSQ Version 2.0 or above	WSQ Version 2.0 or above	WSQ Version 2.0 or above	WSQ Version 2.0 or above	WSQ Version 3.1 or above	WSQ Version 3.1 or above
Simultaneous number of fingers	1	1	1	1 to 2	1 to 2	1 to 3	1 to 4
Sensor certification	PIV	PIV	PIV	PIV	Appendix F	Appendix F	Appendix F

7.7.5.3 Subject acquisition profile for iris / IAP

The profile levels for iris acquisition, which are new to this version of the standard, are optional and are based on those listed in the *Mobile ID Best Practice Recommendation (BPR)* (See **Annex I: Bibliography**) with some modifications, as described here. **Table 13** shows the relevant characteristics from the BPR that differ by **IAP** level.

They are entered in **Field 17.031: Subject acquisition profile – iris / IAP**. The BPR was developed prior to this version of the standard. This version of the ANSI/NIST-ITL standard reflects research associated with the IREX study (See **Annex I: Bibliography**) which was performed after the release of the BPR. There has also been an update to the *ISO/IEC 19794-6* standard referenced in the BPR, based on the IREX study. Margin requirements have been updated in the ISO and ANSI/NIST-ITL standards (See **Table 78 Iris storage formats**). The margins stated in the BPR do not apply when referring to a particular subject acquisition profile level for iris images in this standard. The storage format specified in the BPR for all profile levels is 'Raw' as specified in ISO/IEC 19794-6 and Record Type-17 of the ANSI/NIST-ITL standard. 'Raw' corresponds to **ISF** code level 2 and has dimensions 640 x 480. This is the size output by most deployed iris acquisition systems. It is the display resolution for the Video Graphics Array (VGA).

There is a minimum iris diameter stated in the BPR for each profile level. There is no fixed requirement for iris diameter for specifying the format level in **Field 17.032: Iris storage format / ISF**. The iris diameter requirements of the BPR shall be adhered to if the IAP level is specified in the Type-17 record.

Table 13 Subject acquisition profiles for iris

CAPTURE	IAP 20	IAP 30	IAP 40
Iris diameter in true, non-upscaled pixels	≥ 140 pixels	≥ 170 pixels	≥ 210 pixels
Number of (quasi-) simultaneously captured eyes	≥ 1	≥ 1	2
Exposure time	≤ 33 ms	≤ 15 ms	≤ 10 ms

7.7.6 Resolution

Many of the record types in this standard include images as the data field. Each image formatted in accordance with this standard shall appear to have been captured in an upright position and approximately centered horizontally in the field of view. The scanning sequence (and recorded data) shall appear to have been from left-to-right, progressing from top-to-bottom. For the purpose of describing the position of each pixel within an image to be exchanged, a pair of reference axes shall be used. The origin of the axes, pixel location (0,0), shall be located at the upper left-hand corner of each image. The x-coordinate (horizontal) position shall increase positively from the origin to the right side of the image. The y-coordinate (vertical) position shall increase positively from the origin to the bottom of the image.

Many of the record types in this standard use the term "resolution", in the record type name, field names or in the text describing characteristics about the fields. Generally, the usage shares the commonality of describing pixels per unit of measure. In many cases, a qualifier is used before the term, such as "scanning" resolution or "transmitting" resolution.

All record types containing images are variable resolution except for Type-4, which has a fixed resolution. Record Type-4 shall not be used for anything but the 500 ppi class. The scanner resolution is specified for Record Types 10, 13, 14, 15, 16, 17, 19 and 20 using **Scanned horizontal pixel scale / SHPS** (See Section 7.7.8.7) and **Scanned vertical pixel scale / SVPS** (See Section 7.7.8.8.) These Record Types can handle all resolutions, 500 ppi and above, and are thus variable-resolution image records.

Record Type-7 does not include a field to specify resolution. In previous versions, **Field 1.011 Native scanning resolution / NSR** and **Field 1.012 Nominal resolution / NTR** applied to Record Type-4 and Record Type-7: User-defined image record. In this version, **NSR** and **NTR** only apply to **Record Type-4: Grayscale fingerprint image**, unless specifically stated otherwise in a domain's specifications. This allows users to use different resolutions for the Type-7 record. Since Type-7 records are user-defined, the sender and receiver must exchange information concerning the resolution of the data. In many cases, it is contained in the data record headers.

As used within this standard, and consistent with the definitions in **Section 4,** the following categorization of terms related to resolution is provided to assist the reader in clearly understanding and interpreting these terms:

- Acquisition related – “scanning resolution”, “native scanning resolution”
- Image related – “nominal resolution”, “transmitting resolution”
- Either acquisition or image related – “class resolution”, “tolerance”

Most of the complexity related to resolution pertains to the friction ridge (particularly fingerprints) as described in the following subclauses.

7.7.6.1 Fingerprint resolution requirement

For Appendix F[21] certified devices, resolution accuracy shall not vary more than 1% from the class resolution. A class resolution of 19.69 ppmm (500 ppi) has a lower bound of 19.49 ppmm (495ppi) and an upper bound of 19.89 ppmm (505ppi). See **Table 14.** For Personal Identity Verification (PIV)[22] certified devices with fingerprint subject application profile (**FAP**)[23] Levels 10 to 40 only (see **Section 7.7.5.2)**, resolution accuracy shall not vary more than 2% from the class resolution (see **Table 14).** For example, a class resolution of 19.69 ppmm (500 ppi) has a lower bound of 19.30 ppmm (490ppi) and an upper bound of 20.08 ppmm (510ppi). The 2% tolerance for class resolution applies only to verification / authentication applications – not to identification applications. **FAP** 10 is a minimum requirement and any **FAP** level below 10 is not covered by this standard. See **Table 12** for a description of the **FAP** levels.

Table 14 Class resolution with defined tolerance

Certification	Maximum Tolerance	Class Resolution	
		500	1000
Appendix F	±1%	±5 ppi	±10 ppi
PIV (FAP Level 10 or above)	±2%	±10 ppi	Not Applicable

Tolerance requirements shall apply to the class and nominal resolution requirements throughout this standard.

7.7.6.2 Friction ridge scanner resolution requirement

The following clauses address the scanner or acquisition process requirements for friction ridge acquisition devices.

7.7.6.2.1 Exemplar scanner resolution requirement

Exemplar images shall have a minimum scanning resolution of the 500 ppi class. If Type-4 records are included in the transaction, **Field 1.011 Native scanning resolution / NSR** contains five characters specifying the native scanning resolution in pixels per millimeter. It is expressed as two numeric characters followed by a decimal point and two more numeric characters (e.g. 19.69). This field is set to “00.00” if no Type-4 records are present in the transaction. An implementation domain or application profile may specify that **NSR** may be used to apply to Type-7 records.

[21] IAFIS-DOC-01078-9.1 Criminal Justice Information Services (CJIS) *Electronic Biometric Transmission Specification (EBTS)* May 25, 2010 – *Appendix F - CJIS Image Quality Specifications*
[22] Personal Identity Verification (PIV): *Image Quality Specifications For Single Finger Capture Devices*.
[23] NIST Special Publication 500-280, *Mobile ID Device Best Practice Recommendation Version 1.0*

Record Type-14 shall be used if scanning a fingerprint image at the 1000 ppi class or above. It can also be used for the 500 ppi class.

7.7.6.2.2 Latent image scanner resolution requirement

Latent images shall have a minimum scanning resolution of the 1000 ppi class.

7.7.6.2.3 Scanner resolution migration path

The migration path to higher scanning resolutions for image capturing devices with a native scanning resolution of the 500 ppi class shall be at a rate of 100% of the current native scanning resolution. The recommended migration path progresses from 19.69 ppmm to 39.37 ppmm (500 ppi class to 1000 ppi class), from 39.37 ppmm to 78.74 ppmm (1000 ppi class to 2000 ppi class), etc. Capture devices with native scanning resolutions not in step with this migration path shall provide (through subsampling, scaling, or interpolating downward) a nominal resolution that matches the next lower interval in the migration path. For example, a device with native scanning resolution of 47.24 ppmm (1200 ppi) shall provide a class resolution of 39.37 ppmm (1000 ppi).

7.7.6.3 Friction ridge transmitting resolution requirement

Each image to be exchanged shall have a specific resolution associated with the transmitted data. This transmitting resolution does not have to be the same as the scanning resolution. However, the transmitting resolution shall be within the range of permissible resolution values for that record type.

7.7.6.3.1 Record Type-4 transmitting resolution requirement

When an image is captured at a scanning resolution greater than the permissible upper limit of the transmitting resolution of 500 ppi class, the image shall be subsampled, scaled, or interpolated down. This processing to reduce the scanning resolution to a lower nominal resolution shall be performed before the transmission occurs. Processing to increase the resolution above scanning resolution is not permitted. **Field 1.012 Nominal resolution / NTR** shall specify the transmitting resolution in pixels per millimeter. It is expressed as two numeric characters followed by a decimal point and two more numeric characters (e.g. 19.69). The transmitting resolution shall be within the range 19.30 ppmm (490 ppi) to 20.08 ppmm (510 ppi) for a Type-4 record . This range reflects the 2% tolerance from 500 ppi allowed for PIV certified devices. (See **Table 14**). For example, a sensor that scans natively at 508 ppi would list both **NSR** and **NTR** as 20 ppmm (= 508 ppi). These images should not be sampled down to exactly 500 ppi. This field is set to “00.00” if no Type-4 records are present in the transaction. Given that the transmitting resolution shall not be greater than the scanning resolution, images meant for identification applications, such as those from Appendix F certified devices (See **Table 3**) are restricted to a 1% tolerance from 500 ppi.

With the deprecation of Record Types 3, 5 and 6, **NTR** in this version only directly applies to Record Type-4. New to this version of the standard, **NTR** does not apply to Type-7 records, unless so specified by an implementation domain.

7.7.6.3.2 Variable-resolution Record Types transmitting resolution requirement

For variable-resolution friction ridge images (those in Record Types 13, 14, 15, 19 and possibly in Record Types 16 and 20), the transmitting resolution shall be at least as great as the class resolution of 500 ppi. There is no upper limit on the variable-resolution rate for transmission. However, the transmitting resolution shall not be greater than the scanning resolution. For variable resolution records the **Transmitted horizontal pixel scale / THPS** and the **Transmitted vertical pixel scale / TVPS** shall be specified. (See **Sections 7.7.8.4** and **7.7.8.5).** Before transmitting variable-resolution records, the operational capabilities of the sending and receiving systems should be addressed, and prior agreement should be made with the recipient agency or organization before transmitting the image.

The migration path to higher transmitting resolutions is the same as for the scanning resolutions, i.e., from 500 ppi class to 1000 ppi class; from 1000 ppi class to 2000 ppi class, etc. For images captured at a native scanning resolution greater than the permissible upper limit of a transmitting resolution step in the migration path, it may be necessary to subsample, scale, or interpolate down. The result of this processing is to obtain a nominal scanning resolution that conforms to a step in the transmission migration path.

7.7.7 Sample quality

Many of the Record Types contain optional quality metric information. In addition to the three information items described here, a quality field may contain other information items. Each of the information items is contained in a subfield.

Multiple subfields may be present, each indicating a different quality algorithm, up to a maximum of 9 times. This upper limit has been stated to maintain consistency across all encodings and record types. (In some places in the 2008 version, it was unlimited; another was limited to 1; some had 9. In 2007, some were limited to 4; others to 9.)

The meaning attributed to this metric shall be defined and interpreted by the producer of the scoring algorithm or by the person or system used to assign the metric to the sample. The metric may be a predictor of false rejection performance or another metric indicating a value associated with the quality of the sample for a particular function.

The first information item shall be a quantitative expression of the predicted matching performance of the biometric sample, which is a **quality value / QVU**. This information item shall contain the integer image quality score between 0 and 100 (inclusive) assigned to the image data by a quality algorithm[24]. Higher values indicate better quality. An

[24] The sample quality fields described in this section are not related in structure or values to **Field 14.022:**

entry of "255" shall indicate a failed attempt to calculate a quality score. An entry of "254" shall indicate that no attempt to calculate a quality score was made.

A second information item shall specify the ID of the vendor of the quality algorithm used to calculate the quality score, which is an **algorithm vendor identification / QAV**. This 4-digit hex value (See **Section 5.5 Character types)** is assigned by IBIA and expressed as four characters. The IBIA maintains the Vendor Registry of CBEFF Biometric Organizations that map the value in this field to a registered organization.

A third information item shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be registered with the IBIA, but registration is not required. This is the **algorithm product identification / QAP** that indicates which of the vendor's algorithms was used in the calculation of the quality score. This information item contains the integer product code and should be within the range 1 to 65,535.

Fields using this structure are:

Field 9.135: M1 friction ridge quality data / FQD
(in this field, the second and third information items are optional in order to have consistency with the 2004 version of INCITS 378)
Field 9.316: EFS friction ridge quality metric / FQM
Field 10.024: Subject quality score / SQS
Field 13.024: Latent quality metric / LQM
Field 14.023: Segmentation quality metric / SQM
Field 14.024: Fingerprint quality metric / FQM
Field 15.024: Palm quality metric / PQM
Field 16.024: User-defined image quality metric / UQS
Field 17.024: Image quality score / IQS
Field 19.024: Friction ridge - plantar print quality metric / FQM
Field 99.102: Biometric data quality / BDQ

7.7.8 Image scale values

7.7.8.1 Horizontal line length / HLL

HLL defines the number of pixels contained on a single horizontal line of the image. The maximum horizontal size is limited to 65,535 pixels in Record Types-4 and 8, and to 99,999 for other record types. The minimum value is 10 pixels. [25] The total image size (HLL times VLL) must be able to be accommodated in **Field xx.001** for Traditional encoding. See **Section 7.1.**

NIST quality metric / NQM. That field is used to enter the NIST fingerprint image quality (NFIQ) scores on a scale of 1 to 5, unlike the quality fields described here that have a quality score between 0 and 100.

[25] Some places in the 2007 standard restricted the maximum to 4 digits (9,999). Others allowed up to 65,535. The 2007 version restricted the minimum to three digits (100) in some places. The 2008 version gave examples using 2 digits in Record Type-10. To maintain consistency across encodings and record types, the minimum and maximum are set to 2 digits and 5 digits. This equates to a maximum of 99,999 for most record types, except for 4 and 8 which are restricted to 2 bytes in traditional format (65,535)

These are the **HLL** fields.

Field 4.006: Horizontal line length / HLL
Field 8.006: Horizontal line length / HLL
Field 9.128: M1 horizontal line length /HLL
Field 10.006: Horizontal line length / HLL
Field 13.006: Horizontal line length / HLL
Field 14.006: Horizontal line length / HLL
Field 15.006: Horizontal line length / HLL
Field 16.006: Horizontal line length / HLL
Field 17.006: Horizontal line length / HLL
Field 19.006: Horizontal line length / HLL
Field 20.006: Horizontal line length / HLL

7.7.8.2 Vertical line length / VLL

VLL defines the number of horizontal lines contained in the image. The maximum vertical size is limited to 65,535 pixels in Record Types-4 and 8, and to 99,999 for other record types. The minimum value is 10 pixels. [25]
These are the **VLL** fields.

Field 4.007: Vertical line length / VLL
Field 8.007: Vertical line length / VLL
Field 9.129: M1 vertical line length / VLL
Field 10.007: Vertical line length / VLL
Field 13.007: Vertical line length / VLL
Field 14.007: Vertical line length / VLL
Field 15.007: Vertical line length / VLL
Field 16.007: Vertical line length / VLL
Field 17.007: Vertical line length / VLL
Field 19.007: Vertical line length / VLL
Field 20.007: Vertical line length / VLL

7.7.8.3 Scale units / SLC

The image sampling frequency (pixel density). A value of "1" shall indicate pixels per inch. A value of "2" shall indicate pixels per centimeter. A value of "0" in this field indicates that no scale is provided, and the quotient of **THPS/TVPS** shall provide the pixel aspect ratio.

For contact exemplar friction ridge images, a value of 1 or 2 shall be specified. For a value of 1 or 2, the transmitted horizontal and vertical scales shall be the same. A value of 1 or 2 shall also be specified for latent friction ridge prints if the lifted latent print is transmitted directly from a scanner. If the latent print is contained in a photograph, a value of 1 or 2 shall be entered only if the image of the latent was captured with a scale measurement visible in the image and the pixels across an inch or centimeter can be calculated – given the known characteristics of the camera and its distance from the latent print. A value of 0 for a latent print indicates that the true ppi value of the image is not known.

For non-contact images of body parts, **SLC** shall be set to 0 unless the object being imaged is a fixed distance from the capture device and the ppi or ppmm values for the capture device are accurately known at that fixed distance. (An example might be an iris capture device with a very small effective capture zone).

These are the **SLC** fields.

Field 9.130: M1 scale units / SLC
Field 10.008: Scale units / SLC
Field 13.008: Scale units / SLC
Field 14.008: Scale units / SLC
Field 15.008: Scale units / SLC
Field 16.008: Scale units / SLC
Field 17.008: Scale units / SLC
Field 19.008: Scale units / SLC
Field 20.008: Scale units / SLC

7.7.8.4 Transmitted horizontal pixel scale / THPS

This is the integer pixel density used in the horizontal direction of the image if **SLC** has a value of "1" or "2". If **SLC** has a value of "0", this information item shall contain the horizontal component of the pixel aspect ratio, up to 5 integer digits. For example, if the **SLC** value = 1, then the value of **THPS** could be '1000' for a 1000 ppi sensor.

These are the **THPS** fields.

Field 9.131: M1 transmitted horizontal pixel scale / THPS
Field 10.009: Transmitted horizontal pixel scale / THPS
Field 13.009: Transmitted horizontal pixel scale / THPS
Field 14.009: Transmitted horizontal pixel scale / THPS
Field 15.009: Transmitted horizontal pixel scale / THPS
Field 16.009: Transmitted horizontal pixel scale / THPS
Field 17.009: Transmitted horizontal pixel scale / THPS
Field 19.009: Transmitted horizontal pixel scale / THPS
Field 20.009: Transmitted horizontal pixel scale / THPS

7.7.8.5 Transmitted vertical pixel scale / TVPS

This is the integer pixel density used in the vertical direction of the image if **SLC** has a value of "1" or "2". If **SLC** has a value of "0", this information item shall contain the vertical component of the pixel aspect ratio, up to 5 integer digits. If **SLC** is 1 or 2, then **TVPS** shall equal **THPS**.

These are the **TVPS** fields.

Field 9.132: M1 transmitted vertical pixel scale / TVPS
Field 10.010 Transmitted vertical pixel scale / TVPS
Field 13.010: Transmitted vertical pixel scale / TVPS
Field 14.010: Transmitted vertical pixel scale / TVPS
Field 15.010: Transmitted vertical pixel scale / TVPS
Field 16.010: Transmitted vertical pixel scale / TVPS
Field 17.010: Transmitted vertical pixel scale / TVPS
Field 19.010: Transmitted vertical pixel scale / TVPS
Field 20.010: Transmitted vertical pixel scale / TVPS

7.7.8.6 Bits per pixel / BPX

Some record types have a mandatory field **Bits per pixel / BPX**. This contains the number of bits used to represent a pixel. This field shall contain an entry of "8" for normal grayscale values of "0" to "255" . Any entry in this field greater than "8" shall be used to represent a grayscale pixel with increased proportion. A maximum of 2 digits is allowed for this field.

For color, **BPX** represents the total number of bits per pixel (not per color). For instance, **BPX**=24 represents a 24-bit RGB image using 8 bits for each color.

These are the **BPX** fields.

Field 13.012: Bits per pixel / BPX
Field 14.012: Bits per pixel / BPX
Field 15.012: Bits per pixel / BPX
Field 16.012: Bits per pixel / BPX
Field 17.012: Bits per pixel / BPX
Field 19.012: Bits per pixel / BPX
Field 20.012: Bits per pixel / BPX

7.7.8.7 Scanned horizontal pixel scale / SHPS

The horizontal pixel density used for the scanning of the original image / impression providing that the SLC field contains a "1" or "2". Otherwise, this shall indicate the horizontal component of the pixel aspect ratio, up to 5 integer digits. This field is used if the transmission pixel scale differs from the original image scale, as listed in **Transmitted horizontal pixel scale / THPS** . Note that density is directly related to resolution.

These are the **SHPS** fields.

Field 10.016: Scanned horizontal pixel scale / SHPS
Field 13.016: Scanned horizontal pixel scale / SHPS
Field 14.016: Scanned horizontal pixel scale / SHPS
Field 15.016: Scanned horizontal pixel scale / SHPS
Field 16.016: Scanned horizontal pixel scale / SHPS
Field 19.016: Scanned horizontal pixel scale / SHPS
Field 20.017: Scanned horizontal pixel scale / SHPS

7.7.8.8 Scanned vertical pixel scale / SVPS

The vertical pixel density used for the scanning of the original image / impression providing that the **SLC** field contains a "1" or "2". Otherwise, this shall indicate the vertical component of the pixel aspect ratio, up to 5 integer digits. This field is used if the transmission pixel scale differs from the original image scale, as listed in **Transmitted vertical pixel scale / TVPS** . Note that density is directly related to resolution. If **SLC** is 1 or 2 and **SHPS** is entered, then **SVPS** shall equal **SHPS.**

These are the **SVPS** fields.

Field 10.017: Scanned vertical pixel scale / SVPS
Field 13.017: Scanned vertical pixel scale / SVPS
Field 14.017: Scanned vertical pixel scale / SVPS
Field 15.017: Scanned vertical pixel scale / SVPS
Field 16.017: Scanned vertical pixel scale / SVPS
Field 19.017: Scanned vertical pixel scale / SVPS
Field 20.018: Scanned vertical pixel scale / SVPS

7.7.9 Compression algorithms

Images shall be compressed only from an original uncompressed image. If an image has been received in a compressed format, it shall not be uncompressed and re-compressed in the same or different format. Regardless of the compression algorithm used, the image shall be represented as an array of n rows by m columns by at least 8-bit pixels[26]. Each pixel in a gray-scale image shall be represented by eight or more bits. Color images shall be represented as a series of sequential samples of a red, green, and blue intensity for each pixel. (Other color spaces are also possible. See **Section 7.7.10.3).**

The image shall be organized in row-major order, with the lowest address corresponding to the upper left corner of the image.

If the image is captured in grayscale, then only the luminance component shall be compressed and transmitted. For JPEG, the data shall be formatted in accordance with the *JPEG File Interchange Format, Version 1.02 (JFIF)*. For JPEG 2000, the data shall be formatted in conformance with the JP2 format as described in *ISO 15444-1*. The specifications in *NIST Special Publication 500-289* shall apply to all use of JPEG 2000

[26] Greater than 8-bit is not widely supported and has not been scientifically evaluated.

associated with this standard. Wavelet scalar quantization (WSQ) specifications are contained in *WSQ Gray-scale Fingerprint Image Compression Specification, October 2010*. The FBI maintains a list[27] of certified WSQ implementations, based upon testing performed at NIST[28]. Portable Network Graphics (PNG) is an image format specified in *ISO/IEC 15948*. The specifications in *NIST Special Publication 500-289* shall apply to all use of PNG associated with this standard.

Type-4 records use the code. Others record types use the label.

Table 15 Compression codes

Algorithm Name	Code	Label
Uncompressed	0	NONE
WSQ: Version 3.1 or higher is recommended (Version 2.0 or Version 3.0 may be used for platen areas less than 2 inches in height)	1	WSQ20
JPEG ISO/IEC 10918 (Lossy)	2	JPEGB
JPEG ISO/IEC 10918 (Lossless)	3	JPEGL
JPEG 2000 ISO/IEC 15444-1 (Lossy)	4	JP2
JPEG 2000 ISO/IEC 15444-1 (Lossless)	5	JP2L
Portable Network Graphics	6	PNG

7.7.9.1 Use of compression algorithms for friction ridge images

For each of these fields, the entry corresponds to the appropriate *Label* entry in **Table 15:**

Field 13.011: Compression algorithm / CGA
Field 14.011: Compression algorithm / CGA
Field 15.011: Compression algorithm / CGA
Field 16.011: Compression algorithm / CGA (when a friction ridge image)
Field 19.011: Compression algorithm / CGA
Field 20.011: Compression algorithm / CGA (when a friction ridge image)

Latent images shall not be compressed with any lossy compression algorithm. It is required that images be stored uncompressed, or that PNG or other totally lossless compression algorithm be used for latent images.

The following paragraphs apply to exemplar images.

[27] The list is available at https://fbibiospecs.org/
[28] The conformance testing is described at http://www.nist.gov/itl/iad/ig/wsq.cfm

Wavelet Scalar Quantization (WSQ) shall be used for compressing grayscale friction ridge data at 500 ppi class for new systems. In order to maintain backward compatibility, legacy systems may use JPEGB or JPEGL for compressing 500 ppi class images.

WSQ version 3.1[29] or higher shall be used for WSQ compression of grayscale fingerprint data at the 500 ppi class with a platen of 2 inches or greater in height. WSQ 2.0 or higher may be used for 500 ppi class data taken from a platen of less than 2 inches in height. WSQ shall not be used for other than the 500 ppi class. Any certified WSQ software is able to decode images with an encoder certified for WSQ specification versions 2.0, 3.0 or 3.1. The decoder is the same for all three versions of the specification.

Field 4.008: Compression algorithm / CA only allows the *Code* values of 0 and 1 (See **Table 15)** for new systems, since for such systems only uncompressed or WSQ-compressed 500 ppi images may be transmitted in Type-4 records.

For friction ridge images at the 1000 ppi class, JPEG 2000 shall be used according to the specifications and options contained in Profile for 1000 ppi Fingerprint Compression.

7.7.9.2 Use of compression algorithms for iris images

For iris images, images may be uncompressed or compressed. The compression code shall be one of the following, entered in **Field 17.011: Compression algorithm / CGA**:

- NONE – An entry of "NONE" indicates that the data contained in this record is uncompressed. The image shall be represented as an array of n rows by m columns. Each pixel in a monochrome image shall be represented by eight or more bits. Color images shall be represented as a sequential sample of a red, green, and blue intensity for each pixel (if using RGB - See **Section 7.7.10.3**). The image shall be organized in row-major order, with the lowest address corresponding to the upper left corner of the image.

- PNG – This supports lossless compression. PNG is formally standardized (*ISO/IEC 15948*) and implementations are freely available[30] (libpng).

- JP2 and JP2L - As with other biometrics, while lossless compression is preferred, iris images can be lossy-compressed. The image type (**Field 17.032: Iris storage format / ISF**) should be selected appropriately, and the compression ratio should be set to satisfy some known quantified storage or transmission bandwidth limitation.

The baseline JPEG algorithm (*ISO/IEC 10918*) is not acceptable for iris images and shall not be used. It has been shown that false match rates increase due to the presence of tiling artifacts. While JPEG was allowed in prior versions of this standard for iris compression, it is not allowed for this version. Implementers may want to support JPEG decoding for handling legacy images.

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[29] WSQ 3.1 rectifies problems associated with compression of larger images in earlier version of WSQ. See http://biometrics.nist.gov/cs_links/wsq/WSQ_notice.pdf . The problem was associated with taking images of two thumbs at the bottom of the platen area.

[30] See http://www.libpng.org/pub/png/libpng.html

7.7.9.3 Use of Compression algorithms for facial images

Field 10.011: Compression algorithm / CGA is a mandatory field containing the compression algorithm for Record Type-10. When Record Type-10 contains a facial image, the conditions described in **Annex E: E.6.1 Compression algorithm** apply.

7.7.9.4 Use of Compression algorithms for other data

Many image record types contain a mandatory field **Compression algorithm / CGA**. An entry of "NONE" in this field indicates that the data contained in this record is uncompressed. If a restriction on compression is required for the image type, it is referenced in that Section.

For non-facial images contained in Record Type-10, **Field 10.011: Compression algorithm / CGA** may be set to any value in **Table 15**, except WSQ20. Non-friction ridge images contained in Record Type-16 shall specify the file extension (suffix) corresponding to the compression used, such as JPG, and PNG in **Field 16.011: Compression algorithm / CGA**. A value of "NONE" indicates that the data is uncompressed.

The compression used in **Record Type-7: User-defined image record** is not specified in the standard. It is incumbent upon the sender and receiver of the record to ensure that the data contained in **Record Type-7: User-defined image record** can be decoded properly.

7.7.10 Color, black-and-white, and grayscale image requirements

7.7.10.1 Black and white images (no grayscale)

Image data may be transmitted in either compressed or uncompressed form. The uncompressed binary images shall consist of pixels, each of which shall be quantized to one of two levels (binary representation). A value of zero shall be used to represent a white pixel and a value of one shall be used to represent a black pixel. For transmission of uncompressed binary images, eight pixels shall be left justified and packed into a single unsigned byte. The most significant bit of the byte shall be the first of the eight pixels scanned. This applies to **Field 8.008: Signature image data / DATA** and is allowed in Type-7 records. As explained in Section **8.8.8.2,** binary images are compressed using the *ANSI/EIA-538-1988* standard.

7.7.10.2 Grayscale image data

Grayscale image data may be transmitted in either compressed or uncompressed form. The transmission of uncompressed grayscale images shall consist of pixels, each of which shall normally be quantized to eight bits (256 gray levels) and held in a single unsigned byte. Increased precision for pixel values greater than 255 shall use two unsigned bytes to hold sixteen-bit pixels with values in the range of 0-65535. For grayscale data, a zero shall represent a true black pixel. A true white pixel shall have all of its bits of precision set to "1". Therefore, true white pixels quantized to eight bits shall have a value of "255", while a value of "1023" shall be used for pixels quantized to ten bits. Grayscale values requiring less than 8 or 16 bits shall be expressed as one or two bytes, right justified and zero padded on the left. For grayscale images, in Record types with the mandatory field **Color space / CSP**, the value shall be "GRAY" (See **Table 16**). The transmission of compressed grayscale images shall be the output of the appropriate grayscale compression algorithm specified. Upon reconstruction of a compressed image the grayscale value for each pixel shall be the same (for lossless algorithms) or nearly the same (for lossy algorithms) as pixels in an uncompressed image.

7.7.10.3 Color image data

Scanned images shall consist of nominal 24 to 48-bit RGB pixels. Color image data may be transmitted in either compressed or uncompressed form in certain record types. The transmission of uncompressed color images shall consist of RGB pixels, each component of which shall be quantized to at least 256 levels (8 bits). For each pixel, the three components shall be sequentially formatted for transmission on a pixel-by-pixel basis. **Table 16** lists the codes and their descriptions for each of the available color spaces used within this standard. All other color spaces are to be marked as undefined.

Table 16 Color spaces

Code	Description
UNK	Undefined
GRAY	Grayscale (monochrome)
RGB	Undetermined color space for an RGB image
SRGB	sRGB (*IEC 61966-2-1*)
YCC	YCbCr (legacy)
SYCC	YCbCr (JPEG 2000 compressed)

Several image record types have a field **Color space / CSP.** It shall contain an entry from the CODE column of **Table 16**. If the color image type cannot be determined, an entry of "RGB" shall be entered in this field.

These are the **CSP** fields.

Field 10.012: Color space / CSP
Field 16.013: Color space / CSP
Field 17.013: Color space / CSP
Field 20.013: Color space / CSP

In versions of this standard prior to 2007, the term "color space" referred to device-dependent color information with a particular sequence and range for the three color channels. The choice was either RGB or an RGB-derivative space known as YCC. Neither space provides an objective definition of a particular color or relates to the way in which humans perceive color. For JPEG-compressed color images stored in the JFIF format, the preferred (external) color space is sRGB and an entry of "SRGB" shall be used. Although sRGB is the preferred color space for compressed images for this version, in the 2000 version of this standard, it was stated that "the preferred color space for compressed images using baseline JPEG and JFIF is YCbCr to be coded as 'YCC'," while the color space for uncompressed color images was to be labeled RGB. Therefore, for backward compatibility purposes, new systems shall accommodate JPEG images that have been labeled as using the YCC color space. Systems conforming to this standard shall accept an entry of YCC and interpret it as meaning a (device-dependent) RGB color space.

For JPEG 2000 images stored in the JP2 file format, the available enumerated color spaces are sRGB, sYCC, and grayscale. The preferred (external) color space for color images is sRGB. If a photo acquisition device uses another International Color Consortium[31] (ICC) color profile, the acquisition system shall convert the image data to the sRGB, sYCC, or grayscale color space before the JP2 file may be embedded in a record.

To ensure that color images exchanged between differing systems can be correctly displayed or printed, images should be converted to the device-independent color space, sRGB, before compression or transmission to another system. As defined by *IEC 61966-2-1*, sRGB is a non-linear display profile that accommodates the voltage-to-color response characteristics of most high quality CRT monitors. The colors of the red, green, and blue phosphors (primaries) and the white point setting of an sRGB-conformant monitor are specified in the IEC document. For uncompressed color images containing non-interleaved red, green and blue pixels in that order, the preferred color space is sRGB. Typically, modern digital cameras, desktop scanners, LCD monitors, and printers, although they do not inherently operate in sRGB space, are designed with circuitry or software to produce sRGB output or to accommodate sRGB as an input space. If an image acquisition device's color space is unknown, sRGB is usually a reasonable choice. If an acquisition device and its software cannot provide sRGB output, various color management products are available commercially that use its color profile, often available from its manufacturer, to convert images in its native color space to sRGB.

7.7.11 Eye color

This information appears in **Field 10.027: Subject eye color / SEC** and in **Field 17.020: Eye color / ECL.** The eye color describes the eye color of the subject as seen in the image. If unusual or unnatural, such as is the case when colored contact lenses are present and the 'real' eye color cannot be ascertained, then the color shall be labeled as "XXX". For near infra-red (NIR) images, if this field is entered, it shall be 'XXX'. Values for these fields shall be the alphabetic entries in the "Attribute code" column of **Table 17**.

[31] See http://www.color.org/

Table 17 Eye color codes

Eye color attribute	Attribute code
Black	BLK
Blue	BLU
Brown	BRO
Gray	GRY
Green	GRN
Hazel	HAZ
Maroon	MAR
Multicolored	MUL
Pink	PNK
Unknown	XXX

7.7.12 Paths

Some paths in **Record Type-17: Iris image record** can be a circle or ellipse (**Field 17.033: Iris pupil boundary / IPB**, **Field 17.034: Iris sclera boundary / ISB**, and **Field 10.015: Face image path coordinates in full image / FPFI**). A circle only requires 2 points to define it (See **Table 19**). An ellipse requires 3 points to define it.

Other fields are defined as open and closed paths.

Open paths (also called contours or polylines) and closed paths (polygons) on an image are comprised of a set of vertices. For each, the order of the vertices shall be in their consecutive order along the length of the path, either clockwise or counterclockwise. (A straight line of only two points may start at either end). A path may not have any sides crossing. No two vertices shall occupy the same position. There may be up to 99 vertices.

An open path is a series of connected line segments that do not close or overlap. A closed path (polygon) completes a circuit. The closed path side defined by the last vertex and the first vertex shall complete the polygon. A polygon shall have at least 3 vertices.

There are two different approaches to the paths in this standard. The 2007 and 2008 version of the standard used paths for **Field 14.025: Alternate finger segment position(s) / ASEG.** That approach has been retained in this version for all paths except in the Extended Feature Set (EFS) of Record Type-9. The EFS adopted an approach expressing the path in a single information item, which is different than that used in other record types.

Note that bounding boxes, such as in **Field 14.021: Finger segment position / SEG** are not considered paths in this terminology.

7.7.12.1 Type-9 extended feature set (EFS) paths

The vertices for paths in the EFS Type-9 records are defined in a single information item[32] for each of the following fields (See **Table 30 Type-9 Fields for EFS)**. If multiple paths are present, they are stored within separate subfields. Each vertex is expressed as an (X,Y) pair of positive integers in units of 10 micrometers (0.01mm).

The Extended Feature Set used in the **Record Type-9: Minutiae data record** was developed as a separate encoding structure that has been incorporated into this standard. In order to avoid conflicts with systems that had already programmed using the EFS method of specifying paths, that structure is retained in this standard.

EFS fields using closed paths, and requiring at least 3 vertices, are:

- **Field 9.300: EFS region of interest / ROI**
- **Field 9.302: EFS finger - palm - plantar position / FPP**
- **Field 9.324: EFS distinctive features / DIS**
- **Field 9.357: EFS local quality issues / LQI**
- **Field 9.360: EFS area of correspondence / AOC**

An open path is a series of connected points in which there is not an implicit connection between the last and first vertices. Within EFS, open paths are used in **Field 9.373: EFS ridge path segments / RPS.**

7.7.12.2 All other fields specifying paths

The first information item is dependent upon the Record Type and field.

- In **Field 10.033: Feature contours / FEC** which is an open path, the first information item is the **feature contour code / FCC**, selected from the "Code" column of **Table 18.**

- In Record Type-17 **Fields 17.033** through **17.036**, and in **Field 10.015: Face image path coordinates in full image / FPFI** the first information item is the **boundary code / BYC,** with an alphabetic value selected from the "Code" column of **Table 19**.

- For **Field 10.045: Occlusions / OCC** and **Field 17.037: Non-eyelid occlusions / NEO**, the first information item is the **occlusion opacity / OCY,** selected from the "Code" column of **able 20.**

- In **Field 14.025: Alternate finger segment position(s) / ASEG** and **Field 19.019: Friction ridge - toe segment position(s) / FSP** the first information item contains a **friction ridge generalized position / FGP**, an integer from **Table 8.**

[32] In Traditional encoding, it is entered as a single string of "x1,y1-x2,y2-…-xN,yN" where xK indicates the K^{th} vertex, up to the total number of vertices. A comma "," shall be entered between the X and Y coordinates of a vertex in this string, and a dash "-" shall be entered between coordinate pairs.

- In **Field 20.016: Segments / SEG** the first information item is the **reference segment position / RSP**. This provides a unique index to a segmentation. (See **Section** 7.3.2.2 for its use in **Field xx.997** in other record types.)

- In **Field 21.016: Segments / SEG** the first information item is the **associated segment position / ASP.** This provides a unique index to a segmentation. (See **Section** 7.3.3.2 for its use in **Field xx.995** in other record types.).

For **Field 10.045**, **Field 17.037, Field 20.016,** and **Field 21.016**, the second information item is described below.

- For **Field 10.045: Occlusions / OCC** and **Field 17.037: Non-eyelid occlusions / NEO**, the second information item is the **occlusion type / OCT**. It is one character containing a code from **Table 21**.

- For **Fields 20.016** and **21.016** only, the second information item is the **internal file reference pointer/ IPT**. It is set to 0 if the source representation is a single file. If the external file referenced in **Field 20.994: External file reference / EFR** or **Field 21.994: External file reference / EFR** is a PDF, video, or presentation file, or has multiple locations where a sample may be located, this information item is the reference to the particular instance, such as page, video frame, or slide number used to derive the image transmitted in other record types. If a particular frame is chosen and there is no further image segmentation needed, the following information items shall not be used.

The second (or third in the case of **Field 10.045**, **Field 17.037, Field 20.016,** or **Field 21.016**) information item (**number of points / NOP)** shall specify the number of vertices. The next information items are pairs of x and y coordinates of vertices. The horizontal offsets (X) are the pixel counts to the right, and the vertical offsets (Y) are the pixel counts down from the origin. The first information item in this pairing is the **horizontal point offset / HPO**. The second information item in this pairing is the **vertical point offset / VPO**. Pairings are inserted for each vertex, up to the **NOP**.

Table 18: Feature contour code descriptions

Code	Contour Description
eyetop	Bottom of upper eye lid
eyebottom	Top of lower eye lid
upperliptop	Top of upper lip
upperlipbottom	Bottom of upper lip
lowerliptop	Top of lower lip
lowerlipbottom	Bottom of lower lip
rightnostril	Subject’s right nostril
leftnostril	Subject’s left nostril
lefteyebrow	Curvature of top of subject’s left eye socket
righteyebrow	Curvature of top of subject’s right eye socket
chin	Chin
faceoutline	Face outline includes the entire head, all facial hair, and ears

Table 19: Boundary definition codes

Type	Code	Number of points	Description
Circle	C	2	The boundary is defined by two points: the center is defined in the first point, and any point on the circle is defined as the second point.
Ellipse	E	3	The boundary is defined by three points: both endpoints of one of the ellipse's axes are defined in the first and second points, and one endpoint from the other axis is defined in the third item.
Polygon	P	N (up to 99)	The boundary is defined as a n-vertex, where 'n' is between 3 and 99. The order of the vertices must be in consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. No two vertices may occupy the same location. The polygon side defined by the last point and the first point shall complete the polygon. The polygon must be a single plane figure with no sides crossing and no interior holes.

Table 20: Occlusion opacity

Type	Code	Description
Total	T	There is no detail in the area of the occlusion.
Interference	I	The occlusion contains interfering texture such as eyelashes, hair or reflection.
Partial Light	L	There is detail in the area of the occlusion that is lighter than the rest of the face or iris.
Partial shadow	S	There is detail in the area of the occlusion that is darker than the rest of the face or iris.

Table 21: Occlusion type

Type	Code	Description
Lashes	L	Eyelashes or reflections of eyelashes (iris only)
Head covering	H	Hair, hat, veil, burka, or other head covering (face only)
Specular	S	Specularity, reflection of light
Shadow	C	Shadow cast
Reflection	R	Reflection of an object
Other	O	Any other occlusion, such as eyeglass frames blocking the image

8 Record type specifications

At the beginning of each Section describing a Record Type, there is a record layout table. The Character type is defined in Section **5.5 Character types** . Note that when the character type U is allowed, the character set encoding specified in **Field 1.015 Character encoding / DCS** (if present) is used for the data; otherwise the default is UTF-8.

Cond code (condition code):

- M = Mandatory field, subfield or information item;
- O = Optional field, subfield or information item;
  - M⇑ = Mandatory subfield / information item within the optional field / subfield;
  - O⇑ = Optional subfield / information item within the optional field / subfield;
- D = Field, subfield or information item that's presence is dependent upon certain conditions stated in the text

The 'Character count' does NOT include special characters in Traditional encoding.

When "*" appears it means that the limit is undefined.

When 0 is shown as a valid value (such as "0 < **IDC** < 99 integer"), a zero shall be entered as data. This shall not be interpreted as a null (empty) value.

For data with leading zeros, (such as "0101"), the encodings (Traditional and NIEM-conformant XML) may handle them differently. The leading zeros shall be included in the Traditional encoding as ASCII characters, but need not be included in XML encoding. However, the leading zero(s) shall be shown when displaying the data in printed format. The following fields contain data with leading zeros:

Field 1.002 Version number / VER

Treated as an integer in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

Field 1.011 Native scanning resolution / NSR

Treated as a decimal number in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

Field 1.012 Nominal resolution / NTR

Treated as a decimal number in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

Field 99.100: CBEFF header version / HDV

Treated as a character string in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

Field 99.101: Biometric type / BTY

Treated as an enumerated list of integers in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

8.1 Record Type-1: Transaction information record

Record Type-1 is mandatory. Only one Type-1 record is present per transaction. **Table 22** contains the fields associated with this Record Type. Note that since the alternate character encoding is specified in this record, there must be specified characters agreed upon in order to read this Record Type, particularly with Traditional encoding, and the characters that can be represented by the 7-bit ASCII code are those characters (See **Table 93** for these characters). There are no character types defined as 'U' for any fields in this Record Type. (See Section **5.5** for a description of the character types). This provides for backward compatibility with previous versions of the standard. This is particularly important for Traditional Encoding. See **Annex B: Traditional encoding** for details.

Table 22 Type-1 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
1.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
1.002	**VER**	**VERSION NUMBER**	M	N	T-4; X=3[33]	4	VER = 0500	1	1
1.003	**CNT**	**TRANSACTION CONTENT**	M					1	1
		Subfield: Single set of information items	M					1	1
	FRC	first record category code	M	N	1	1	FRC = 1	1	1

[33] Traditional encoding (T) requires a leading zero. XML (X) encoding does not.

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	CRC	content record count	M	N	1	3	CRC = count of record types 2 through 99; min = 1; max = 999; positive integer	1	1
		Subfields: Repeating pairs of information items	M					CRC value	CRC value
	REC	record category code	M	N	1	2	REC = 2 or 4; or 7 ≤ REC ≤ 10 or 13 ≤ REC ≤ 21; or REC = 98 or 99; integer	1	1
	IDC	information designation character	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
1.004	**TOT**	**TYPE OF TRANSACTION**	M	A	1	16	user-defined	1	1
1.005	**DAT**	**DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
1.006	**PRY**	**PRIORITY**	O	N	1	1	1 ≤ PRY ≤ 9 positive integer	0	1
1.007	**DAI**	**DESTINATION AGENCY IDENTIFIER**	M	ANS	1	*	none	1	1
1.008	**ORI**	**ORIGINATING AGENCY IDENTIFIER**	M	ANS	1	*	none	1	1
1.009	**TCN**	**TRANSACTION CONTROL NUMBER**	M	AN	1	*	none	1	1
1.010	**TCR**	**TRANSACTION CONTROL REFERENCE NUMBER**	O	AN	1	*	none	0	1
1.011	**NSR**	**NATIVE SCANNING RESOLUTION**	M	NS	T=5; X=4 [33]	5	NSR = 00.00 if no Type-4 records in transaction; otherwise xx.xx	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
1.012	**NTR**	**NOMINAL RESOLUTION**	M	NS	T=5; X=4 [33]	5	NTR = 00.00 if no Type-4 records in transaction; otherwise xx.xx	1	1
1.013	**DOM**	**DOMAIN NAME**	O					0	1
	DNM	domain name	M⇑	A NS	1	*	none	1	1
	DVN	domain version number	O⇑	A NS	1	*	none	0	1
1.014	**GMT**	**GREENWICH MEAN TIME**	O	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
1.015	**DCS**	**CHARACTER ENCODING**	O					0	1
		Subfield: A single set of information items (The 2007 version allowed multiple character encoding sets, but with XML this is not possible and was not included in the 2008 version. To maintain consistency in encodings, only one subfield instance is now allowed.)	M⇑					1	1
	CSI	character encoding set index	M⇑	N	1	3	$0 \leq CSI \leq 4$ or $128 \leq CSI \leq 999$ integer See **Table 4**	1	1
	CSN	character encoding set name	M⇑	A NS	1	16	See **Table 4**	1	1
	CSV	character encoding set version	O⇑	A NS	1	16	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
1.016	**APS**	**APPLICATION PROFILE SPECIFICATIONS**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	APO	application profile organization	M⇑	A NS	1	*	none	1	1
	APN	application profile name	M⇑	A NS	1	*	none	1	1
	APV	application profile version number	M⇑	A NS	1	*	none	1	1
1.017	**ANM**	**AGENGY NAMES**	O					0	1
	DAN	destination agency name	O⇑	A NS	1	*	none	0	1
	OAN	originating agency name	O⇑	A NS	1	*	none	0	1

8.1.1 Field 1.001 Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.1.2 Field 1.002 Version number / VER

This mandatory four-character ASCII value shall be used to specify the current version number of the standard implemented by the software or system creating the transaction. The format of this field shall consist of four numeric characters. The first two characters shall specify the major version number. The last two characters shall be used to specify the minor revision number. This version of the standard has the entry "0500". See **Section** 8 for information concerning leading zeros.

8.1.3 Field 1.003 Transaction content / CNT

This mandatory field[34] shall list and identify each of the records in the transaction by record type and its IDC value. It also specifies the order in which the remaining records shall appear in the file. It shall consist of two or more subfields. The first subfield shall relate to this Type-1 record.

[34] This was called **File content** in earlier versions of the standard.

- The first information item (**first record category code / FRC**) within this subfield shall be "1". This indicates that the first record in the transaction is a Type-1 record consisting of header information.

- The second information item of this subfield (**content record count / CRC)** shall be the sum of the Type-2 through Type-99 records contained in this transaction. This number is also equal to the count of the remaining subfields of **Field 1.003 Transaction content / CNT**. The maximum value for CRC is 999.

Each of the remaining subfields of **Field 1.003 Transaction content / CNT** corresponds to a single Type-2 through Type-99 record contained in the transaction. Two information items shall comprise each of these subfields:

- The first information item (**record category code / REC**), shall contain a number chosen from the "record identifier" column of **Table 3**.

- The second information item (**information designation character / IDC**) shall be an integer equal to or greater than zero and less than or equal to 99. See **Section 7.3.1**.

8.1.4 Field 1.004 Type of transaction / TOT

This mandatory field shall contain an identifier, which designates the type of transaction and subsequent processing that this transaction should be given. This shall be a maximum of 16 alphabetic characters. The **TOT** shall be in accordance with definitions provided by the domain or application profile. Earlier versions of this standard specifically restricted the character length of **TOT** to 4 characters.

8.1.5 Field 1.005 Date / DAT

This mandatory field shall contain the local date that the transaction was submitted. See **Section 7.7.2.3.**

8.1.6 Field 1.006 Priority / PRY

This optional field shall contain a single information character to designate the urgency with which a response is desired. The values shall range from 1 to 9, with 1 denoting the highest priority. The default value shall be defined by the agency receiving the transaction.

8.1.7 Field 1.007 Destination agency identifier / DAI

This mandatory field shall contain the identifier of the administration or organization designated to receive the transmission. The size and data content of this field shall be user-defined and in accordance with the application profile. See **Section 7.6.** The name of the destination agency may be entered in **Field 1.017 Agency names / ANM**. A valid value for this field is "Not Specified." All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.1.8 Field 1.008 Originating agency identifier / ORI

This mandatory field shall contain the identifier of the administration or organization originating the transaction. The size and data content of this field shall be user-defined and in accordance with the application profile. See **Section 7.6.** The name of the originating agency may be entered in **Field 1.017 Agency names / ANM.** A valid value for this field is "Not Specified." All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.1.9 Field 1.009 Transaction control number / TCN

This mandatory field shall contain the transaction control number as assigned by the originating agency. A unique (for the originating agency) alphanumeric control number shall be assigned to each transaction. For any transaction that requires a response, the respondent shall refer to this number in communicating with the originating agency.

8.1.10 Field 1.010 Transaction control reference / TCR

This optional field shall be used for responses that refer to the **TCN** of a previous transaction involving an inquiry or other action that required a response.

8.1.11 Field 1.011 Native scanning resolution / NSR

This mandatory field shall be set to "00.00" if there are no Type-4 records in the transaction. See **Section 8** for information concerning leading zeros. This field does not apply to Type-7 records in this version of the standard, unlike in previous versions, unless specified as such by the domain or application profile. The special character that is allowed is ".".

When there are Type-4 records present, this field is used to specify the native scanning resolution of the friction ridge image capture device. This field shall specify the resolution in pixels per millimeter. The resolution shall be expressed as two numeric characters followed by a decimal point and two more numeric characters.

If Record Type-4 is used and images are scanned at greater than the class of 500 ppi, they shall be subsampled, scaled down, or interpolated down to produce a class resolution of 500 ppi for transmission. Users shall utilize Record Type-14 if transmitting a fingerprint image at greater than the limits of the 500 ppi class. Images with scanning resolution greater than or equal to the 1000 ppi class shall not be transmitted using Record Type-4.

8.1.12 Field 1.012 Nominal resolution / NTR

This mandatory field shall be set to "00.00" if there are no Type-4 records in the transaction. See **Section 8** for information concerning leading zeros. This field does not apply to Type-7 records in this version of the standard, unlike in previous versions, unless specified as such by the domain or application profile.The special character that is allowed is ".".

When there are Type-4 records present, this field specifies the nominal resolution for the image(s) being exchanged. This field shall specify the resolution in pixels per millimeter. The resolution shall be within the range 19.30 ppmm (490 ppi) to 20.08 ppmm (510 ppi). For example, a sensor that scans natively at 508ppi would list both **NSR** and **NTR** as 20ppmm (=508ppi). These images should not be sampled down to exactly 500ppi. See **Section 7.7.6.3**. This field was called "**Nominal transmitting resolution**" in earlier versions of the standard. The mnemonic is still retained as **NTR** in this version.

The 2007 version of the standard stated: "Any transmitting resolution within the range of the minimum scanning resolution to a value of 20.47 ppmm plus or minus 0.20 ppmm (520 ppi plus or minus 5 ppi) is permitted for the processing of high resolution records." This version of the standard specifically prohibits transmission resolution above 510 ppi (the upper limit of the 500 ppi class). Note that Appendix F maximum variance is 5 ppi and PIV maximum variance is 10 ppi. (See **Table 14 Class resolution with defined tolerance**)

8.1.13 Field 1.013 Domain name / DOM

This optional field identifies the domain name for the user-defined Type-2 record implementation. The domain name may only appear once within a transaction. It shall consist of one or two information items. See **Section 6** for more information and the relationship to **Field 1.016 Application profile specifications / APS**. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

- The mandatory first information item (**domain name / DNM**) will uniquely identify the agency, entity, or implementation used for formatting the fields in the Type-2 record. The default value for the field shall be the North American Domain implementation (NORAM).
- An optional second information item (**domain version number / DVN**) shall contain the unique version of the particular implementation, such as 7.02.

8.1.14 Field 1.014 Greenwich mean time / GMT

This optional field provides a mechanism for expressing the date and time in terms of universal Greenwich Mean Time (GMT) units. See **Section 7.7.2.2.**

8.1.15 Field 1.015 Character encoding / DCS

This optional field specifies the character encoding that may appear within this transaction for data with the character type listed as "U" or 'user-defined' in the record format tables. This field shall contain one set of information items (coded as a subfield). This is consistent with the 2008 version of the standard. The 2007 version allowed multiple character encoding sets. See **Annex B: Traditional encoding** and **Annex C: NIEM-conformant encoding rules** for details on the use of this field.

For a description of the use of alternate character encoding see **Section 5.6.**

- The first information item (**character encoding index / CSI**) is the index number that references an associated character encoding. See the "Character encoding index" column of **Table 4** for the valid values for this information item.

- The second information item (**character encoding name / CSN**) shall be the "Character encoding name" associated with that index number, taken from **Table 4**. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

- The optional third information item (**character encoding version / CSV**) is the specific version of the character encoding used. In the case of the use of UTF-8, the third optional information item may be used to hold the specific version used, so that the display terminal can be switched to the correct font family. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.1.16 Field 1.016 Application profile specifications / APS

Use of this optional field indicates the transaction's conformance with one or more Application Profile Specifications that are derived from *ANSI/NIST-ITL 1-2011*, such as EBTS or INT-I. There may be multiple subfields, each designating an application profile to which this transaction conforms. If multiple Application Profile Specifications are included in this field, the specifications must be compatible with each other: this transaction must be in conformance with all of the cited specifications. See **Section 6**. Each subfield shall consist of three mandatory information items:

- The first information item (**application profile organization / APO**) will uniquely identify the agency or entity responsible for the specification. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

- The second information item (**application profile name / APN**) shall contain the name of the specification. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

- The third information item (**application profile version number / APV**) shall contain the specific version of the specification. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.1.17 Field 1.017 Agency names / ANM

This optional field is comprised of two optional information items. The first is the **destination agency name / DAN**. This corresponds to the agency listed in **Field 1.007 Destination agency identifier / DAI**. The second optional information item is the **originating agency name / OAN.** This corresponds to the agency listed in **Field 1.008 Originating agency identifier / ORI**. Both information items are alphanumeric and can have any special characters in the names. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.2 Record Type-2: User-defined descriptive text record

Type-2 records are optional, but when present, shall contain textual information relating to the subject of the transaction. This record may include such information as the state or FBI numbers, physical characteristics, demographic data, and the subject's criminal history. Every transaction usually contains one or more Type-2 records which is dependent upon the entry in **Field 1.004 Type of transaction / TOT.**

Table 23 Type-2 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
2.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
2.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	$0 \leq \text{IDC} \leq 99$ integer	1	1
2.003 and above	**USER-DEFINED**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	

8.2.1 Field 2.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.2.2 Field 2.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-2 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section 7.3.1.**

8.2.3 Fields 2.003 and above: user-defined fields

Individual fields shall conform to the specifications set forth by the agency to which the transmission is being sent, to the domain listed in **Field 1.013 Domain name / DOM**, the application profiles listed in **Field 1.016 Application profile specifications / APS** and to the requirements specified in **Section 5.1.**

8.3 Record Type-3: Deprecated

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for the specifications of this Record Type. No instances of Record Type-3 shall be included in a transaction conformant with this version of the standard.

8.4 Record Type-4: Grayscale fingerprint image

The Type-4 record is based on the use of a captured fingerprint image obtained using a class scanning resolution of the 500 ppi class. (See **Section 7.7.6).** Record Type-4 cannot be updated to include new fields, since the Traditional encoding for this record type is fixed in order. It shall not be used for other than 500 ppi class images. All images that are compressed should be compressed using WSQ. JPEG compression is retained solely for backwards compatibility with legacy systems and it should not be used in any new implementation.

Table 24 Type-4 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length; therefore the character min and max values are the same for traditional format (denoted by T= value). They are expressed in bytes. For XML, the min and max values are the character count (denoted by X= value).

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
4.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
4.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	T=1 X=1	T=1 X=2	0 ≤ IDC ≤ 99 integer	1	1
4.003	**IMP**	**IMPRESSION TYPE**	M	N	T=1 X=1	T=1 X=2	0 ≤ IMP ≤ 3 or IMP = 8 or 20 ≤ IMP ≤ 29 integer See **Table 7**	1	1
4.004	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	N	T=1 X=1	T=1 X=3	0 ≤ FGP ≤ 15 or FGP = 255 integer See **Table 8**	T = 6; X= 1	6
4.005	**ISR**	**IMAGE SCANNING RESOLUTION**	M	N	T=1 X=1	T=1 X=1	ISR = 0 or 1 integer	1	1
4.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	T=2 X=2	T=2 X=5	10 ≤ HLL ≤ 65535 positive integer	1	1
4.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	T=2 X=2	T=2 X=5	10 ≤ VLL ≤ 65535 positive integer	1	1
4.008	**GCA**	**COMPRESSION ALGORITHM**	M	N	T=1 X=1	T=1 X=1	0 ≤ value ≤ 1 integer	1	1
4.009	**DATA**	**IMAGE DATA**	M	B	T=1 X=1	T=* X=*	none	1	1

8.4.1 Field 4.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.4.2 Field 4.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-4 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.4.3 Field 4.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint was obtained. See **Section 7.7.4.1** for details.

8.4.4 Field 4.004: Friction ridge generalized position / FGP

This mandatory field shall contain the decimal code number corresponding to the finger position and shall be taken from **Table 8.** Only finger numbers 0-15 apply to Type-4[35]. Up to five additional finger positions shall be referenced by entering the alternate finger positions using the same format. If fewer than five finger position references are to be used, the unused position references shall be filled with 255 for Traditional format. Six values shall be entered in each record for Traditional format. See **Section 7.7.4.2** for more information.

If Record Type-4 is used and images are scanned at a step in the migration path greater than the class of 500 ppi (effectively 510 ppi) , they shall be subsampled, scaled down, or interpolated down to produce a class resolution of 500 ppi for transmission. Users are required to use Record Type-14 if transmitting a fingerprint image at greater than 20.08 ppmm (510 ppi). See **Section 7.7.6.2.**

8.4.5 Field 4.005: Image scanning resolution / ISR

The mandatory ISR field relates to the *scanning* resolution of this image. Previous versions of this standard stated that 0 in this field represents the 'minimum scanning resolution.' The minimum scanning resolution was defined in ANSI/NIST-ITL 1-2007 as “19.69 ppmm plus or minus 0.20 ppmm (500 ppi plus or minus 5 ppi).” Therefore, if the image scanning resolution corresponds to the Appendix F certification level (See **Table 14 Class resolution with defined tolerance**), a 0 shall be entered in this field.

A value of 1 is entered if the actual scanning resolution (outside of the Appendix F certification range) is specified in **Field 1.011 Native scanning resolution / NSR**.

[35] The 2007 and 2008 versions of this standard restricted the FGP to a range of 0 to 14. Code 15 had been added to this version.

8.4.6 Field 4.006: Horizontal line length / HLL

This mandatory field shall contain the number of pixels on a single horizontal line of the transmitted image. See **Section 7.7.8.1.**

8.4.7 Field 4.007: Vertical line length / VLL

This mandatory field shall contain the number of pixels on a single horizontal line of the transmitted image. See **Section 7.7.8.2.**

8.4.8 Field 4.008: Compression algorithm / CA

This is a mandatory field, used to specify the type of compression algorithm used. A zero denotes no compression. Otherwise, the WSQ algorithm should be used to compress the data, and is indicated by a value of 1. Codes 2 and 3 are retained solely for backwards compatibility with those legacy systems that use JPEG compression and should not normally be used. See Section **7.7.9.1**.

8.4.9 Field 4.009: Image data / DATA

This is a mandatory field.

8.5 Record Type-5: Deprecated

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for specifications. No instances of Record Type-5 shall be included in a transaction conformant with this version of the standard.

8.6 Record Type-6: Deprecated

See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for specifications. No instances of Record Type-6 shall be included in a transaction conformant with this version of the standard.

8.7 Record Type-7: User-defined image record

Type-7 records shall contain user-defined image information relating to the transaction submitted for processing. New implementations based on this standard are encouraged to use the **Record Type-13: Friction-ridge latent image record** for latent records, and other record types, as appropriate, for transmitting biometric and forensic images. Images transmitted using Record Type-7 shall consist of scanned pixels that may be either binary or grayscale output. Each grayscale pixel value shall be expressed as an unsigned byte. A value of 0 shall be used to define a black pixel and an unsigned value of 255 shall be used to define a white pixel. For binary pixels, a value of 0 shall represent a white pixel and a value of 1 shall represent a black pixel. Resolution and compression is not specified for this Record Type. See **Section 7.7.6** for information about the difference in the handling of Type-7 resolution in this version of the standard and earlier versions.

Table 25 Type-7 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length for Field 7.002; therefore the character min and max values are the same for traditional format (denoted by T= value). They are expressed in bytes. For XML, the min and max values are the character count (denoted by X= value).

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	MIn #	Max #		MIn #	Max #
7.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**	1	1
7.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	T=1 X=1	T=1 X=2	$0 \leq$ IDC ≤ 99 integer	1	1
Additional fields	**USER-DEFINED**	**USER-DEFINED**	user-defined	user-defined			user-defined	user-defined	user-defined

8.7.1 Field 7.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.7.2 Field 7.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-7 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section** 7.3.1.

8.7.3 Fields 7.003 through 7.999: User-defined fields

The remaining fields of the Type-7 record shall be user-defined. Individual fields shall conform to the specifications of the agency to which the transmission is being sent.

8.8 Record Type-8: Signature image record

Type-8 records shall contain either scanned or vectored signature data, covering an area of up to 1000 mm2. Two signature image records (from the operator and the subject) are allowed per transaction. See Section **7.7.6** for resolution information. Vectored signature data shall be expressed as a series of numbers.

Table 26 Type-8 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length for Fields 8.002 through 8.007; therefore the character min and max values are the same for traditional format (denoted by T= value). They are expressed in bytes. For XML, the min and max values are the character count (denoted by X= value).

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
8.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
8.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	T=1 X=1	T=1 X=2	$0 \leq IDC \leq 99$ integer	1	1
8.003	**SIG**	**SIGNATURE TYPE**	M	N	T=1 X=1	T=1 X=1	SIG = 0 or 1	1	1
8.004	**SRT**	**SIGNATURE REPRESENTATION TYPE**	M	N	T=1 X=1	T=1 X=1	SRT = 0 or 1 or 2	1	1
8.005	**ISR**	**IMAGE SCANNING RESOLUTION**	M	N	T=1 X=1	T=1 X=1	ISR = 0 or 1	1	1
8.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	T=2 X=1	T=2 X=5	HLL = 0 or $10 \leq HLL \leq 65535$ integer	1	1
8.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	T=2 X=1	T=2 X=5	VLL = 0 or $10 \leq VLL \leq 65535$ integer	1	1
8.008	**DATA**	**SIGNATURE DATA**	M	dependent upon value of SRT			dependent upon value of SRT	1	1

8.8.1 Field 8.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.8.2 Field 8.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-8 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.8.3 Field 8.003: Signature type / SIG

This mandatory field shall contain 0 for the signature image of the subject, or 1 for the signature image of the official processing the transaction.

8.8.4 Field 8.004: Signature representation type / SRT

This mandatory field shall be 0 if the image is scanned and not compressed, a 1 if the image is scanned and compressed, and 2 if the image is vector data.

8.8.5 Field 8.005: Image scanning resolution / ISR

This mandatory field shall contain 0 if the scanned and transmitted image resolution is within the range of 19.49 ppmm (495 ppi) to 19.89 ppmm (505 ppi). A value of 1 indicates a different, unreported, image resolution[36]. A value of 0 shall also be used if the image is vector data.

8.8.6 Field 8.006: Horizontal line length / HLL

This mandatory field shall be used to specify the number of pixels contained on a single horizontal line of the transmitted signature image. For vectored signature data, the value shall be zero. See **Section 7.7.8.1.**

8.8.7 Field 8.007: Vertical line length / VLL

This mandatory field shall be used to specify the number of horizontal lines contained in the transmitted signature image. For vectored signature data, the value shall be zero. See **Section 7.7.8.2.**

8.8.8 Field 8.008: Signature image data / DATA

This mandatory field shall contain uncompressed scanned image signature data, compressed scanned image signature data, or vectored image signature data. The entry contained in the **SRT** field shall indicate which form of the signature data is present.

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[36] In previous versions of the standard, a 0 indicated the 'minimum scanning resolution' and a 1 indicated the native scanning resolution. Native scanning resolution was defined in **Field 1.011 Native scanning resolution / NSR** as applying only to Types 3 through 7. This change of language is to make clear that the value of 1 does not relate to the contents of Field 1.011. Field 1.011 applies only to Type-4 data.

8.8.8.1 Uncompressed scanned image data

If the **SRT** field contains the value of zero, then this field shall contain the uncompressed scanned binary image data for the signature. In uncompressed mode, the data shall be packed at eight pixels per byte.

8.8.8.2 Compressed scanned image data

If the **SRT** field contains the value of one, then this field shall contain the scanned binary image data for the signature in compressed form using the *ANSI/EIA-538-1988 facsimile compression algorithm*.

8.8.8.3 Vectored image data

If the **SRT** field contains the value of two, then this field shall contain a list of vectors that describes the pen position. Each vector has three parts.

- The first part is an X coordinate value (horizontal).
- The second part is a Y coordinate value (vertical).
- The third part is the pen pressure value of line segments within the signature.

Both the X and Y coordinates shall be expressed in units of .0254 mm (.001 inches) referenced from the bottom leftmost corner of the signature. Positive values of X shall increase from left-to-right and positive values of Y shall increase from bottom-to-top.

The pen pressure shall be a constant value until the next vector becomes active. A value or pressure of 0 shall represent a “pen-up” (or no pressure) condition. The value of 1 shall represent the least recordable pressure for a particular device, while 254 shall represent the maximum recordable pressure for that device. To denote the end of the vector list, 255 shall be inserted in this entry.

8.9 Record Type-9: Minutiae data record

Type-9 records shall contain text describing minutiae and related information encoded from a finger, palm, or plantar image. There is no limit on the number of Type-9 records for a latent search transaction. The Type-9 record shall also be used to exchange minutiae and related information from latent friction ridge images between similar or different systems.

Note that **Fields 9.005 through 9.012** in this version of the standard shall not appear for all new applications and are 'legacy fields'. For users encountering these fields in legacy systems, please refer to *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for a description of those fields. Old (legacy) data containing these fields may still be transmitted in a transaction conformant to the this version .

Reserved blocks, each consisting of several fields, are registered and allocated for use by specific vendors. As these blocks may contain proprietary information, no detailed information is provided regarding the content of these vendor-defined feature sets aside from the range of field numbers in this standard. For detailed information on each of these fields, the vendor should be contacted. These alternative blocks of reserved fields allow vendors to encode minutiae data and any additional required characteristic or feature data in accordance with their own system's specific hardware and software configuration. Table 27 identifies the vendor implementations and their assigned blocks of field numbers. For those vendors not identified in the table, **Fields 9.176** through **9.225** may be used to record their proprietary features[37]. Any vendor may use these fields to record information. The name of the vendor or developer of the proprietary feature data, the name and version of the algorithm used, the target device for which the data is generated, and the contact information, together with the feature data shall be recorded within this block of fields.

Record **Fields 9.126** through **9.150** correspond to the conventions defined and described originally by the *ANSI INCITS 378* standard. Record **Fields 9.300** through **9.399** are the Extended Feature Set, which is new for this version of the standard.

In the 2008 version of the standard, only one vendor block (including the M1 format) could be present in a single record. The 2007 version allowed multiple blocks to be present. The 2011 version is consistent with the 2007 version for all encodings -- allowing multiple blocks (including the INCITS 378 block and the EFS block) to be present.

Although this record type may also be used to accommodate a variety of methods used by different AFIS vendors for encoding minutiae data according to their particular requirements, each vendor implementation shall contain the first four fields described below. Fields corresponding to the *INCITS-378* features, the Extended Feature Set and the Universal Latent annotation[37] may be used with or without the fields associated with registered implementations.

Table 27 Type-9 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
9.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
9.003	**IMP**	**IMPRESSION TYPE**	M	N	1	2	Value from **Table 7**	1	1

[37]New for this version of the standard.

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.004	**FMT**	**MINUTIA FORMAT**	M	A	1	1	FMT = U FMT = S only if including legacy fields 9.005-9.012 from old record sources	1	1
9.005-9.012		**Legacy Fields; See *ANSI/NIST-ITL 1-2007* or *ANSI/NIST-ITL 2-2008* for a description of these fields**	Only to be used for interchange of legacy data.						
9.013-9.030		**FBI IAFIS FEATURE SET**	O	user-defined			user-defined	user-defined	
9.031-9.055		**COGENT FEATURE SET**	O	user-defined			user-defined	user-defined	
9.056-9.070		**MOTOROLA FEATURE SET**	O	user-defined			user-defined	user-defined	
9.071-9.099		**MORPHOTRAK FEATURE SET**	O	user-defined			user-defined	user-defined	
9.100-9.125		**NEC FEATURE SET**	O	user-defined			user-defined	user-defined	
9.126-9.150		**INCITS 378 FIELDS**	O	**See Table 28**					
9.151-9.175		**L1 / IDENTIX FEATURE SET**	O	user-defined			user-defined	user-defined	
9.176-9.225		**OTHER FEATURE SETS - DEFINED FIELDS**	O	**See Table 29**					
9.226-9.299		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.300-9.399		**EXTENDED FEATURE SET**	O	**See Table 30**					
9.400-9.900		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.901	**ULA**	**UNIVERSAL LATENT ANNOTATION**	O					0	1
		Subfield: repeating values	M⇑	ANS	22	300	date concatenated with text.	1	*
9.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GMT	Greenwich mean time	M⇑	See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
9.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
9.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
9.905-9.999		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

Table 28 Type-9 Fields for INCITS 378 features

Note: The condition codes in this table apply if the block of features is present. The entire block may be absent from a transaction. Thus, mandatory, indicates 'mandatory if this block of records is present.

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.126	**CBI**	**M1 CBEFF INFORMATION**	M					1	1
	CFO	CBEFF format owner	M	N	2	2	CFO = 27	1	1
	CFT	CBEFF format type	M	N	3	3	CFT = 513 or 514 for INCITS 378-2004 and 515 for INCITS 378-2009	1	1
	CPI	CBEFF product identifier	M	H	8	8	none	1	1
9.127	**CEI**	**M1 CAPTURE EQUIPMENT ID**	M					1	1
	AFS	appendix F status	M	A	4	4	AFS = APPF or NONE	1	1
	CID	capture equipment ID	M	U	1	30	none (0 = unreported)	1	1
9.128	**HLL**	**M1 HORIZONTAL LINE LENGTH**	M	N	2	5	$10 \leq HLL \leq 99999$ positive integer	1	1
9.129	**VLL**	**M1 VERTICAL LINE LENGTH**	M	N	2	5	$10 \leq VLL \leq 99999$ positive integer	1	1
9.130	**SLC**	**M1 SCALE UNITS**	M	N	1	1	SLC = 0, 1 or 2	1	1
9.131	**THPS**	**M1 TRANSMITTED HORIZONTAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
9.132	**TVPS**	**M1 TRANSMITTED VERTICAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
9.133	**FVW**	**M1 FINGER VIEW**	M	N	1	2	$0 \leq FVW \leq 15$ integer	1	1
9.134	**FGP**	**M1 FRICTION RIDGE GENERALIZED POSITION**	M	N	1	2	$0 \leq FGP \leq 10$ See **Table 8**	1	1
9.135	**FQD**	**M1 FRICTION RIDGE QUALITY DATA**	M					1	1
		Subfields: Repeating sets of information items	M⇑					1	9

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or QVU = 255 integer	1	1
	QAV	algorithm vendor identification	O⇑	H	4	4	0000 ≤ QAV ≤ FFFF	0	1
	QAP	algorithm product identification	O⇑	N	1	5	1 ≤ QAP ≤ 65535 positive integer	0	1
9.136	**NOM**	**M1 NUMBER OF MINUTIAE**	M	N	1	4	1 ≤ NOM ≤ 9999 positive integer	1	1
9.137	**FMD**	**M1 FINGER MINUTIAE DATA**	M					1	1
		Subfields: Repeating sets of information items	M⇑					NOM	NOM
	MAN	minutia index number	M	N	1	4	1 ≤ MAN ≤ NOM positive integer	1	1
	MXC	X coordinate	M	N	1	5	1 ≤ MXC ≤ HLL positive integer	1	1
	MYC	Y coordinate	M	N	1	5	1 ≤ MYC ≤ VLL positive integer	1	1
	MAV	minutia angle	M	N	1	3	0 ≤ MAV ≤ 179 positive integer	1	1
	M1M	minutia type	M	N	1	1	MTY = 0, 1 or 2	1	1
	QOM	quality of minutia	M	N	1	3	0 ≤ QOM ≤ 100 integer	1	1
9.138	**RCI**	**M1 RIDGE COUNT INFORMATION**	D					0	1
		Subfield: Set of information items (Note that the first subfield is in the same format as following subfields.)	M⇑					1	1
	REM	ridge count extraction method	M⇑	N	1	1	REM = 0, 1 or 2	1	1
	FI1	filler 1	M⇑	N	1	1	FI1 = 0	1	1
	FI2	filler 2	M⇑	N	1	1	FI2 = 0	1	1
		Subfields: Repeating sets of information items	M⇑					1	8 times NOM

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	CMI	center minutia index number	M	N	1	4	1 ≤ CMI ≤ NOM positive integer	1	1
	NMN	neighboring minutia index number	M	N	1	4	1 ≤ NMN ≤ NOM positive integer	1	1
	NRC	number of ridges crossed	M	N	1	2	1 ≤ NRC ≤ 99 positive integer	1	1
9.139	**CIN**	**M1 CORE INFORMATION**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	XCC	X coordinate	M⇑	N	1	5	1≤ XCC ≤ HLL positive integer	1	1
	YCC	Y coordinate	M⇑	N	1	5	1≤ YCC ≤ VLL positive integer	1	1
	ANGC	angle of the core	M⇑	N	1	3	0 ≤ ANGC ≤ 179 positive integer	1	1
9.140	**DIN**	**M1 DELTA INFORMATION**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	XCD	X coordinate	M⇑	N	1	5	1≤ XCD ≤ HLL positive integer	1	1
	YCD	Y coordinate	M⇑	N	1	5	1≤ YCD ≤ VLL positive integer	1	1
	ANG1	First angle of the delta	M⇑	N	1	3	0 ≤ ANG1 ≤ 179 positive integer	1	1
9.141	**ADA**	**M1 ADDITIONAL DELTA ANGLES**	D					0	1
		Subfields (in the same order as those of DIN): Repeating sets of information items	M⇑					1	9
	ANG2	Second angle of the delta	M⇑	N	1	3	0 ≤ ANG2≤ 179 positive integer	1	1
	ANG3	Third angle of the delta	M⇑	N	1	3	0 ≤ ANG3 ≤ 179 positive integer	1	1

Table 29 Fields for other feature sets

Note: The condition codes in this table apply if the block of features is present. The entire block may be absent from a transaction. Thus, mandatory, indicates 'mandatory if this block of records is present'.

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.176	**OOD**	**OTHER FEATURE SETS - OWNER OR DEVELOPER**	M	U	1	40	none	1	1
9.177	**PAG**	**OTHER FEATURE SETS – PROCESSING ALGORITHM**	M					1	1
	PAN	name of algorithm	M⇑	U	1	100	none	1	1
	PAV	version of algorithm	O⇑	U	1	100	none	0	1
9.178	**SOD**	**OTHER FEATURE SETS - SYSTEM OR DEVICE**	O					0	1
	OFN	name of system or device	M⇑	U	1	100	none	1	1
	OFV	version of system or device	O⇑	U	1	100	none	0	1
9.179	**DTX**	**OTHER FEATURE SETS – CONTACT INFORMATION**	M	U	1	1000	none	1	1
9.180-9.225		**OTHER FEATURE SETS – USER-DEFINED FIELDS**	O	user-defined			user-defined	0	1

Table 30 Type-9 Fields for EFS

Note: The condition codes in this table apply if the block of features is present. The entire block may be absent from a transaction. Thus, mandatory, indicates 'mandatory if this block of records is present'.

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.300	**ROI**	**EFS REGION OF INTEREST**	M					1	1
	EWI	ROI width	M	N	1	5	1 ≤ EWI ≤ 50000 positive integer	1	1
	EHI	ROI height	M	N	1	5	1 ≤ EHI ≤ 50000 positive integer	1	1
	EHO	ROI horizontal offset	O	N	1	5	1 ≤ EHO ≤ 50000 positive integer	0	1
	EVO	ROI vertical offset	O	N	1	5	1 ≤ EVO ≤ 50000 positive integer	0	1
	ROP	ROI polygon	O	NS	1	1188	None	0	1
9.301	**ORT**	**EFS ORIENTATION**	O					0	1
	EOD	Direction	M⇑	NS	1	4	-179 ≤ EOD ≤ 180 integer	1	1
	EUC	Uncertainty	O⇑	N	1	3	0 ≤ EUC ≤ 180 integer	0	1
9.302	**FPP**	**EFS FINGER, PALM, PLANTAR POSITION**	M					1	1
		Subfields: Repeating sets of information items	M⇑					1	20
	FGP	friction ridge generalized position	M	N	1	2	value from Table 8	1	1
	FSM	finger segment	O	A	3	3	FSM = DST, PRX, MED or UNK See **Table 9**	0	1
	OCF	off-center fingerprint	O	A	1	1	OCF = T, R or L See **Table 31**	0	1
	SGP	segment polygon	O	NS	1	1188	none	0	1
9.303	FSP	**EFS FEATURE SET PROFILE**	O					0	1
		Subfields: Repeating values	M⇑	N	1	2	none	1	9

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.304 - 9.306		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.307	**PAT**	**EFS PATTERN CLASSIFICATION**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	7
	GCF	general class	M⇑	A	2	2	values from **Table 32**	1	1
	SUB	subclass	D	A	2	2	values from **Table 32**	0	1
	WDR	whorl-delta relationship	D	A	1	1	WDR = I, O or M	0	1
9.308	**RQM**	**EFS RIDGE QUALITY MAP**	O					0	1
		Subfields: Repeating values (one entry for each row)	M⇑	AN	1	50, 000	String containing any of the following characters: 0,1,2,3,4,5,6,7,8,9, A,B,C,D,E,F See **Table 103** and **Table 33**	1	(EHI ÷ GSZ) + 1
9.309	**RQF**	**RIDGE QUALITY MAP FORMAT**	D					0	1
	GSZ	grid size	M⇑	N	1	2	1 ≤ GSZ ≤ 41 positive integer	1	1
	RDF	ridge quality data format	M⇑	A	3	3	RDF = UNC or RLE See **Table 34**	1	1
9.310	**RFM**	**EFS RIDGE FLOW MAP**	O					0	1
		Subfields: Repeating values (one entry for each row)	M⇑	AN	1	100, 000	See **Table 35**	1	(EHI ÷ SFQ) + 1
9.311	**RFF**	**EFS RIDGE FLOW MAP FORMAT**	O					0	1
	SFQ	sampling frequency	M⇑	N	1	2	1 ≤ SFQ ≤ 41 positive integer	1	1
	RDF	ridge flow data format	M⇑	AN	3	3	RDF = UNC or B64 See **Table 34**	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.312	**RWM**	**EFS RIDGE WAVELENGTH MAP**	O					0	1
		Subfields: Repeating values	M⇑	AN	1	100, 000	string containing 2 digit positive integers or XX characters	1	(EHI ÷ FWS) + 1
9.313	**RWF**	**EFS RIDGE WAVELENGTH MAP FORMAT**	O					0	1
	FWS	sampling frequency	M⇑	N	1	2	1 ≤ FWS ≤ 41 integer	1	1
	FDF	data format	M⇑	A	3	3	FDF = UNC	1	1
9.314	**TRV**	**EFS TONAL REVERSAL**	O	A	1	1	TRV = N or P see **Table 36**	0	1
9.315	**PLR**	**EFS POSSIBLE LATERAL REVERSAL**	O	A	1	1	PLR = L or U see **Table 37**	0	1
9.316	**FQM**	**EFS FRICTION RIDGE QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 integer or QVU = 254 or 255	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
9.317	**PGS**	**EFS POSSIBLE GROWTH OR SHRINKAGE**	O					0	1
	TGS	growth or shrinkage type	M⇑	A	1	1	TGS = G, S or B see **Table 38**	1	1
	CGS	growth or shrinkage comment	M⇑	U	1	1000	none	1	1
9.318-9.319		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.320	**COR**	**EFS CORES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	CXC	X coordinate	M⇑	N	1	5	0 ≤ CXC < EWI integer	1	1
	CYC	Y coordinate	M⇑	N	1	5	0≤ CYC < EHI integer	1	1
	CDI	direction	O⇑	NS	1	4	-179 ≤ CDI ≤ 180	0	1
	RPU	radius of position uncertainty	O⇑	N	1	3	0 ≤ RPU ≤ 999	0	1
	DUY	direction uncertainty	O⇑	N	1	3	0 ≤ DUY ≤ 180 integer	0	1
9.321	**DEL**	**EFS DELTAS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	DXC	X coordinate	M⇑	N	1	5	0 ≤ DXC < EWI integer	1	1
	DYC	Y coordinate	M⇑	N	1	5	0≤ DYC < EHI integer	1	1
	DUP	direction up	O⇑	N	1	3	0 ≤ DUP ≤ 180	0	1
	DLF	direction left	O⇑	N	1	3	0 ≤ DLF ≤ 180	0	1
	DRT	direction right	O⇑	N	1	3	0 ≤ DRT ≤ 180	0	1
	DTP	type	O⇑	AN	1	3	value from Table 40	0	1
	RPU	radius of position uncertainty	O⇑	N	1	3	1 ≤ RPU ≤ 999	0	1
	DUU	direction uncertainty up	O⇑	N	1	3	0 ≤ DUU ≤ 180	0	1
	DUL	direction uncertainty left	O⇑	N	1	3	0 ≤ DUL ≤ 180	0	1
	DUR	direction uncertainty right	O⇑	N	1	3	0 ≤ DUR ≤ 180	0	1
9.322	**CDR**	**EFS CORE-DELTA RIDGE COUNTS**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	225
	CIX	core index	M⇑	AN	1	2	1 ≤ CIX ≤ 99 integer or CIX = L or U	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	DIX	delta index	M⇑	AN	1	2	1 ≤ DIX ≤ 99 integer or DIX = L or R	1	1
	MNRC	min ridge count	M⇑	N	1	2	1 ≤ MNRC ≤ 99 positive integer	1	1
	MXRC	max ridge count	O⇑	N	1	2	1 ≤ MXRC ≤ 99 positive integer	0	1
9.323	**CPR**	**EFS CENTER POINT OF REFERENCE**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	3
	CPM	method	M⇑	AN	1	1	CMP = L or 0 or 1 or H see Table 41	1	1
	PXC	X coordinate	M⇑	NS	1	5	-EHO < PXC ≤ 50,000 integer	1	1
	PYC	Y coordinate	M⇑	NS	1	5	-EVO < PYC ≤ 50,000 integer	1	1
	CRU	radius of position uncertainty	O⇑	N	1	3	0 ≤ CRU ≤ 999	0	1
9.324	**DIS**	**EFS DISTINCTIVE FEATURES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	DIT	distinctive feature type	M⇑	A	4	9	entries from Table 42	1	1
	DFP	distinctive features polygon	O⇑	NS	11	1188	none	0	1
	DFC	distinctive features comment	O⇑	U	1	1000	none	0	1
9.325	**NCOR**	**EFS NO CORES PRESENT**	D	A	1	1	NCOR = Y	0	1
9.326	**NDEL**	**EFS NO DELTAS PRESENT**	D	A	1	1	NDEL = Y	0	1
9.327	**NDIS**	**EFS NO DISTINCTIVE FEATURES PRESENT**	D	A	1	1	NDIS = Y	0	1
9.328-9.330		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.331	**MIN**	**EFS MINUTIAE**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	999
	MXC	X coordinate	M⇑	N	1	5	0 ≤ MXC < EWI integer	1	1
	MYC	Y coordinate	M⇑	N	1	5	0≤ MYC < EHI integer	1	1
	MTD	Theta degrees	M⇑	N	1	3	1≤ MTD ≤ 180 positive integer	1	1
	MTY	minutia type	M⇑	A	1	1	MTY = E, B or X see **Table 43**	1	1
	MRU	radius of position uncertainty	O⇑	N	1	3	0 ≤ MRU ≤ 999	0	1
	MDU	minutiae direction of uncertainty	O⇑	N	1	3	0 ≤ MDU ≤ 180	0	1
9.332	**MRA**	**EFS MINUTIAE RIDGE COUNT ALGORITHM**	D	AN	5	8	MRA = OCTANT , EFTS7 or QUADRTANT see **Table 44**	0	1
9.333	**MRC**	**EFS MINUTIAE RIDGE COUNTS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	7992
	MIA	minutia index A	M⇑	N	1	4	1 ≤ MIA ≤ 9999 positive integer	1	1
	MIB	minutia index B	M⇑	N	1	4	1 ≤ MIB ≤ 9999 positive integer	1	1
	MIR	ridge count	M⇑	N	1	2	0 ≤ MIR ≤ 99 positive integer	1	1
	MRN	reference number	O⇑	N	1	1	1 ≤ MRN ≤ 8 positive integer	0	1
	MRS	residual	O⇑	N	1	1	MRS = 0 or 1	0	1
9.334	**NMIN**	**EFS NO MINUTIA PRESENT**	D	A	1	1	NMIN = Y	0	1
9.335	**RCC**	**EFS RIDGE COUNT CONFIDENCE**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
		Subfields: Repeating sets of information items	M⇑					1	7992
	ACX	X coordinate Point A	M⇑	N	1	5	0 ≤ ACX < EWI integer	1	1
	ACY	Y coordinate Point A	M⇑	N	1	5	0 ≤ ACY < EHI integer	1	1
	BCX	X coordinate Point B	M⇑	N	1	5	0 ≤ BCX < EWI integer	1	1
	BCY	Y coordinate Point B	M⇑	N	1	5	0 ≤ BCY < EHI integer	1	1
	MORC	method of ridge counting	M⇑	A	1	1	MORC = A, T or M see **Table 45**	1	1
	MCV	confidence value	M⇑	N	1	2	0 ≤ MCV ≤ 99 integer	1	1
9.336-9.339		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.340	**DOT**	**EFS DOTS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	999
	DOX	dot X coordinate	M⇑	N	1	5	0 ≤ DOX < EWI integer	1	1
	DOY	dot Y coordinate	M⇑	N	1	5	0 ≤ DOY < EHI integer	1	1
	DOL	dot length	O⇑	N	1	2	1 ≤ DOL ≤ 99 positive integer	0	1
9.341	**INR**	**EFS INCIPIENT RIDGES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	999
	X1C	X coordinate Point 1	M⇑	N	1	5	0 ≤ X1C < EWI integer	1	1
	Y1C	Y coordinate Point 1	M⇑	N	1	5	0 ≤ Y1C < EHI integer	1	1
	X2C	X coordinate Point 2	M⇑	N	1	5	0 ≤ X2C< EWI integer	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	Y2C	Y coordinate Point 2	M⇑	N	1	5	0 ≤ Y2C < EHI integer	1	1
9.342	**CLD**	**EFS CREASES AND LINEAR DISCONTINUITIES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	999
	X1D	X coordinate Point 1	M⇑	N	1	5	0 ≤ X1D <EWI positive integer	1	1
	Y1D	Y coordinate Point 1	M⇑	N	1	5	0 ≤ Y1D <EHI integer	1	1
	X2D	X coordinate Point 2	M⇑	N	1	5	0 ≤ X2D < EWI integer	1	1
	Y2D	Y coordinate Point 2	M⇑	N	1	5	0 ≤ Y2D < EHI integer	1	1
	TPD	type	M⇑	AN	2	5	See values in **Table 46**	1	1
9.343	**REF**	**EFS RIDGE EDGE FEATURES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	999
	CLX	X coordinate	M⇑	N	1	5	0 ≤ CLX < EWI integer	1	1
	CLY	Y coordinate	M⇑	N	1	5	0 ≤ CLY < EHI integer	1	1
	CLT	type	M⇑	A	1	1	CLT = P, I or D	1	1
9.344	**NPOR**	**EFS NO PORES PRESENT**	D	A	1	1	NPOR = Y	0	1
9.345	**POR**	**EFS PORES**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9999
	POX	X coordinate	M⇑	N	1	5	0 ≤ POX < EWI integer	1	1
	POY	Y coordinate	M⇑	N	1	5	0 ≤ POY < EHI integer	1	1
9.346	**NDOT**	**EFS NO DOTS PRESENT**	D	A	1	1	NDOT = Y	0	1
9.347	**NINR**	**EFS NO INCIPIENT RIDGES PRESENT**	D	A	1	1	NINR = Y	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
9.348	**NCLD**	**EFS NO CREASES PRESENT**	D	A	1	1	NCLD = Y	0	1
9.349	**NREF**	**EFS NO RIDGE EDGE FEATURES PRESENT**	D	A	1	1	NREF = Y	0	1
9.350	**MFD**	**EFS METHOD OF FEATURE DETECTION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	FIE	field	M⇑	ANS	3	999	ALL or 9.300 < value < 9.373 separated by comma	1	1
	FME	method	M⇑	A	3	4	see **Table 47**	1	1
	FAV	algorithm vendor	D	U	1	40	none	0	1
	FAL	algorithm	D	U	1	40	none	0	1
	ESN	examiner surname	D	U	1	40	none	0	1
	EGN	examiner given name	D	U	1	40	none	0	1
	EAF	examiner affiliation	D	U	1	99	none	0	1
	EMT	date and time	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	NTS	notes	O⇑	U	1	99	none	0	1
9.351	**COM**	**EFS COMMENT**	O	U	1	126	none	0	1
9.352	**LPM**	**EFS LATENT PROCESSING METHOD**	O					0	1
		Subfields: Repeating values (one entry for each method)	M⇑	AN	3	3	see **Table 48**	1	9
9.353	**EAA**	**EFS EXAMINER ANALYSIS ASSESSMENT**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	AAV	value assessment code	M⇑	A	5	8	see Table 49	1	1
	ALN	examiner last name	M⇑	U	1	40	none	1	1
	AFN	examiner first name	M⇑	U	1	40	none	1	1
	AAF	examiner affiliation	M⇑	U	1	99	none	1	1
	AMT	date and time (GMT)	M⇑	See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	1	1
	ACM	comment	O⇑	U	1	200	none	0	1
	CXF	analysis complexity flag	O⇑	A	7	7	CXF = COMPLEX	0	1
9.354	**EOF**	**EFS EVIDENCE OF FRAUD**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	4
	FRA	fraud type	M⇑	A	3	3	see Table 50	1	1
	CFD	comment	O⇑	U	1	200	none	0	1
9.355	**LSB**	**EFS LATENT SUBSTRATE**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	3
	CLS	code	M⇑	AN	1	2	see Table 51	1	1
	OSD	object / substrate description	O⇑	U	1	1000	none	0	1
9.356	**LMT**	**EFS LATENT MATRIX**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	3
	TOM	code	M⇑	N	1	2	$0 \le$ TOM ≤ 10 see Table 52	1	1
	CLA	comment	O⇑	U	1	1000	none	0	1
9.357	**LQI**	**EFS LOCAL QUALITY ISSUES**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
		Subfields: Repeating sets of information items	M⇑					1	*
	LQT	type	M⇑	A	4	10	see **Table 53**	1	1
	LQP	polygon	M⇑	NS	11	1188	none	1	1
	LQC	comment	O⇑	U	1	1000	none	0	1
9.358-9.359		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.360	**AOC**	**EFS AREA OF CORRESPONDENCE**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	CIR	IDC reference	M⇑	N	1	2	$0 \leq CIR \leq 99$ integer	1	1
	AOP	Polygon (closed path)	M⇑	NS	11	1188	none	1	1
	CAC	comment	O⇑	U	1	1000	none	0	1
9.361	**CPF**	**EFS CORRESPONDING POINTS OR FEATURES**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	COL	label	M⇑	AN	1	3	none	1	1
	TOC	type of correspondence	M⇑	A	1	2	value from **Table 55**	1	1
	CFN	corresponding field number	D	N	3	3	value from **Table 54**	0	1
	FOC	corresponding field occurrence	D	N	1	3	$1 \leq FOC \leq 999$ integer	0	1
	CXC	corresponding x coordinate	D	N	1	5	$0 \leq CXC < EWI$ integer	0	1
	CYC	corresponding y coordinate	D	N	1	5	$0 \leq CYC < EHI$ integer	0	1
	COC	comment	O⇑	U	1	1000	None	0	1
9.362	**ECD**	**EFS EXAMINER COMPARISON DETERMINATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	EDC	IDC reference	M⇑	N	1	2	0 ≤ EDC ≤ 99 integer	1	1
	EDE	determination	M⇑	AS	4	6	value from **Table 56**	1	1
	WIP	work in progress	M⇑	A	5	11	WIP = PRELIMINARY or FINAL	1	1
	ELN	examiner last name	M⇑	U	1	40	none	1	1
	EFN	examiner first name	M⇑	U	1	40	none	1	1
	EAF	examiner affiliation	M⇑	U	1	99	none	1	1
	DTG	date and time (GMT)	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	CZZ	comment	O⇑	U	1	200	none	0	1
	CCF	complex comparison flag	O⇑	A	7	7	CCF = COMPLEX	0	1
9.363	**RRC**	**EFS RELATIVE ROTATION OF CORRESPONDING PRINT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	RIR	rotation IDC reference	M⇑	N	1	2	0 ≤ RIR ≤ 99 integer	1	1
	ROR	Relative overall rotation	M⇑	NS	1	4	-179 ≤ ROR ≤ 180 integer	1	1
9.364-9.371		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.372	**SIM**	**EFS SKELETONIZED IMAGE**	O	Base 64	8	*	none	0	1
9.373	**RPS**	**EFS RIDGE PATH SEGMENTS**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
		Subfields: Repeating values	M⇑	NS	11	1188	none	1	*
9.374-9.399		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

8.9.1 Field 9.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.9.2 Field 9.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-9 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section 7.3.1.**

8.9.3 Field 9.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint was obtained. See **Section 7.7.4.1** for details.

8.9.4 Field 9.004: Minutiae format / FMT

This mandatory field is retained only for backward compatibility. It was a mandatory field in previous versions of the standard. This field shall always have a value "U", unless including legacy fields 9.005 through 9.012 (described in *ANSI/NIST-ITL 1-2007* and *ANSI/NIST-ITL 2-2008*), when this field shall contain "S".

8.9.5 INCITS 378 feature set

This entire block of fields is optional. Descriptions of fields in the range 126-150 use the word 'mandatory' to indicate 'mandatory if this block of records is present'. "Optional" in this block of fields shall mean 'optional if this block of records is present'. The INCITS Technical Committee M1 developed int *INCITS 378* standard. The term 'M1' is used in lieu of INCITS 378 to shorten the field names.

8.9.5.1 Field 9.126: M1 CBEFF information / CBI

This field is mandatory if the INCITS 378 feature set is contained in the transaction. Otherwise, it shall not occur. It shall contain three information items when present.

* The first information item (**CBEFF format owner / CFO**) shall contain the value "27". This is the identification of the assigned by the International Biometric Industry Association (IBIA) to INCITS Technical Committee M1.

* The second information item (**CBEFF format type / CFT**) is assigned a value of "513" (following INCITS 378-2004) if this record contains **Field 9.137: M1 finger minutiae data / FMD** without **Field 9.138: M1 ridge count information / RCI, Field 9.139: M1 core information / CIN** or **Field 9.140: M1 delta information / DIN**. A value of "514" (following *INCITS 378-2004*) indicates the presence of **Field 9.137** and any of the other fields mentioned above. If *INCITS 378-2009* is followed, a value of "515" is entered and does not indicate the specific presence or absence of these fields.

* The third information item (**CBEFF product identifier / CPI**) identifies the "owner" of the encoding equipment. The vendor establishes this value. It may be obtained from the IBIA website (www.ibia.org) if it is posted.

Note that the 2004 version of INCITS 378 had one item for the product identifier. This was clarified and broken into two items in the 2009 version of INCITS 378: the product identifier and the format type. Each of these two items in INCITS 378-2009 is specified as two bytes in length, with the value of zero prohibited for the format type. Since the addition of another information item to this field would break backward compatibility with the 2007 version of the ANSI/NIST-ITL standard (Traditional encoding), the third information item listed above (**CBEFF product identifier / CPI**) shall be interpreted as combining the product identifier and the format type as specified in INCITS 378-2009 or the value that may have been entered by a user interpreting INCITS 378-2004. The maximum length of **CPI** has been extended to 8 from 4 as a result.

8.9.5.2 Field 9.127: M1 capture equipment identification / CEI

This mandatory field shall contain two information items.

- The first (a**ppendix F status / AFS**) shall contain "APPF" if the equipment used originally to acquire the image was certified to conform to Appendix F specifications [38]. If the equipment did not conform it will contain the value of "NONE".

- The second information item (**capture equipment ID / CID**) shall contain a vendor-assigned product number / identifier (up to 30 characters) of the capture equipment. A value of "0" indicates that the capture equipment ID is unreported.

8.9.5.3 Field 9.128: M1 horizontal line length /HLL

This is a mandatory field. See **Section 7.7.8.1** for details.

8.9.5.4 Field 9.129: M1 vertical line length / VLL

This is a mandatory field. See **Section 7.7.8.2** for details.

8.9.5.5 Field 9.130: M1 scale units / SLC

This is a mandatory field. See **Section 7.7.8.3** for details.

[38] See the list of certified products at http://fbibiospecs.org

8.9.5.6 Field 9.131: M1 transmitted horizontal pixel scale / THPS

This is a mandatory field. See **Section 7.7.8.4** for details.

8.9.5.7 Field 9.132: M1 transmitted vertical pixel scale / TVPS

This is a mandatory field. See **Section 7.7.8.5** for details.

8.9.5.8 Field 9.133: M1 finger view / FVW

This mandatory field contains the view number of the finger associated with this record's data. The view number begins with "0" and increments by one to "15". Finger view differentiates multiple images of the same finger that are included in the transaction to be taken consecutively to develop an "average" template for that particular set of finger minutiae for enrollment applications.

8.9.5.9 Field 9.134: M1 friction ridge generalized position / FGP

This is a mandatory field. See **Section 7.7.4.2** for details. Valid codes for this field are between 1 and 10, taken from **Table 8** to indicate the finger position. (Note that codes 16 and 17 are not covered in INCITS 378). The 2007 version restricted this to fingerprint codes. The 2008 version also allowed palm codes, but this version of the ANSI/NIST-ITL standard does not in order to maintain consistency with INCITS 378.

8.9.5.10 Field 9.135: M1 friction ridge quality data / FQD

This mandatory field shall contain the quality of the overall finger minutiae data. There may be a subfield for each algorithm and predictive performance measure. Each subfield shall contain the first information item (**quality value / QVU)** described in **Section 7.7.7**. The second two information items are optional for this field. (**algorithm vendor identification / QAV** and **algorithm product identification / QAP).**

The 2004 version of INCITS 378 had only 1 byte for quality with no second and third information items. The 2009 version of INCITS 378 had all three information items and all three are mandatory in that standard. The 2007 and 2008 versions of ANSI/NIST-ITL mandated the presence of all three information items. However, this version of ANSI/NIST-ITL allows the second and third items to be optional, in order to accommodate those users following the 2004 version of INCITS 378.

8.9.5.11 Field 9.136: M1 number of minutiae / NOM

This mandatory field shall contain a count of the number of minutiae recorded in this block.

8.9.5.12 Field 9.137: M1 finger minutiae data / FMD

The total number of subfields shall agree with the count found in **Field 9.136: M1 number of minutiae / NOM**. Each subfield has six information items.

- The first information item (**minutia index number / MAN**), shall be initialized to "1" and incremented by "1" for each additional minutia in the fingerprint.

- The second information item **(‘x’ coordinate / MXC**) is expressed in pixel units.
- The third information item **(‘y’ coordinate / MYC)** is expressed in pixel units.
- The fourth information item **(minutia angle / MAV)** is recorded in units of two degrees. This value shall be nonnegative between 0 and 179, inclusive.
- The fifth information **(minutia type / M1M)** has a value of “0” to represent a minutiae of type “OTHER”, a value of “1” for a ridge ending and a value of “2” for a ridge bifurcation.
- The sixth information item **(quality of minutia / QOM)** shall range from 1 as a minimum to 100 as a maximum. A value of “0” indicates that no quality value is available. Note that this is an integer.

8.9.5.13 Field 9.138: M1 ridge count information / RCI

This optional field shall consist of subfields of three information items. It can only appear if a value of '514' or '515' is entered in **CFT** of **Field 9.126: M1 CBEFF information / CBI**. For the first subfield:

- The first information item **(ridge count extraction method / REM**) shall have a value of 0, 1 or 2. A “0” indicates that no assumption shall be made about the method used to extract ridge counts, nor their order in the record. A “1” indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in four quadrants, and ridge counts for each center minutia are listed together. A “2” indicates that for each center minutiae, ridge count data was extracted to the nearest neighboring minutiae in eight octants, and ridge counts for each center minutia are listed together.
- The remaining two information items **(filler 1 / FI1** and **filler 2 / FI2**) of this first repeating subfield shall each contain “0”.

Subsequent subfields have three information items each:

- The first information item **(center minutia index / CMI**) is a positive integer.
- The second information item **(neighboring minutia index / NMN**) is a positive integer. It shall not be equal to CMI.
- The third information **(number of ridges crossed / NRC**) is a positive integer.

8.9.5.14 Field 9.139: M1 core information / CIN

This optional field shall consist of one subfield for each core present in the original image. It can only appear if a value of '514' or '515' is entered in **CFT** of **Field 9.126: M1 CBEFF information / CBI**. Each subfield consists of three information items.

- The first item (**'x' coordinate / XCC**) is an integer in pixel units.
- The second item (**'y' coordinate / YCC**) is an integer in pixel units.
- The third information item (**angle of the core / ANGC**) is recorded in units of two degrees. The value shall be between 0 and 179, inclusive.

8.9.5.15 Field 9.140: M1 delta information / DIN

This optional field shall consist of one subfield for each delta present in the original image. It can only appear if a value of '514' or '515' is entered in **CFT** of **Field 9.126: M1 CBEFF information / CBI**. Each repeating subfield consists of three information items[39].

- The first item (**'x' coordinate / XCD**) is an integer in pixel units.
- The second item (**'y' coordinate / YCD**) is an integer in pixel units.
- The third information item (**first angle of the delta / ANG1**) is recorded in units of two degrees. The value shall be between 0 and 179, inclusive. This is the angle closest to 90 degrees.

8.9.5.16 Field 9.141: M1 additional delta angles / ADA

This optional field shall only appear if **Field 9.140: M1 delta information / DIN** is included in this record.[39] This field has been added to handle the two additional angle specifications of INCITS 378 while maintaining backward compatibility with the 2007 version of this standard (Traditional encoding). The subfields shall describe the same deltas in the same order as the subfields of **Field 9.140: M1 delta information / DIN**.

- The first information item (**second angle of the delta /ANG2**) is the next angle encoded in order of appearance when moving counterclockwise.
- The second information item (**third angle of the delta / ANG3)** is the last angle encoded in order of appearance when moving counterclockwise.

8.9.6 Externally defined feature sets

This standard has reserved several blocks of fields for external definition. These blocks of fields may be used in conjunction with other blocks of fields[40].

[39] In earlier versions of this standard, only one angle was referenced; however, the 2004 and 2009 versions of INCITS 378 standard specify three angles for each delta. The second two angles are contained in **Field 9.141**.

[40] This was allowed in the 2007 version of the standard, but not the 2008 version. This version is consistent with the 2007 version, in allowing multiple blocks in a single record.

8.9.6.1 FBI / IAFIS feature set

Fields 9.013 through **9.030** are reserved for this block. These fields are defined in the FBI's EFTS version 7.1 through EBTS version 9.2 but are superseded in EBTS9.3; see www.fbibiospecs.org .

8.9.6.2 3M (Cogent) feature set

Fields 9.031 through **9.055** are reserved for this block. For information on these fields, consult 3M.

8.9.6.3 MorphoTrak (legacy Motorola) feature set

Fields 9.056 through **9.070** are reserved for this block. For information on these fields, consult MorphoTrak.

8.9.6.4 MorphoTrak feature set

Fields 9.071 through **9.099** are reserved for this block. For information on these fields, consult MorphoTrak.

8.9.6.5 NEC feature set

Fields 9.100 through **9.125** are reserved for this block. For information on these fields, consult NEC.

8.9.6.6 L1- Identix feature set

Fields 9.151 through **9.175** are reserved for this block. For information on these fields, consult L1.

8.9.6.7 Other feature sets

Fields 9.176 through **9.225** are reserved for this block. This block of fields is reserved for those vendors whose proprietary feature set was not available or not included in the *ANSI/NIST-ITL 1-2007* standard. Vendors who believe that the INCITS 378 feature set and the Extended Feature Set do not meet the requirements of their algorithms may use these proprietary feature set fields. These fields may also be used by those vendors with previously registered minutiae blocks for the purpose of identifying the use of different processing algorithms. Fields labeled mandatory in this Section are only mandatory if the block is used. Otherwise, the field shall be absent from the transaction.

8.9.6.7.1 Field 9.176: Other feature sets - owner or developer / OOD

This mandatory field shall contain an unformatted text string identifying the editing station or the name of the owner or developer of the processing algorithm.

8.9.6.7.2 Field 9.177: Other feature sets - processing algorithm / PAG

This mandatory field has two information items. The first (**name of algorithm / PAN**) is mandatory if this field is used. The second information item (**version of algorithm /PAV**) is optional. Both information items may have up to 100 characters as unformatted text.

8.9.6.7.3 Field 9.178: Other feature sets - system or device / SOD

This optional field with two information items. The first item (**name of system or device / OFN**) is mandatory if this field appears. It shall contain an unformatted text string with the name of the system or device for which the data in this record is being generated. The second information item (**version of system or device / OFV)** is optional, to identify the version of the data generated.

8.9.6.7.4 Field 9.179: Other feature sets - contact information / DTX

This mandatory field shall contain unformatted text with the contact information for additional details regarding the feature data. At a minimum, the text shall identify the name of the organization responsible for the information content.

8.9.6.7.5 Fields 9.180 through 9.225: Other feature sets - user-defined fields

These fields shall be used to record specific vendor proprietary information regarding minutiae feature data. The vendor shall define the format and content of each field.

8.9.7 Extended Feature Set

This entire block of fields is optional. Descriptions of fields in the range 9.300-9.399 use the word ‘mandatory’ to indicate “mandatory if this block of records is present”. 'Optional' in this block of fields shall mean “optional if this block of records is present”.
This data block defines the content, format, and units of measurement for the definition and/or exchange of friction ridge feature information that may be used in the identification of a subject based on friction ridge information. This information is intended for an individual examiner to define the content of a single impression or comparison of two impressions, as well as for interchange between criminal justice administrations or organizations that use friction ridge information for identification purposes. This specification defines a quantifiable, repeatable, and clear method of characterizing the information content of a fingerprint or other friction ridge image. See **Annex F: Extended Feature Set Detailed Intructions** for specific instructions on entering data in these fields.

8.9.7.0.1 EFS coordinate system

With the exception of **Field 9.323: EFS center point of reference / CPR**, the relative position of all EFS features shall be expressed as positive integers in units of 10 micrometers (0.01 mm or 0.00039 in), with the origin in the top left of the **Field 9.300: EFS region of interest / ROI**. In this coordinate system, values of X increase from left to right and values of Y increase from top to bottom. All positions shall be in the range (0,0)-(ROI.width-1, ROI.height-1). Width and/or height dimensions for a single impression will always fall within an upper bound of 50 cm (19.7”, or 50,000 units). This is not counted in pixels. This is the origin used in EFTS, EBTS (both the FBI's and that of the Department of Defense), INTERPOL's INT-I and the IAFIS Type-9 fields, but not in the original ANSI/NIST Type-9 **Fields 9.005** through **9.012** (legacy fields), which use a bottom left origin.

There are no specific maximum dimensions in the coordinate system, because dimensions are limited by the image dimensions, and ANSI/NIST-ITL-1 2011 does not have stated maximum dimensions for Type 13, 14, or 15 images. Dimensions for a single impression will always fall well within an upper bound of 50cm (19.7", or 50000 units)[41].

In all cases for the EFS, when specific distances are specified, the distances are stated in terms that correspond to an integer number of pixels at 500 pixels per inch, and the metric equivalents are rounded to two significant digits (0.01 mm).

8.9.7.0.2 EFS region of interest

The Region of Interest is defined in **Field 9.300: EFS region of interest / ROI** as a rectangle and/or a polygon that bounds the area of the original image containing a single friction ridge impression, and separates it from the background and any other friction ridge data present in the image. With the exception of **Field 9.323: EFS center point of reference / CPR**, all EFS features are in relation to the Region of Interest, not to the original image: all coordinates are relative to the top left corner of the ROI, and may not equal or exceed the width and height of the ROI. The ROI may be identical to the dimensions of the image.

When the **ROI** is a polygon, the **ROI** rectangle is simply a bounding box around that polygon: the **ROI** offset is defined as the minimum of the X and Y coordinates of all **ROI** vertices, and the **ROI** width and height are defined as the range (maximum – minimum) of the X and Y coordinates of all **ROI** vertices. It is permissible for the ROI rectangle to be expanded slightly around the ROI polygon so that its dimensions or offset are evenly divisible by 4 or 8, as long as this does not exceed the bounds of the image itself. See **Figure 6** for an example.

[41] A 99th percentile adult male hand (wrist to fingertip) is 8.4" (213 mm) long; a 99th percentile adult male foot is 11.7" (298 mm) long. [A. R. Tilley, *The Measure of Man and Woman: Human Factors in Design, Revised Edition*; Wiley; 2002] In extreme cases palms may be 32.4 cm long (12.75") and feet may be 47 cm long (18.5"). (e.g., Robert Pershing Wadlow [*Guinness Book of World Records Online*, www.guinnessworldrecords.com/])

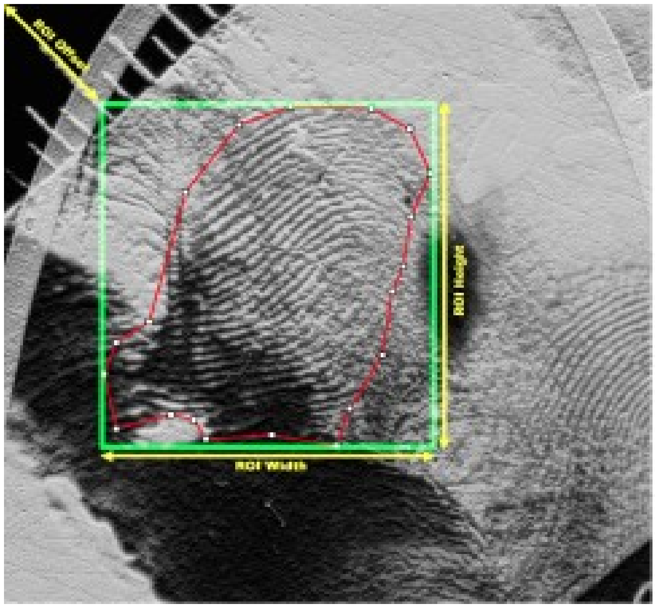


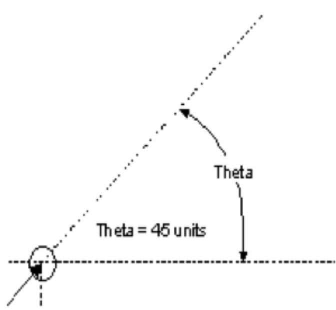
Figure 6: Region of interest

There can only be one region of interest for a given feature set. If there are multiple impressions within a single image, more than one feature set can be marked for the image, resulting in multiple Type-9 records associated with a single image, differentiated by the region of interest, as specified in **Field 9.300: EFS region of interest / ROI**.

8.9.7.0.3 EFS angles

All angles are measured in integer degrees. Positive numbers indicate angles counterclockwise from the right, whereas negative numbers (when permitted by specific fields) indicate angles clockwise from the right.

Figure 7: Measurement of angles.



8.9.7.1 Field 9.300: EFS region of interest / ROI

See **Section 8.9.7** for a general description of **ROI**. This mandatory field defines a rectangle (and an optional polygon) that bounds the region of the image that contains the fingerprint of interest and separates it from the background and any other fingerprints present in the image. This field contains five information items. Width and height are mandatory. The other items are optional.

- The first information item **(width / EWI)** is the integer width of the region of interest in units of 10 micrometers (0.01mm)
- The second information item **(height / EHI)** is the height of the region of interest in units of 10 micrometers (0.01mm).
- The third information item **(horizontal offset / EHO)** is the horizontal distance in units of 10 micrometers from the left edge of the original image to the left edge of the region of interest. This information item defaults to a value of zero if absent.
- The fourth information item **(vertical offset / EVO)** is the vertical distance in units of 10 micrometers from the top edge of the original image to the top edge of the region of interest. This information item defaults to a value of zero if absent.
- The fifth information item (**ROI Polygon / ROP**) contains a polygon (closed path) that further defines the friction ridge area under consideration within the **ROI.** The format of polygons is described in **Section 7.7.12**. If the polygon is defined, the **ROI** rectangle shall be the bounding box for the polygon. The vertices of the polygon are relative to the **ROI**. In Traditional encoding, the three special characters allowed are – $^{R}{}_{S}$ and , . See **Section B.2.5 Type-9 record**. These special characters are not used in XML Encoding. For the layout of this information item, see **Annex G: Type-9.**

8.9.7.2 Field 9.301: EFS orientation / ORT

This optional field allows the orientation (deviation from upright) and its uncertainty to be specified. See **Annex F, F.6.1.2 Field 9.301: EFS orientation / ORT instructions** for more information about this field. If this field is omitted, the direction shall default to 0 (upright) and uncertainty shall default to 15, indicating that the image is rotated 0±15°. If orientation cannot be determined, the uncertainty value shall be set to 180. This field contains the following two information items:

- The first information item (**direction / EOD**) contains the deviation of the region of interest from upright (fingertip up) in integer degrees. Positive angles are counterclockwise, negative angles are clockwise. A value of “0” indicates an upright direction. Valid values range from “-179” through “180”. The allowed special character is the negative sign.
- The second information item (**uncertainty / EUC**) contains the uncertainty of the orientation direction, in non-negative integer degrees; the resulting orientation is Direction± Uncertainty°. Valid values range from “0” to “180”.

8.9.7.3 Field 9.302: EFS finger - palm - plantar position / FPP

This mandatory field shall contain one or more of the possible physical positions that correspond to the region of interest. For example, a region of interest that includes a finger's medial and proximal segment can note those as multiple data entries, with polygons to indicate the locations. For more information about this field, see **Annex F F.6.1.3 Field 9.302: EFS finger - palm - plantar position / FPP instructions .**

This field may contain multiple subfields to designate different friction ridge generalized positions and/or finger segments; polygons are required in this case to delineate the locations of the positions. Polygons may overlap if appropriate. A subfield contains the following four information items:

- The first information item (**friction ridge generalized position / FGP**) contains the code number corresponding to the known or most probable position shall be taken and entered as a one- or two-character value. The codes are listed in **Table 8**. See **Section 7.7.4.2**.

- The second information item (**finger segment / FSM**) is optional and only applies to fingerprints in which all or part of the medial or proximal segments (lower joints) are present in the image, in which case the 3-character code from **Table 9** is used to indicate the finger segment position (DST, PRX, or MED) UNK for "Unknown" may also be specified. See **Figure 3** for the segment positions. This information item defaults to DST if the **friction ridge generalized position / FGP** indicates a fingerprint and the Finger Segment is not specified; in which case, the impression shall be regarded as including solely the distal segment with no substantive portions of the medial or proximal segments. This information item shall be omitted if the **friction ridge generalized position / FGP** indicates a palm or plantar.

- The third information item (**off-center fingerprint / OCF**) is optional and only applies to fingerprints in which the impression does not contain the central area of the fingerprint (i.e. the core or a center point of reference), in which case the 1-character code from **Table 31** is used to indicate the off-center position of the fingerprint image. This information item shall be omitted if the **friction ridge generalized position / FGP** indicates a palm or plantar.

- The fourth information item (**segment polygon / SGP**) is optional. It is a closed path polygon that delineates the area that corresponds to the specified position / segment. See **Section 7.7.12** for details. In Traditional encoding, the three special characters allowed are – $^{R}{}_{S}$ and , . See **Section B.2.5 Type-9 record**. These special characters are not used in XML Encoding. For the XML layout of this information item, see **Annex G: Type-9.**

Table 31 Off-center fingerprint positions

Name	Code	Description
Tip	T	The plain or rolled tip of the image
Right Side	R	The right side of the finger or thumb
Left Side	L	The left side of the finger or thumb

8.9.7.4 Field 9.303: EFS feature set profile / FSP

This optional numeric field is used to indicate an EFS Profile, which defines the specific set of EFS fields incorporated in a specific ANSI/NIST-ITL transaction. Profiles can be incorporated by reference into the definition of transactions: this decoupling of feature sets from transactions enables different transactions to share a common feature set, aiding in interoperability. If a given ANSI/NIST-ITL transaction is conformant with two or more profiles, the code for each profile is entered in a separate subfield. The valid values for this field are available in the *EFS Profile Specification*, which can be downloaded from http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

8.9.7.5 Field 9.307: EFS pattern classification / PAT

This optional field contains fingerprint classification information for the image. This field shall only be used for fingerprints, and shall be omitted for other friction ridge impressions. The field consists of three information items grouped together in a subfield. For more information about this field, see **Annex F F.6.2.1 Field 9.307: EFS pattern classification / PAT instructions .**

There may be up to seven subfields, indicating all possible pattern classifications.

- The first information item (**general class / GCF**) is the general set of pattern classifications (arch, whorl, left & right loop) used by most current automated systems. This is a two character value selected from **Table 32**.

- The second information item (**subclass / SUB**) is the detailed sub-classification of arches and whorls that may optionally be provided by a human examiner or automated system. This information item shall only be included for arches or whorls, and only if the sub-classification can be determined precisely. This is a two character value selected from **Table 32**.

- The third information item (**whorl - delta relationship / WDR**) may optionally be used by a human examiner or automated system to provide the relationship between the deltas in a whorl. This information item shall only be included for whorls if the subclass is known, and only if the whorl delta relationship can be determined precisely. This information item shall be set to: I (Inner), O (Outer), or M (Meeting).

Table 32 Pattern classification codes

	Pattern Classification	General Class	Subclass	Whorl – Delta Relationship
Arches	Arch, type not designated	AU		
	- Plain Arch		PA	
	- Tented Arch		TA	
Whorls	Whorl, type not designated	WU		
	- Plain Whorl		PW	I, O, or M
	- Central Pocket Loop		CP	I, O, or M
	- Double Loop		DL	I, O, or M
	- Accidental Whorl		AW	I, O, or M
Loops	Right Slant Loop	RS		
	Left Slant Loop	LS		
Unable to print	Amputation	XX		
	Temporarily unable to print (e.g., bandaged)	UP		
Unable to classify	Unable to Classify	UC		
	- Complete Scar	SR		
	-Dissociated Ridges/Dysplasia	DR		

8.9.7.6 Field 9.308: EFS ridge quality/confidence map / RQM

Local friction ridge quality (as defined in the Ridge Quality Map) is an assessment of confidence in small local areas within an image. The local quality map is used to define the confidence in all other features, and therefore is key information. In addition, when the quality map indicates a high-quality region in which features are not marked, that information can be used as "negative features" or definitive absence of features, which can be used for exclusion.

For every cell in a grid superimposed on the Region of Interest, this optional field notes the local ridge quality of the friction ridge detail within that cell. Local ridge quality defines clarity in terms of the ability to discern detail in a given location. The quality of each cell will be represented with a local quality value 0 through 5 representing the quality of ridge detail in that cell, as specified in **Table 33**. If a region of interest is defined, cells outside of the ROI polygon shall be set to a local quality value of 0 (black).

This optional field is comprised of a repeating set of values. The number of subfields corresponds to the number of cells in a column of the image. Each row value is encoded as shown in **Table 34.** See **Field 9.309: EFS ridge quality map format / RQF** for the definition of the grid size and data representation.

Table 33 Local ridge quality codes

Name	Local Quality Code	Shorthand description	Display color	
Definitive pores	5	Pores and ridge edges are obvious and unambiguous		Aqua [RGB=(0,240,240)]
Definitive ridge edges, debatable pores	4	Ridge edges, minutiae, and ridge flow are obvious and unambiguous; pores are either debatable or not present		Blue [RGB=(0,0,255)]
Definitive minutiae, debatable ridge edges	3	Minutiae, and ridge flow are obvious and unambiguous; ridge edges are debatable		Green [RGB=(0,255,0)]
Definitive ridge flow, debatable minutiae	2	Continuity of ridge flow is certain; minutiae are debatable		Yellow [RGB=(255,255,0)]
Debatable ridge flow	1	Continuity of ridge flow is uncertain		Red [RGB=(255,0,0)]
Background	0	No ridge information		Black or no color [RGB=(0,0,0)]

8.9.7.7 Field 9.309: EFS ridge quality map format / RQF

This optional field defines the grid size or data representation format used in **Field 9.308: EFS ridge quality/confidence map / RQM**. Its use is mandatory if that field is present. This field consists of two information items:

- The first information item (**grid size / GSZ**) shall be used to define grid sizes (both the horizontal and vertical dimensions of a single cell in the grid): valid settings range from "1" (0.01mm) through "41" (0.41mm). The recommended grid size is 0.20mm (0.008") – note this is 4 pixels at 500ppi, or 8 pixels at 1000ppi.

- The second information item (**data format / RDF**) defines the format used in **Field 9.308**, using the codes defined in **Table 34.** For all formats:

  - The first cell starts at the top left corner of the Region of Interest, with cells in order left to right.
  - All of the quality values for each row are stored in one repeating subfield.

- The subfields are ordered from top to bottom.
- If the width and/or height of the Region of Interest are not evenly divisible by the Grid Size, partial cells shall be included at the right and/or bottom of the ridge flow map.

Table 34 Ridge quality map data representation format options

Type	Code	Description
Uncompressed (concatenated decimal)	UNC	The values for each grid cell in the Ridge Quality Map field are single-character integers as defined in **Table 33**, with one character per cell. All quality values for one row are concatenated left to right, with one repeating subfield of **Field 9.308: EFS ridge quality/confidence map / RQM** for each row. The number of characters in one repeating subfield of **Field 9.308** is the same as the number of cells in one row: the Region of Interest's width divided by the Grid Size, rounded up to the nearest integer.
Run-Length Encoded	RLE	The unencoded values for each entry are identical to those used in UNC format. The numeric values for each grid cell (0-5) are then replaced with alphabetic equivalents (A-F), and then any sequential runs of the same character are prefixed by the decimal count of repeated characters. Individual characters are not preceded by a count. For example: 00000000000000000000000000000000000000000000000000 (50 characters) Is saved as "50A" 00000000000011223345555554444422100000000000000000 (50 characters) Is saved as "12A2B2C2DE6F5E2CB16A" (20 characters)

8.9.7.8 Field 9.310: EFS ridge flow map / RFM

This optional field contains the direction of friction ridges at sampling points throughout the region of interest. The sampling frequency is optionally defined in **Field 9.311: EFS ridge flow map format / RFF**, and otherwise defaults to 0.41 mm in uncompressed format. The first sampling point in the image is the top left-most point in the region of interest. The same sampling frequency is used both horizontally and vertically. Values shall be included for all sampling points in the region of interest, even if the sampling points are at the edge of the region of interest. For each sampling point, angles shall be reported in integer degrees, with 0 degrees to the right (horizontal), increasing counterclockwise to a maximum value of 179° (since 180°=0°). Undefined angles are recorded in **Field 9.311: EFS ridge flow map format / RFF**. Each subfield corresponds to one row of the map in order from top to bottom.

The area used for determining direction (window size) may be larger or smaller than the sampling frequency. Different window sizes may be used within a single image, at the discretion of the implementer. For example, an implementer may choose to use a uniform window size except in areas of high curvature, in which a smaller window size may be used.

8.9.7.9 Field 9.311: EFS ridge flow map format / RFF

This optional field permits setting the sampling frequency or data representation format used in the **Field 9.310: EFS ridge flow map / RFM** to values other than the defaults. Its use is conditional on the presence of **Field 9.310**. This field consists of two information items:

- The first information item (**sampling frequency / SFQ**) is set by default to 0.41mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01mm) through "41" (0.41mm).

- The second information item (**data format / RDF**) defines the format used in the Ridge Flow Map field, as defined in Table 35. The default is the uncompressed ("UNC") format.

Table 35 Ridge flow map data representation format options

Type	Code	Description
Uncompressed (concatenated hexadecimal)	UNC	Each ridge flow value is a 2-character hexadecimal value. The angles are stored in 2-character hexadecimal representation with leading zeros, so valid values range from "00" (0dec) to "B3" (179dec). Undefined angles: If the direction cannot be determined at a given location, the location at that point shall be marked as "XX". All of the ridge flow values for a given row shall be concatenated in order left to right and saved as a separate instance / repeating subfield of **Field 9.310: EFS ridge flow map / RFM**. The number of characters in one repeating subfield of **Field 9.310** is twice the number of cells in one row.
base-64	B64	Each ridge flow value is a 1-character base-64 value. The angles are divided by three to enable storing in a single base-64 character, which has the effect of quantizing to three degrees. Undefined angles: If the direction cannot be determined at a given location, the location at that point shall be marked as "*" (asterisk). All of the ridge flow values for a given row shall be concatenated in order left to right and saved as a separate instance / repeating subfield of **Field 9.310**. The number of characters in one instance of **Field 9.310: EFS ridge flow map / RFM** is the number of cells in one row.

8.9.7.10Field 9.312: EFS ridge wavelength map / RWM

This optional field contains the peak-to-peak distance between ridges at various sampling points throughout the region of interest. The sampling frequency is optionally defined in **Field 9.313: EFS ridge wavelength map format / RWF**, and otherwise defaults to 0.41 mm in uncompressed format. The first sampling point in the image is the top left-most point. The same sampling frequency is used both horizontally and vertically. Values shall be included for all sampling points in the image, even if the sampling points are at the edge of the image.

For each sampling point in the Region of Interest, distances between ridge peaks, measured perpendicular to ridge flow, shall be reported in 2-character decimal format using units of 10 micrometers (0.01mm). The size of the area around the sampling point (window size) used to determine measurements is left to the discretion of the implementer, and may vary within an image. Unknown values shall be set to "XX". Valid values are therefore "01" (0.01mm) through "99" (0.99mm or greater). (In practice, the actual stored values are likely to be "30" to "70" in most cases (0.3 – 0.7 mm). The 2-character decimal wavelength values for each sampling point are concatenated left to right for all sampling points in a row. Each subfield corresponds to one row of the map, in order from top to bottom. The number of characters in one subfield is twice the number of sampling points in one row.

8.9.7.11 Field 9.313: EFS ridge wavelength map format / RWF

This field permits setting the sampling frequency or data representation format used in **Field 9.312: EFS ridge wavelength map / RWM** to values other than the defaults, and is conditional on the presence of **Field 9.312.** It consists of two information items:

- The first information item (**sampling frequency / FWS**) is set by default to 0.41mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01mm) through "41" (0.41mm).

- The second information item (**data format / FDF**) is optional. It defines the format used in **Field 9.312**. The default (and currently the only setting) is the uncompressed ("UNC") format.

8.9.7.12 Field 9.314: EFS tonal reversal / TRV

Ridges in friction ridge images are generally represented as dark areas, with valleys as light areas. This field indicates whether the entire image is reversed tonally (black-for-white). If all or part of the image is reversed tonally, this 1-character optional field is set to the appropriate value from **Table 36**. Otherwise this field is omitted.

Partial tonal inversion can occur in different ways. If definable portions of the image are negative, **Field 9.357: EFS local quality issues / LQI** can be used to define the specific tonally reversed areas.[42] Note that in some cases, the tonal reversal is so mixed that only portions of individual ridges are reversed, making it impractical or impossible to define the tonally reversed areas.[43]

When this field is set, the image in the Type-13 record shall be left as it was originally received (i.e., tonally reversed): setting this field and reversing the image when saving will result in inconsistent data. When this field is set, a software user interface may display the tonally corrected image, but save the image as originally received with this field set.

[42] Example: very heavy pressure can leave matrix from valleys, whereas lighter pressure at the edges of the same impression would leave matrix from ridges.
[43] Example: if light powder is applied from a single direction, one edge of each ridge is light and the remainder dark.

Table 36 Tonal reversal codes

Code	Description
N	Negative – ridges are light and valleys are dark throughout the image.
P	Partial – ridges are light and valleys are dark only in portions of the image

8.9.7.13 Field 9.315: EFS possible lateral reversal / PLR

This field indicates if the original image is or may be laterally reversed (i.e., flipped left-right). In many cases, an examiner cannot tell the correct lateral direction of the image, such as latents on tape that has been closed on itself, or latents that may have been transferred to the substrate/surface. If the image is or may be laterally reversed, this 1-character optional field is set to the appropriate value from **Table 37** otherwise, this field is to be omitted.

When this field is set to L (Image is known to be laterally reversed), the image in the associated type-13 record shall be left as it was originally received (i.e., laterally reversed): setting this field and reversing the image when saving will result in inconsistent data. When this field is set a software user interface may display the laterally corrected image, but save the image as received with this field set.

When this field is set to U (Image may be laterally reversed), it is incumbent on the recipient (software system or examiner) to search/compare the impression and features both as presented and flipped left-right.

Table 37 Lateral reversal codes

Code	Description
L	Image is known to be laterally reversed.
U	Image may be laterally reversed

8.9.7.14 Field 9.316: EFS friction ridge quality metric / FQM

This optional field specifies one or more different metrics of friction ridge quality for the friction ridge impression corresponding to this record, as delimited by the region of interest. Each subfield contains three information items, as described in **Section 7.7.7**.

8.9.7.15 Field 9.317: EFS possible growth or shrinkage / PGS

This optional field is only used in the unusual circumstance that the friction ridge impression is believed to have changed size or scale from potential comparisons. This provides for handling of images from deceased subjects with desiccated skin, or with swollen skin due to water exposure. This also provides for handling of overall growth of subjects between capture, such as in comparing an adult's fingerprints with those taken as a child. In these cases the size of ridges and distances between ridges change to a greater extent than would ordinarily be assumed in comparisons; this field acts as a flag to indicate that greater than ordinary dimensional variation should be expected in performing subsequent comparisons.

This field is to be omitted unless there is reason to believe that growth or shrinkage may have occurred. This field consists of two information items:

- The first information item **(type / TGS**) is selected from the "Code" column **Table 38.** It is one character.

- The second information item (**growth or shrinkage comment / CGS**) contains optional text describing the rationale for believing that growth or shrinkage may have occurred.

Table 38 Growth or shrinkage codes

Code	Description
G	Growth: impression is believed to be dimensionally larger than exemplars or other prints from the same subject.
S	Shrinkage: impression is believed to be dimensionally smaller than exemplars or other prints from the same subject.
B	Both: impression may be dimensionally larger or smaller than exemplars or other prints from the same subject.

8.9.7.16 Field 9.320: EFS cores / COR

A core is located at the focus of the innermost recurving ridge line of a ridge pattern: if the ridge is viewed as a section of a circle, the core is the center of that circle; if the ridge is viewed as an ellipse or parabola, the core is the focal point of that curve. Note that the core is not on the innermost recurving ridgeline itself.

The direction of the core is away from the center of the curve. The core or cores of a fingerprint are defined for all pattern classifications other than plain arches, as shown in **Table 39**. Cores may be marked on tented arches if an innermost recurving ridge is present above the delta, so that each side of the recurving ridge extends to either side of the delta. Plain or central pocket loop whorls will only have one core if the innermost recurving ridge is circular, or two cores if elliptical. A circular whorl only has one core and does not have a defined direction. Accidentals may have any number of cores.

If one or more cores are present and the feature set is from a fingerprint, **Field 9.307: EFS pattern classification / PAT** should be defined. Note that this does not mean that the classification has to be known definitively, but must at least be known to the extent of excluding plain arches. When no cores are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

For palmprints or other non-fingerprint friction ridge images, any number of core-like patterns may be defined using this field if such structures are present. Each core is defined in a separate subfield.

Table 39 Number of cores and deltas by pattern class

Pattern Classification		Cores	Deltas
Arches	- Plain Arch	0	0
	- Tented Arch	0 or 1	0 or 1
Whorls	- Plain Whorl	1 or 2	2
	- Central Pocket Loop	1 or 2	2
	- Double Loop	2	2
	- Accidental Whorl	N	N
Loops		1	1

Each subfield consists of the following information items:

- The first information item (**'x' coordinate / CXC**) shall be expressed in integer units of 10 micrometers (0.01mm).

- The second information item (**'y' coordinate / CYC**) shall be expressed in integer units of 10 micrometers (0.01mm).

- The third information item (**direction / CDI**) is optional. This shall be set to the average tangent direction of the two closest ridges as measured 1.63mm (0.064 inches) from the focal point. This is approximately the same as the direction of the directrix of the best fitting parabola. The direction shall be omitted (left empty) for circular whorls, or if the direction is unknown.

- The fourth information item (**radius of position uncertainty / RPU**) defines the radius of a circle centered at the location (X,Y) of the core; the circle is sized to include the area of other possible locations of the core, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the image.

- The fifth information item **(direction uncertainty / DUY**) is optional. It contains the uncertainty of the direction of the core, in non-negative integer degrees. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

Figure 8: Placement of the core at the focus of the innermost recurving ridgeline

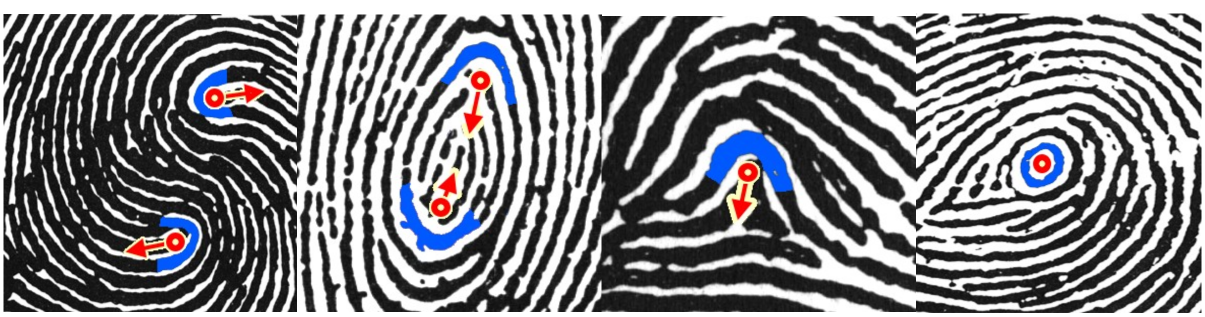


Figure 9: Examples of core locations for a double loop whorl, plain whorl, tented arch, and central pocket loop whorl

8.9.7.17 Field 9.321: EFS deltas / DEL

For fingerprints, one or more deltas are defined for all pattern classifications other than plain arches, as shown in **Table 40**. For palmprints or other non-fingerprint friction ridge images, any number of delta-like patterns may be defined using this field if such structures are present. Each delta is defined in a separate subfield. For more information about this field, see **Annex F F.6.3.1 Field 9.321: EFS deltas / DEL instructions .**

When no deltas are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

Each subfield consists of the following information items:

- The first information item **('x' coordinate / DXC**) is expressed in units of 10 micrometers (0.01mm) and is mandatory.
- The second information item **('y' coordinate / DYC**) is expressed in units of 10 micrometers (0.01mm) and is mandatory.
- The third information item **(direction up / DUP**) is optional and is expressed in degrees counterclockwise from the right[44].
- The fourth information item **(direction left / DLF**) is optional and is expressed in degrees counterclockwise from the right[44].
- The fifth information item **(direction right / DRT**) is optional and is expressed in degrees counterclockwise from the right[44].
- The sixth information item **(type / DTP**) is optional and contains the type of delta, as defined in **Table 40**.
- The seventh information item **(radius of position uncertainty / RPU**) is optional. It defines the radius of a circle centered at the location (X,Y) of the delta; the circle is sized to include the area of other possible locations of the delta, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the image.
- The eighth information item (**direction uncertainty up / DUU**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

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[44]. The three angles shall be reported in order by increasing angle, which for fingerprint deltas with known orientation will result in the order up, left, then right. These three information items may be omitted (left empty).

- The ninth information item **(direction uncertainty left / DUL**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

- The tenth information item **(direction uncertainty right / DUR**) is optional. It contains the uncertainty of the delta angle up. Valid values range from "0" to "180": a value of "0" (default) indicates a certain direction, while a value of "180" indicates an unknown orientation.

Table 40 EFS delta codes

Applies to	Code	Name	Description
Fingerprint	L	Left fingerprint delta	The delta to the left of the image for whorls or right loops. For accidentals with more than two deltas, this indicates the leftmost delta.
Fingerprint	R	Right fingerprint delta	The delta to the right of the image for whorls or left loops. For accidentals with more than two deltas, this indicates the rightmost delta.
Palm	I00 I02..I05 I07..I10 I16 I17	Interdigital delta (with finger number)	The deltas at the base of the fingers in the interdigital areas. The finger number shall be noted if known (2 to 5, 7 to 10, or 16 or 17, selected from **Table 8 Friction ridge position code & recommended image dimensions)**, else set to 0. Note that thumbs do not have interdigital deltas.
Palm	C	Carpal delta	The delta at the base of the palm where the thenar and hypothenar meet.
Fingerprint, Palm, or Foot	<empty>	Other delta	Any other delta or delta-like structure in a friction ridge impression.

8.9.7.18 Field 9.322: EFS core delta ridge counts / CDR

This field contains the count of intervening ridges between each core and delta. Each ridge count has a minimum and maximum value, so that a range may be noted. If the exact value is known, then that value should be put in the minimum and maximum fields. If only a minimum is known, such as when a delta is not visible, the maximum value shall be omitted. Ridge counts may be any non-negative integer. When this field is used for fingerprints, ridge counts shall be provided between each core and each delta, unless there are more than two cores or two deltas in an accidental whorl, in which case only the leftmost and rightmost of the cores and deltas need be used for ridge counts. Each subfield represents a distinct core-delta ridge count. Each subfield consists of four information items:

- The first information item **(core index / CIX)** is the (1-based) index of the core corresponding to this count ("1" if only one core is defined). If the relevant core is not defined, this shall be set to "U" to indicate an upper core or "L" to indicate a lower core (whorls only), permitting minimum ridge counts when cores are not in the region of interest.

- The second information item **(delta index / DIX)** is the (1-based) index of the delta corresponding to this count ("1" if only one delta is defined). If the relevant delta is not defined, this shall be set to "L" to indicate a left delta or "R" to indicate a right delta, permitting minimum ridge counts when deltas are not in the region of interest.

- The third information item (**minimum ridge count / MNRC**) contains the precise ridge count, if it is known; otherwise, it contains the minimum of the range of ridge count values.

- The fourth information item (**maximum ridge count / MXRC**) contains the precise ridge count (if the count is known precisely), or the maximum of the range of ridge count values (if there is a known or estimated maximum); otherwise, it shall be omitted.

8.9.7.19 Field 9.323: EFS center point of reference / CPR

This field contains the location of a center point of reference of a fingerprint, which may be used to define how centered a fingerprint is, as a feature, for registration or orientation, and for quality measurements. While the core may serve some of the same purposes, a center point of reference is defined for arches and provides a single center location for complex whorls, unlike cores. For more information about this field see **ANNEX F F.6.3.2 Field 9.323: EFS center point of reference / CPR instructions.**

The center point of reference is the sole EFS feature that can be located outside of the EFS region of interest. For example, this allows the estimated center of the finger to be marked even for an extreme side. The origin of **CPR**, like all other EFS features, is relative to the top left of **Field 9.300: EFS region of interest / ROI.** Note that this means that the X and Y values for **CPR** are the only EFS coordinates that may be negative, or greater than the **ROI** width or height. The center point of reference must be within the bounds of the overall image itself. Thus the allowed special character is the negative sign.

The location of a center point of reference can be determined using different algorithms, as stored in the Method information item, in which case different center points of reference may be stored in different data entries (repeating subfield). The center point of reference is defined for fingerprints or toe prints, not for other types of friction ridge images. This field consists of the following information items:

- The first information item **(method / CPM)** is the method of determining the X, Y location, selected from the "Code" column of **Table 41**. It is a one character value.
- The second information item (**'x' coordinate / PXC**) is in units of 10 micrometers (0.01mm)
- The third information item (**'y' coordinate / PYC**) is in units of 10 micrometers (0.01mm)
- The fourth information item (**radius of position uncertainty / CRU**) is optional. The radius of position uncertainty is 0 (default) if the location is known precisely; otherwise the position is marked at the best estimate of position, with a radius including the area of other possible locations, in integer units of 10 micrometers (0.01mm). The radius of uncertainty may overlap the edge of the image.

Table 41 EFS methods of determining center point of reference locations

Name	Code	Description
Lateral center only	L	The center location is defined laterally (across the finger) but is not meaningful in the other dimension (longitudinally, or along the finger), such as for defining the center line of arches, tips, and lower joints. Lateral center is only meaningful if the orientation (**Field 9.301: EFS orientation / ORT**) is known; the point marked is the center with respect to the orientation angle.
Uppermost point of the ridge with greatest curvature	0	For a fingerprint with a known or estimated orientation, the center point is determined by finding the highest point of each ridge that is convex and pointing upward, and measuring the curvature/peak angle by following the ridge 1.63mm (0.064in) in both directions from that point. The point with the minimum angle (greatest curvature) is the center point of reference.
Overall fingerprint focal point	1	The overall fingerprint focal point is the point where the lines perpendicular to ridge flow converge.
Human estimate of finger center	H	Human estimation of the approximate center of distal fingerprint pad, used when methods or 1 are not practical.

8.9.7.20 Field 9.324: EFS distinctive features / DIS

This field is used to define one or more areas containing unusually discriminating features that are not fully defined using other Extended Friction Ridge features. The characteristics noted in this field are specific to the friction skin itself, as opposed to issues specific to the impression (such as smudging) that are noted in **Field 9.357: EFS local quality issues / LQI**.

When no distinctive features are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

This field consists of three information items:

- The first information item (**type / DIT**) is selected from the "Code" column of **Table 42**.

- The second information item (**distinctive features polygon / DFP**) is optional. It is a closed path polygon that outlines the area of the distinctive feature. See **Section 7.7.12.** In Traditional encoding, the three special characters allowed are $^{R}{}_{S}$, the comma and the dash . See **Section B.2.5 Type-9 record.** These special characters are not used in XML Encoding. For the XML layout of this information item, see **Annex G: Type-9.**

- The third information items (**distinctive features comment / DFC**) shall contain optional text describing the feature. It is a maximum of 1000 characters.

Table 42 EFS types of distinctive features

Code	Description
SCAR	Scar
WART	Wart or blister
MINGROUP	Unusual group or cluster of minutiae
CORE	Unusually distinctive core area
DELTA	Unusually distinctive delta area
MINUTIA	Unusually shaped minutia
CREASE	Unusually distinctive crease
CLEAR	Large clear field of ridges; large clear area with no minutiae
DYSPLASIA	Dissociated ridges / Dysplasia
OTHERFEAT	Other unusual features not characterized elsewhere; details should be noted in comments

8.9.7.21 Field 9.325: EFS no cores present / NCOR

This optional field is used to indicate whether the analysis process has determined that no cores could be discerned in the image. If the analysis process has determined that no cores could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.22 Field 9.326: EFS no deltas present / NDEL

This optional field is used to indicate whether the analysis process has determined that no deltas could be discerned in the image. If the analysis process has determined that no deltas could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.23 Field 9.327: EFS no distinctive features present / NDIS

This optional field is used to indicate whether the analysis process has determined that no distinctive features could be discerned in the image. If the analysis process has determined that no distinctive features could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.24 Field 9.331: EFS minutiae / MIN

Detailed instructions concerning this field are in **Annex F F.6.4.1 Field 9.331: EFS minutiae / MIN instructions.**

The type of minutiae shall be marked if clearly identifiable as a ridge ending or bifurcation; otherwise, it shall be marked as unknown type. The location for a bifurcation shall be at the "Y" of the ridge, with the direction running down the valley. The location for a ridge ending or unknown type shall be at the "Y" of the valley, with the direction running up the ridge. If the precise location for a ridge ending cannot be ascertained, a radius of uncertainty shall be marked to include the area of possible locations. If the type is unknown, the radius of uncertainty shall be indicated.

When no minutiae are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

This field consists of multiple subfields, each consisting of six information items:

- The first information item (**'x' coordinate / MXC**) is expressed in units of 10 micrometers (0.01mm).
- The second information item **('y' coordinate / MYC)** is expressed in units of 10 micrometers (0.01mm).
- The third information item **(theta / MTD)** is expressed in degrees.
- The fourth information item **(type / MTY)** is selected from the "Code" column of **Table 43.**
- The fifth information item **(radius of position uncertainty / MRU)** defines the radius of a circle centered at the location (X,Y) of the minutia.
- The sixth information item **(direction uncertainty / MDU)** contains an integer from "0" (default) to "180" indicating the precision in the direction (theta) of the minutia, measured in degrees. The resulting direction is Theta±Uncertainty°.

Table 43 EFS codes for minutia types

Code	Description
E	Ridge ending
B	Ridge bifurcation
X	Ridge ending or bifurcation, no distinction provided

8.9.7.25 Field 9.332: EFS minutiae ridge count algorithm / MRA

This optional field defines the algorithm used in determining how neighboring minutiae are selected for use in the ridge counts in **Field 9.333: EFS minutiae ridge counts / MRC**. The value for this field shall be selected from the "Code" column of **Table 44**.

Table 44 EFS codes for minutiae ridge count algorithms

Code	Description
OCTANT	The minutiae used for ridge counts are the nearest neighbors in eight octants, with the center of the 0th octant defined by the current minutia's theta, and the 1st through 7th octants proceeding counter clockwise. Ridge count values are set to number of intervening ridges. (Default)
EFTS7	Identical to OCTANT algorithm, except that ridge count values are one more than the number of intervening ridges. This was the format used by the FBI in its EFTS Version 7.1
QUADRANT	The minutiae used for ridge counts are the nearest neighbors in four quadrants, defined by the image's vertical and horizontal axes. The quadrants, with the 1st quadrant at the upper right and the 2nd through 4th quadrants proceeding counterclockwise. Ridge count values are set to the number of intervening ridges.

8.9.7.26 Field 9.333: EFS minutiae ridge counts / MRC

This field contains the counts of intervening ridges between specified minutiae. **Field 9.332: EFS minutiae ridge count algorithm / MRA** governs how the minutiae are selected for ridge counts, and the details of how the ridges are counted. Each ridge count is represented in a separate subfield.

Field 9.335: EFS minutiae ridge count confidence / RCC may be used to indicate ridge count confidence between minutiae. If **Field 9.372: EFS skeletonized image / SIM** is used, ridge counts can be derived from that field rather than included explicitly.

Each subfield consists of five information items:

- The first information item (**minutia index A / MIA**) contains the index of the first minutia.
- The second information item (**minutia index B / MIB**) contains the index of the second minutia.
- The third information item (**ridge count / MIR**) contains the number of intervening ridges between minutiae A and B. Unknown ridge counts shall be omitted (left empty). The **Field 9.332: EFS minutiae ridge count algorithm / MRA** governs other details or special cases (if any).

- The fourth information item (**reference number / MRN**) is optional and, if used, contains a reference number specific to the ridge count algorithm. For the OCTANT and EFTS7 ridge count algorithms, this information item specifies the octant. For the QUADRANT ridge count algorithms, this information item specifies the quadrant.

- The fifth information item (**residual / MRS**) is optional and is specific to the OCTANT and EFTS7 ridge count algorithms, specifying the half of the octant in which the neighboring minutia lies. The residual is 0 if the neighboring minutia lies in the clockwise half of the octant, or 1 if the minutia lies in the counterclockwise half of the octant.

8.9.7.27 Field 9.334: EFS no minutiae present / NMIN

This optional field indicates whether the analysis determined that no minutiae could be discerned in the image. If the analysis process has determined that no minutiae could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.28 Field 9.335: EFS minutiae ridge count confidence / RCC

This optional field is used to indicate confidence in intervening ridge counts between any two points. Each ridge count confidence value is represented in a separate data entry (repeating subfield). While primarily used to indicate ridge count confidence between minutiae, this confidence measure may also apply to other features such as Core/Delta ridge counts.

If this field not used, the default assumption is that the ridge counts were manually determined. This field provides a means to save state when only a portion of ridge counts have been manually checked. This field consists of six information items:

- The first information item (**ax / ACX**) contains the x coordinates for Point A, in units of 10 micrometers (0.01mm).

- The second information item (**ay / ACY**) contains the y coordinates for Point A, in units of 10 micrometers (0.01mm).

- The third information item (**bx / BCX**) contains the x coordinates for Point B, in units of 10 micrometers (0.01mm).

- The fourth information item (**by / BCY**) contains the y coordinates for Point B, in units of 10 micrometers (0.01mm).

- The fifth information item (**method of ridge counting / MORC**) states the method by which ridge counts were determined and/or validated selected from **Table 45.**

- The sixth information item (**confidence value / MCV)** contains the integer confidence value for a ridge count from 0 to 99, with 0 indicating no confidence.

Table 45 EFS codes for methods of ridge counting

Definition	Value	Description
Auto	A	The ridge count was automatically performed without human review
Manual Tracing	T	The ridge count was automatically determined, based on a skeletonized image created by a human examiner.
Manual Ridge Count	M	The ridge count was determined or validated manually by a human examiner.

8.9.7.29 Field 9.340: EFS dots / DOT

A dot is a single or partial ridge unit that is shorter than local ridge width. Longer ridge units are considered standard ridges and should be marked as such, with two ridge endings. Potential dots that are substantially thinner than local ridge width should be marked as incipient ridges. A dot is marked by its center point. Elongated dots may optionally have their length marked along the longest dimension.

When no dots are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

This field consists of a repeating subfield (one for each dot) with the following three information items:

- The first information item (**dot 'x' coordinate / DOX**) is the x coordinate of the center of the dot, expressed in units of 10 micrometers (0.01mm).

- The second information item (**dot 'y' coordinate / DOY**) is the y coordinate of the center of the dot, expressed in units of 10 micrometers (0.01mm).

- The third information item (**dot length / DOL**) is an optional information item containing the length of the dot along its longest dimension in integer units of 10 micrometers.

8.9.7.30 Field 9.341: EFS incipient ridges / INR

An incipient is a thin ridge, substantially thinner than local ridge width. An incipient is marked as one or more line segments, each defined with the (X, Y) endpoints along its longest dimension. If the incipient is a series of clearly separate (thin) dots, they should be marked as separate incipient ridges. If an unbroken incipient curves, it should be marked as a series of adjoining line segments.

When no incipient ridges are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

This field consists of a subfield for each segment of an incipient ridge, each with four information items:

- The first information item (**x1 / X1C**) contains the ‘x’ coordinate of one endpoint, in units of 10 micrometers (0.01mm).
- The second information item (**y1 / Y1C)** contains the ‘y’ coordinate of one endpoint, in units of 10 micrometers (0.01mm).
- The third information item (**x2 / X2C**) contains the ‘x’ coordinate of the other endpoint, in units of 10 micrometers (0.01mm).
- The fourth information item (**y2 / Y2C**) contains the ‘y’ coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

8.9.7.31 Field 9.342: EFS creases and linear discontinuities / CLD

This optional field defines the permanent flexion creases (shown in **Figure 10**), as well as linear discontinuities (minor creases, cracks, cuts, and thin or non-permanent scars). If a continuous discontinuity curves, it should be marked as a series of adjoining line segments. If a crease is feathered or composed of a series of crisscross creases, each of the short creases shall be marked separately.

When no creases or linear discontinuities are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

Each segment of a crease or linear discontinuity is represented as a separate subfield consisting of five information items:

- The first information item (**dx1 / X1D**) shall contain the ‘x’ coordinate of one endpoint, in units of 10 micrometers (0.01mm).
- The second information item (**dy1 / Y1D**) shall contain the ‘y’ coordinate of one endpoint, in units of 10 micrometers (0.01mm).
- The third information item (**dx2 / X2D**) shall contain the ‘x’ coordinate of the other endpoint, in units of 10 micrometers (0.01mm).

- The fourth information item (**dy2 / Y2D**) shall contain the 'y' coordinate of the other endpoint, in units of 10 micrometers (0.01mm).
- The fifth information item (**type / TPD**) shall be noted using the codes from **Table 46**[45]

Table 46 EFS codes for permanent flexion creases

Name	Code	Location
Distal interphalangeal crease	DIP	Finger between medial and distal segments, or Thumb between proximal and distal segments
Proximal interphalangeal crease	PIP	Finger between proximal and medial segments
Proximal digital crease	PDC00 – PDC10 PDC16, PDC17	Finger or Thumb at Palm. The 2-digit position code for the relevant finger, selected from Table 8 is appended to the string PDC (e.g. PDC01-PDC10, PDC16, PDC17) The fingerprint position code is 00 if the finger position cannot be determined.
Radial longitudinal crease (Also known as bottom crease)	RLC	Palm around base of thumb (thenar)
Proximal transverse crease (Also known as middle crease)	PTC	Diagonal across palm
Distal transverse crease (Also known as top crease)	DTC	Palm at base of interdigital area
Wrist crease (also known as wrist bracelet)	WC	Wrist

[45] For fingerprints, the only permanent flexion crease is the DIP (the distal inter-phalangeal crease separating the distal and medial segments of the finger, or between the proximal and distal segments of the thumb); all other permanent flexion creases relate to the palms or lower finger joints. For a feathered crease, multiple line segments may all share the same flexion crease label.

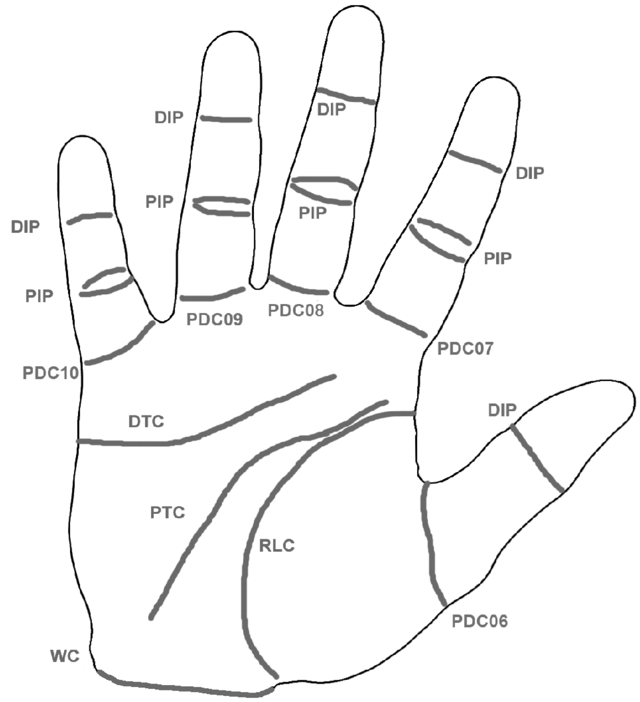

Figure 10: EFS locations of major flexion creases

8.9.7.32 Field 9.343: EFS ridge edge features / REF

Ridge edge features include Protrusions (abrupt increases in ridge width), Indentations (abrupt decreases in ridge width), and Discontinuities (points where a ridge stops briefly).

For more information about ridge edge features, see **Annex F F.6.5.1 Field 9.343: EFS ridge edge features / REF instructions .**

When no ridge edge are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

Each ridge edge feature is represented as a separate subfield consisting of three information items:

- The first information item **(x coordinate / CLX)** contains the 'x' coordinate of the center of the feature, in units of 10 micrometers (0.01mm).
- The second information item **(y coordinate / CLY)** contains the 'y' coordinate of the center of the feature, in units of 10 micrometers (0.01mm).
- The third information item (**type / CLT**) states the type of feature: P (Protrusion), I (Indentation), or D (Discontinuity).

8.9.7.33 Field 9.344: EFS no pores present / NPOR

This optional field is used to indicate whether the analysis process has determined that no pores (**Field 9.345: EFS pores / POR**) could be discerned in the image. If the analysis process has determined that no dots could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.34 Field 9.345: EFS pores / POR

Each pore is marked by its center point.

When no pores are present, this field shall not be used. See **Table 102: Features and Corresponding presence fields .**

Each pores is represented as a separate repeating subfield consisting of two information items:

- The first information item **(x coordinate / POX)** contains the 'x' coordinate of the center of the pore, in units of 10 micrometers (0.01mm).
- The second information item **(y coordinate / POY)** contains the 'y' coordinate of the center of the pore, in units of 10 micrometers (0.01mm).

8.9.7.35 Field 9.346: EFS no dots present / NDOT

This optional field is used to indicate whether the analysis process has determined that no dots are present. If the analysis process has determined that no dots could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.36 Field 9.347: EFS no incipient ridges present / NINR

This optional field is used to indicate whether the analysis process has determined that no incipient ridges could be discerned in the image. If the analysis process has determined that no incipient ridges could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.37 Field 9.348: EFS no creases or linear discontinuities present / NCLD

This optional field is used to indicate whether the analysis process has determined that no creases could be discerned in the image. If the analysis process has determined that no creases could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.38 Field 9.349: EFS no ridge edge features present / NREF

This optional field is used to indicate whether the analysis process has determined that no ridge edge features could be discerned in the image. If the analysis process has determined that no ridge edge features could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 102: Features and Corresponding presence fields .**

8.9.7.39 Field 9.350: EFS method of feature detection / MFD

This optional field states the method(s) by which the Extended Friction Ridge features were detected and/or edited. Each time that fields are created or modified, the date and name of the automated algorithm or human examiner is noted in a new data entry (repeating subfield).[46] This field consists of nine information items, of which the first two are mandatory.

- The first information item (**field / FIE**) indicates which fields correspond to the method noted: it shall contain a single field (e.g. "9.331"), a comma-separated list of fields without spaces (e.g. "9.340,9.341,9.343"), or "ALL". The allowed special characters are the comma and the period.

- The second information item **(method / FME**) shall state the method by which the fingerprint features were detected and encoded, using the values from the "Code" column of **Table 47**.

- The third information item **(algorithm vendor / FAV**) should identify the vendor of the encoding algorithm if the method is not "MAN".

- The fourth information item **(algorithm / FAL**) should identify the algorithm by name and version for methods other than "MAN".

- The fifth information item **(examiner surname / ESN**) should contain the surname (last name) of the fingerprint examiner, for methods other than "AUTO".

- The sixth information item **(examiner given name / EGN**) should contain the first name (given name, or first and middle names) of the fingerprint examiner for methods other than "AUTO."

- The seventh information item **(examiner affiliation / EAF**) should contain the employer or organizational affiliation of the examiner, for methods other than "AUTO".

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[46] When features are created or edited on multiple occasions, the new data entries should be added to this field without deleting the original data entries. For example, if minutiae are manually encoded by an examiner, then subsequently a second examiner modifies the minutiae, there would be two "MAN" entries for **Field 9.331: EFS minutiae / MIN**.

- The eighth information item **(date and time / EMT**) should contain the date and time that the determination was made, using Greenwich Mean Time (GMT). See **Section 7.7.2.2**.

- The ninth information item **(notes / NTS**) is an optional item that may contain text with additional information regarding the detection or modification of features.

Table 47 EFS codes for methods of feature detection

Code	Usage
AUTO	The fingerprint features were detected and encoded by an automated process without any possibility of human editing. The algorithm shall be noted in the appropriate information item.
REV	The fingerprint features were detected and encoded by an automated process, and manually reviewed without the need for manual editing. The algorithm and examiner's name shall be noted in the appropriate information items.
EDIT	The fingerprint features were detected and encoded by an automated process, but manually edited. The algorithm and examiner's name shall be noted in the appropriate information items.
MAN	The fingerprint features were manually detected and encoded. The examiner's name shall be noted in the appropriate information item.

8.9.7.40 Field 9.351: EFS comments / COM

This optional text field contains additional information not noted in other fields. This may include unformatted text information such as location, background information, or descriptive information. If comments need to be made about specific portions of the impression, use **Field 9.324: EFS distinctive features / DIS** or **Field 9.332: EFS minutiae ridge count algorithm / MRA**.

8.9.7.41 Field 9.352: EFS latent processing method / LPM

This optional text field contains a three-letter code from **Table 48** indicating the technique(s) used to process the latent fingerprint. This field is only used for latent images. Unprocessed impressions (patent images visible to the naked eye) shall be labeled VIS. Multiple methods should be marked by separate subfields. Methods should only be marked if they contributed substantively to the visualization of the image, and shall not be a list of all methods attempted.

8.9.7.42 Field 9.353: EFS examiner analysis assessment / EAA

This optional text field indicates an examiner's assessment of the value of the single impression delineated by **Field 9.300: EFS region of interest / ROI**. See also **Field 9.362: EFS examiner comparison determination / ECD** for comparison determinations. This field consists of seven information items, of which the first five are mandatory:

- The first information item **(value assessment code / AAV**) indicates the value of the impression, from **Table 49**.
- The second information item **(examiner last name / ALN**) shall contain the surname (last name) of the fingerprint examiner.
- The third information item **(examiner first name / AFN**) shall contain the first name (given name, or first and middle names) of the fingerprint examiner.
- The fourth information item **(examiner affiliation / AAF**) shall contain the employer or organizational affiliation of the examiner.
- The fifth information item **(date and time / AMT**) shall contain the date and time that the determination was made, using Greenwich Mean Time (GMT). See **Section 7.7.2.2.**
- The sixth information item is optional **(comment / ACM**), and contains additional clarifying information for the examiner analysis assessment.
- The seventh information item is optional (**analysis complexity flag / CXF).** It is only used when the examiner determines that the analysis was complex as defined in *Standards for examining fraction ridge impressions and resulting conclusions*. (See **Normative references)** In that case, an entry of "COMPLEX" is made. This decision is based on the available quality of features, low specificity of features, significant distortion, or disagreement among examiners. This information item is included for use in quality assurance / quality control processes.

8.9.7.43 Field 9.354: EFS evidence of fraud / EOF

This text field indicates that there is basis for determination that the image may be fraudulent. This field consists of two information items:

- The first information item **(type of fraud / FRA**) indicates the potential type of fraud attempted as determined from the impression, using the values in the "Code" column from **Table 50.**

- The second information item (**comment / CFD**) is optional. It contains text that provides clarifying information regarding the assessment of potential evidence of fraud.

8.9.7.44 Field 9.355: EFS latent substrate / LSB

This field is used to define the substrate, or surface on which the friction ridge impression was deposited. If multiple substrates are present, they are represented by separate subfields consisting of the following information items:

- The first information item **(code / CLS)** indicates the type of substrate, from the Code column of **Table 51**.

- The second information item (**object or substrate description / OSD**) is optional and may contain text that describes the object or surface on which the print was deposited, or provides clarifying information regarding the substrate. An example is "Neck of green glass beer bottle".

8.9.7.45 Field 9.356: EFS latent matrix / LMT

This field is used to define the matrix, or substance deposited by the finger that forms the impression. Each latent matrix is represented by a separate data entry (repeating subfield). This field consists of two information items:

- The first information item is mandatory and indicates the **type of matrix / TOM**, from the Code column of **Table 52**. All visible contaminants are apparent rather than necessarily known to certainty: for example, the substrate may be marked as blood if it appears to be blood; if known for certain that should be indicated as a comment.

- The second information item (**comment / CLA**) is optional and may contain text that provides clarifying information regarding the matrix.

Table 48 EFS codes for methods of latent processing

Code	Processing method	Code	Processing method
12I	1,2 Indanedione	LIQ	Liquinox
ADX	Ardrox	LQD	Liquid-drox
ALS	Alternate light source	MBD	7-p-methoxybenzylanimo-4-nitrobenz-2-oxa-1, 3-diazole
AMB	Amido black	MBP	Magnetic black powder
AY7	Acid yellow 7	MGP	Magnetic grey powder
BAR	Basic red 26	MPD	Modified physical developer
BLE	Bleach (sodium hypochlorite)	MRM	Maxillon flavine 10gff, Rhodamine 6g, and MBD
BLP	Black powder	NIN	Ninhydrin
BPA	Black powder alternative (for tape)	OTH	Other
BRY	Brilliant yellow (basic yellow 40)	PDV	Physical developer
CBB	Coomassie brilliant blue	R6G	Rhodamine 6G
CDS	Crowle's double stain	RAM	Cyanoacrylate fluorescent dye (Rhodamine 6G, Ardrox, MBD)
COG	Colloidal gold	SAO	Safranin O
DAB	Diaminobenzidine	SDB	Sudan black
DFO	1,8-diazafluoren-9-one	SGF	Superglue fuming (cyanoacrylate)
FLP	Fluorescent powder	SPR	Small particle reagent
GEN	Genipin	SSP	Stickyside powder
GRP	Gray powder	SVN	Silver nitrate
GTV	Gentian violet	TEC	Theonyl Europiom Chelate
HCA	Hydrochloric acid fuming	TID	Titanium dioxide
IOD	Iodine fuming	VIS	Visual (patent image, not processed by other means)

Table 48 EFS codes for methods of latent processing

Code	Processing method
ISR	Iodine spray reagent
LAS	Laser
LCV	Leucocrystal violet
WHP	White powder
ZIC	Zinc chloride

Table 49 EFS codes for value assessments

Code	Usage
VALUE	The impression is of value and is appropriate for further analysis and potential comparison. Sufficient details exist to render an individualization and/or exclusion decision.
LIMITED	The impression is of limited, marginal, value. It is not of value for individualization, but may be appropriate for exclusion.
NOVALUE	The impression is of no value, is not appropriate for further analysis, and has no use for potential comparison.
NONPRINT	The image is not a friction ridge impression.

Table 50 EFS codes for fraud type assessments

Name	Code	Usage
Evidence of evasion	EVA	Evasion includes actions that prevent/lessen the likelihood of matching such as by degrading or obscuring physical characteristics or mutilating fingers.
Evidence of spoofing	SPO	Spoofing includes purposefully attempting to be identified as a different person in a biometric system; techniques include modifying biological characteristics and using fabricated characteristics.
Evidence of forged evidence	FOR	Forged evidence is forensic evidence that was fraudulently placed on the surface from which it was collected, using another mechanism or device than the natural contact with friction ridge skin.
Evidence of fabricated evidence	FAB	Fabricated evidence is forensic evidence that never existed on the surface from which it was supposedly collected.

Table 51 EFS codes for types of latent substrates

Category	Code	Description
Porous Substrate	1A	Paper
	1B	Cardboard
	1C	Unfinished/raw wood
	1D	Other/unknown porous substrate
Nonporous Substrate	2A	Plastic
	2B	Glass
	2C	Metal, painted
	2D	Metal, unpainted
	2E	Glossy painted surface
	2F	Tape, adhesive side
	2G	Tape, nonadhesive side
	2H	Aluminum foil
	2I	Other/unknown nonporous substrate
Semi-porous Substrate	3A	Rubber or latex
	3B	Leather
	3C	Photograph, emulsion side
	3D	Photograph, paper side
	3E	Glossy or semi-glossy paper or cardboard
	3F	Satin or flat finish painted surface
	3G	Other/unknown semi-porous substrate
Other / Unknown Substrate	4A	Other substrate (Specify)
	4B	Unknown substrate

Table 52 EFS codes for types of latent matrices

Code	Description
1	Natural perspiration and/or body oils (eccrine and/or sebaceous)
2-7:	*Visible contaminants:*
2	Blood
3	Paint
4	Ink
5	Oil or grease
6	Dirt or soil
7	Other visible contaminants
8	Impression in pliable material
9	Contaminant removal via touch
10	Other/unknown matrix

8.9.7.46 Field 9.357: EFS local quality issues / LQI

This optional field is used to define one or more areas containing quality or transfer issues that indicate that the anatomical friction ridge features may not have been accurately represented in the image. Each area with local quality issues is represented as a separate repeating subfield. The problems noted in this field apply to the specific impression under consideration; anatomical features of the friction skin itself (such as scars) are noted in (**Field 9.324: EFS distinctive features / DIS**). Each subfield consists of three information items:

- The first information item (**type / LQT**) is the type of quality issue, selected from the "Code" column of **Table 53**.
- The second information item (**polygon / LQP**) is a closed path outlining the area of the quality issue. See Section 7.7.12. In Traditional encoding, the three special characters allowed are $^{R}_{S}$, the dash, and the comma. See **Section B.2.5 Type-9 record**. These special characters are not used in XML Encoding. For the XML layout of this information item, see **Annex G: Type-9.**
- The third information item (**comment / LQC**) is optional and may contain text describing the quality issue.

Table 53 EFS codes of quality issue types

Code	Description
ARTIFACT	Digital artifacts, such as occasionally caused by compression or livescan devices.
BACKGROUND	Interference with background makes following ridges difficult (e.g. check patterns)
COMPRESSED	Distorted area in which ridges are compressed together
DISTORT	Miscellaneous distortion (See also Compressed and Stretched)
NEGATIVE	Used if only a portion of the friction ridge image is tonally reversed (has ridges and valleys inverted so that ridges appear white and valleys appear black). Note that Field 9.314 Tonal Reversal (TRV) is used if the entire image is tonally reversed.
OVERDEV	Overdeveloped area: excessive processing medium such as ink, powder, etc.
OVERLAP	Area in which another friction ridge impression is superimposed over the impression of interest
SMEAR	Smeared or smudged area
STRETCHED	Distorted area in which ridges are stretched apart from each other
TAPE	Lifting tape artifacts (crease, bubble, etc.)
OTHER	Other quality issues not characterized elsewhere; details should be noted in Comments

8.9.7.47 Field 9.360: EFS area of correspondence / AOC

This field is to be used only when two or more images contained in a single *ANSI/NIST-ITL* transaction are compared as candidates for individualization (potential mates). The area of correspondence is a polygon enclosing the region of usable ridge detail present in both images being compared. If the corresponding areas are discontinuous, more than one area of correspondence may be defined for a pair of images, each in a separate subfield. One Type-9 record may have multiple **AOC**s defined that correspond to different images, as shown in **Figure 11**, each in a separate repeating subfield. **Figure 11** shows the interrelationships of the **IDC**s and **AOC**s for three different Type-9 records in a single transaction.

Note that the **AOC** in a given Type-9 record contains an **IDC** reference for one or more other Type-9 record in a transaction. For example, a latent could have areas of correspondence with both the rolled and plain exemplars from one subject, or a latent could have areas of correspondence with candidate exemplars from two different subjects. If two prints overlap but neither encloses the area of the other (such as shown in **Figure 11**, the **AOC** shall be marked for both prints. If the area of a small print is completely enclosed by the area of a larger print so that the **AOC** for the small print is identical to the **ROI**, the **AOC** may be omitted for the smaller print.

Each subfield consists of 3 information items:

- The first information item **(corresponding IDC reference / CIR**) indicates the IDC for the target image / Type-9 record for a given **AOC**. See **Section 7.3.1.**[47]

- The second information item **(corresponding polygon / AOP**) defines the outline of the corresponding area. It is a closed path. See **Section 7.7.12.1** for a description of how to enter this information item. In Traditional encoding, the three special characters allowed are $^{R}{}_{S}$, the dash, and the comma. See **Section B.2.5 Type-9 record**. These special characters are not used in XML Encoding. For the XML layout of this information item, see **Annex G: Type-9.**

- The third information item **(corresponding area comment / CAC**) is optional and allows a free text comment or description related to the **AOC**.

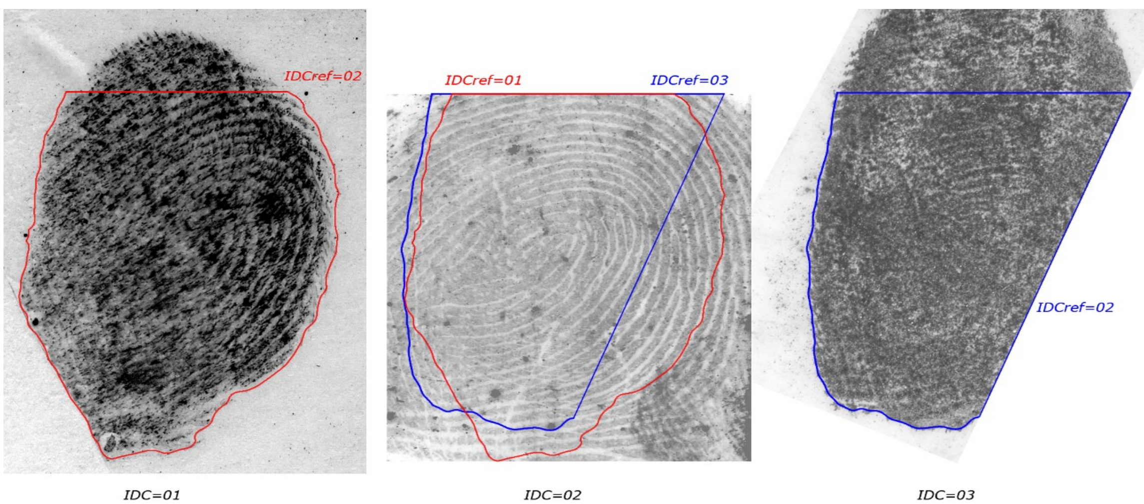

Figure 11 EFS IDC references in areas of correspondence for more than 2 images

8.9.7.48 Field 9.361: EFS corresponding points or features / CPF

This optional field is used to label points or features for comparison of the current feature set with other Type-9 feature sets in a transaction, as shown in **Figure 12**, which shows the interrelationships of the **CPF** labels for three different Type-9 records in a single transaction. This field is to be used only when two or more images contained in a single transaction are compared, either as candidates for individualization (potential mates), or for annotating reasons for exclusion. For more information about the field, see **Annex F**

[47] **Figure 11** shows examples of the use of **IDC** references in Corresponding Regions of Interest. The first image (**IDC** = 01) has a single **AOC**, corresponding to the second image, so **CIR** =02; the second image (**IDC** = 02) has **AOC**s corresponding to each of the other images, having **IDC** = 01 and **IDC** = 03; the third image (I**DC -** 03) has a single **AOC**, corresponding to the second image, so **CIR** = 02.

F.6.7.1 Field 9.361: EFS corresponding points or features / CPF instructions .

For each of the images being compared, specific points or features are marked in each of the Type-9 records, with correspondence indicated by the use of the same label, each in a separate data entry (repeating subfield). Labels within a single Type-9 record shall be unique. For example, if a transaction contains one latent and multiple candidate exemplars, a feature labeled “A” in the latent’s Type-9 feature set corresponds with the feature labeled “A” (if present) in all of the exemplar Type-9 feature sets.

Corresponding Points or Features may refer to arbitrary points, or may refer to predefined features (as noted in **Table 54**). The features include point features (such as minutiae, dots, or pores), but also may refer to areas (such as distinctive characteristics), lines (incipient ridges or creases), or paths (ridge path segments). Arbitrary points may be used to indicate characteristics that were not noted during analysis, or to indicate points in an exemplar that was not previously marked up.

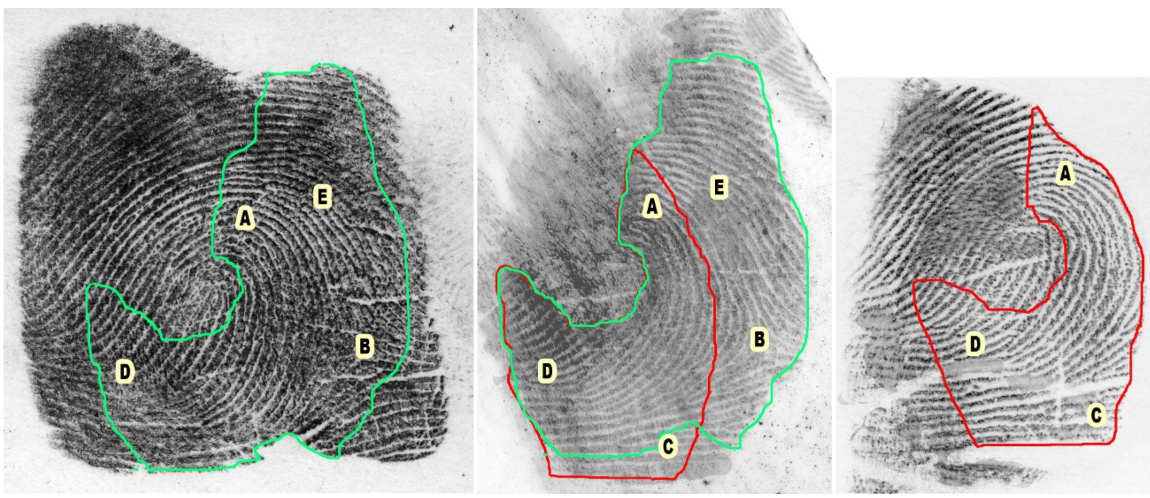

Figure 12: EFS areas and points of correspondence in rolled exemplar, latent, and plain exemplar images

Each feature corresponds to a separate subfield, of up to seven information items.

- The first information item **(label / COL)** is a mandatory 1-3 character alphanumeric label is used to indicate correspondence between CPFs in different Type-9 records. The label names may be selected and assigned at the discretion of the system or the examiner. Labels within a single Type-9 record shall be unique. Note that the use of a given label in one type-9 record means that that point or feature corresponds with any or all other features with the same label in other Type-9 records in the transaction.

- The second information item **(type of correspondence / TOC)** is a mandatory 1- or 2-character information item (code) used to indicate the type of correspondence or non-correspondence, set to the appropriate “Code” value from **Table 55.**

- The third information item **(corresponding field number / CFN)** is conditional, used only if **TOC** = F or DF. The Field Number information item indicates the type of field being compared, and shall correspond to the “Field number” column of **Table 54**. This is the Type-9 field number of the compared field.

- The fourth information item **(corresponding field occurrence / FOC)** is conditional, used only if **TOC** = F or DF. This information item indicates which repeating subfield of the specified field the label is applied to. Note that this is a 1-based index, not a 0-based index. Occurrences are numbered starting with 1.

- The fifth information item **(corresponding 'x' coordinate / CXC)** is conditional, used only if **TOC** = P or DP. It is expressed in units of 10 micrometers (0.01mm).

- The sixth information item **(corresponding 'y' coordinate / CYC)** is conditional, used only if **TOC** = P or DP. It is expressed in units of 10 micrometers (0.01mm).

- The seventh information item **(comment / COC)** is optional and may contain a text comment or description related to the **CPF**.

Table 54 EFS codes for field numbers used for corresponding features

Field number	Type
320	Cores
321	Deltas
324	Distinctive Characteristics
331	Minutiae
340	Dots

Field number	Type
341	Incipient Ridges
342	Creases and Linear Discontinuities
343	Ridge Edge Features
345	Pores
373	Ridge Path Segments

Table 55 EFS codes for types of corresponding points and features

Category	Type	Code	Description
Definite correspondence	Feature	F	The labeled feature definitely corresponds to the specific feature defined by the Field Number and Field Occurrence information items. (X and Y information items are unused)
	Point	P	The labeled feature definitely corresponds to the location with the coordinates defined in the X,Y information items. (Field Number and Field Occurrence information items are unused)
Possible or debatable correspondence	Debatable Feature	DF	The labeled feature may debatably correspond to the feature defined by the Field Number and Field Occurrence information items. (X and Y information items are unused)
	Debatable Point	DP	The labeled feature may debatably correspond to the location with the coordinates defined in the X,Y information items. (Field Number and Field Occurrence information items are unused)
Definite lack of correspondence	Does not exist	X	The labeled feature definitely does not exist in the impression, and the consistency of presentation of the potentially corresponding region is sufficient to make a definite determination. (X, Y, Field Number, and Field Occurrence information items are unused)
Inconclusive	Out of region	R	The labeled feature is not visible in the impression because it lies outside of the area of correspondence for this image: the feature may or may not be present, but the impression does not include the relevant area (X, Y, Field Number, and Field Occurrence information items are unused)
	Unclear area	U	The labeled feature is not visible in the impression because the potentially corresponding region is not sufficiently clear: the feature may or may not be present, but local quality issues prevent a definite determination. (X, Y, Field Number, and Field Occurrence information items are unused)

8.9.7.49 Field 9.362: EFS examiner comparison determination / ECD

This optional text field indicates an examiner's determination based on analysis and comparison of two specified friction ridge images. If multiple examiners' determinations are represented, each is contained separately in a repeating subfield. Comparison determinations against multiple impressions in the same transaction are specified in a separate subfield with distinct **IDC** references. Each subfield consists of at least seven information items. The eighth and ninth information items are optional:

- The first information item (**IDC reference / EDC**) indicates the target image for a given determination, and is used in the same way as the IDC in **Field 9.360: EFS area of correspondence / AOC**. See **Section 7.3.1.**

- The second information item **(determination / EDE**) indicates a comparison conclusion, using the "Code" column from **Table 56**. The allowed special character is the underscore.

- The third information item **(work in progress / WIP**) is set to "PRELIMINARY" (default) or "FINAL". For a determination to be accepted for further processing, the status shall be set to "FINAL". The purpose of this is to allow saving work in progress.

- The fourth information item **(examiner last name / ELN**) is the surname (last name) of the fingerprint examiner.

- The fifth information item **(examiner first name / EFN**) is the given name (first name or first and middle names) of the fingerprint examiner.

- The sixth information item **(examiner affiliation / EAF**) is the employer or organizational affiliation of the examiner.

- The seventh information item **(date and time / DTG**) is the date and time that the determination was made, in terms of Greenwich Mean Time units. See **Section 7.7.2.2.**

- The eighth information item **(comment / CZZ**) is optional and may contain text that provides clarifying or qualifying information regarding the comparison determination.

- The ninth information item (**complex comparison flag / CCF)** is optional. It is only used when the examiner determines that the comparison was complex as defined in *Standards for examining friction ridge impressions and resulting conclusions.* (See **Section 3 Normative references**), based on the available quality and quantity of features, low specificity of features, significant distortion, or disagreement among examiners. In such case, the value shall be set to 'COMPLEX'. This information item is included for use in quality assurance/quality control processes.

Table 56 EFS codes for comparison determinations

Category	Code	Description / Usage
Individualization	INDIV	The two impressions originated from the same source.
Inconclusive due to insufficient information	INC_I	Individualization and exclusion are not possible because of insufficient corresponding or contradictory data. This category should be used if the specific other types of inconclusive determinations do not apply.
Inconclusive, but with corresponding features noted	INC_C	No conclusive determination can be made. Corresponding features are present, and no substantive contradictory features are present. The correspondence of features is supportive of the conclusion that the two impressions originated from the same source, but not to the extent sufficient for individualization. This determination should be made if the examiner determines that the impressions are almost certainly from the same source, but cannot make an individualization determination. This is sometimes described as a qualified conclusion.
Inconclusive, but with dissimilar features noted	INC_D	No conclusive determination can be made. Non-corresponding features are present. The dissimilarity of features is supportive of the conclusion that the two impressions originated from different sources, but not to the extent sufficient for exclusion. This determination should be made if the examiner determines that the impressions are almost certainly not from the same source, but cannot make an exclusion determination. This is sometimes described as a qualified exclusion.
Inconclusive due to no overlapping area	INC_N	Individualization and exclusion are not possible because no corresponding or potentially corresponding areas of friction ridge detail are present. This determination should be made if there is sufficient information in the impressions to determine that there are no areas in the impressions to compare, such as when one print is of the left half of a finger and the other is of the right half.
Exclusion of source	EX_SRC	The two impressions originated from different sources of friction ridge skin (e.g. different fingers), but the subject cannot be excluded.
Exclusion of subject	EX_SUB	The two impressions originated from different subjects.
No determination	NONE	No determination has been made. (default)

8.9.7.50 Field 9.363: EFS relative rotation of corresponding print / RRC

This optional field may be used when two or more images contained in a single ANSI/NIST-ITL transaction are compared. This field indicates the relative overall rotation necessary for the prints to be compared. Each subfield consists of 2 information items. The number of subfields is limited only by the number of Type-9 records in the transaction.

The first information item (**rotation IDC reference / RIR**) indicates the **IDC** for the Type-9 record associated with the target image/ Type-9 record for a given **RRC**. See Section 7.3.1. See **Field 9.360** or **Field 9.362** for examples of other **IDC** references.)

The second information item (**relative overall rotation / ROR**) defines the integer number of degrees that the target image and/or features referenced by **RIR** shall be rotated to correspond to the data in this Type-9 record. Positive numbers indicate degrees counterclockwise; negative numbers indicate degrees clockwise: (-179 to 180 inclusive). The allowed special character is the negative sign.

8.9.7.51 Field 9.372: EFS skeletonized image / SIM

This optional field contains a skeletonized image, also known as a ridge tracing, which reduces the friction ridge impression to an image with thinned representations of each ridge. Incipient ridges, dots, ridge discontinuities, and protrusions are not included in the skeleton. The skeletonized image is a 2-tone image with a white background and a black single-pixel-wide thinned representation of each ridge. Each black pixel may have 1, 2, or 3 neighboring black pixels; other values (0, 4-8) are errors. The same information may alternatively be represented using **Field 9.373: EFS ridge path segments / RPS**. For more information about skeletonized images, See **Annex F F.6.8 Ridge path: skeletonized image and ridge path segments.**

The skeletonized image is stored as a 1-bit grayscale PNG compressed image, bit-packed 6 bits per character using Base-64 representation (See **Annex A: Character encoding information**). The entire PNG[48]-formatted image is included as a single data entry / information item. Interlacing, alpha transparency, and color palettes shall not be used. . The skeletonized image's dimensions shall be identical width and height of the **ROI** (See **Field 9.300: EFS region of interest / ROI**). The resolution of the skeletonized image shall be the same as the original image, and shall be set in the PNG header.

8.9.7.52 Field 9.373: EFS ridge path segments / RPS

This optional field contains an alternate representation of the same skeletonized image data contained in **Field 9.372: EFS skeletonized image / SIM**. Each ridge path segment is saved as an open path (ordered set of vertices). See **Section 7.7.12.1.** Multiple segments may be included in this field. Incipient ridges, dots, ridge discontinuities, and protrusions are not included in the ridge path representation. Each skeletonized ridge segment is stored as a separate subfield. Each endpoint of a ridge segment is either shared by three ridge segments (at a bifurcation) or is unique to a single ridge segment (at a ridge ending). For more information about ridge path segments, See **Annex F F.6.8 Ridge path: skeletonized image and ridge path segments.**

Each ridge path segment (if completely visible) is the portion of a ridge that connects two minutiae, so each ridge path segment starts and stops either where the ridge intersects another ridge path segment (a bifurcation) or ends (a ridge ending). In the infrequent case in which a ridge segment forms a complete loop back on itself without intersecting another ridge segment (such as near the core of some plain whorls or central pocket loops), the ridge path starts and stops at a single arbitrary point on the ridge. Ridge path segments may not be visible over their entire length due to image consistency-of-presentation problems or due to being truncated by the edge of the impression, and therefore one or both ends of a ridge segment may not end at points defined as minutiae.

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[48] PNG (Portable Network Graphics) is specified in ISO / IEC 15948:2004 See **Section 3 Normative references.**

8.9.8 Latent workstation annotations

8.9.8.1 Field 9.901: Universal latent workstation annotation information / ULA

This optional field is used to store annotation, logging, or processing information associated with the FBI-developed Universal Latent Workstation (ULW) or compatible software. If present, this text field shall consist of one or more entries, each with up to 300 characters that describe a single processing step. Each entry shall begin with the date and time followed by a hyphen encoded as: "{M}M/{D}D/YYYY {h}h:mm:ss {AM|PM} - " *(*e.g. "3/27/2010 7:21:47 PM - "). The remainder of the entry shall contain an unformatted text string describing a process or procedure applied to the fingerprint, palmprint, or plantar print associated with this Type-9 record. Additional entries may be included, each describing a subsequent processing step. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.9.8.2 Field 9.902: Annotation information / ANN

This optional field is used to store annotation, logging, or processing information associated with one or more processing algorithms or latent workstations (other than the FBI-developed ULW). See **Section 7.4.1.**

8.9.9 Workstation identifiers

8.9.9.1 Field 9.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 93 Character encoding set values** may be used.

8.9.9.2 Field 9.904: Make/model/serial number / MMS

This is an optional field. See Section **7.7.1.2** for details.

8.10 Record Type-10: Facial, other body part and SMT image record

Type-10 records shall contain face, SMT, and / or other body part image data and related information pertaining to the specific image contained in this record. It shall be used to exchange both grayscale and color image data in a compressed or uncompressed form.

Table 57 Type-10 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
10.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
10.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
10.003	**IMT**	**IMAGE TYPE**	M	AS	4	11	value from **Table 58**	1	1
10.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
10.005	**PHD**	**PHOTO CAPTURE DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
10.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	2	5	10 ≤ HLL ≤ 99999 positive integer	1	1
10.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	2	5	10 ≤ VLL ≤ 99999 positive integer	1	1
10.008	**SLC**	**SCALE UNITS**	M	N	1	1	0 ≤ SLC ≤ 2 integer	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
10.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
10.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
10.011	**CGA**	**COMPRESSION ALGORITHM**	M	AN	3	5	value from **Table 15**	1	1
10.012	**CSP**	**COLOR SPACE**	M	A	3	4	values from **Table 16**	1	1
10.013	**SAP**	**SUBJECT ACQUISITION PROFILE**	D	N	1	2	see values in **Table 10**	0	1
10.014	**FIP**	**FACE IMAGE BOUNDING BOX COORDINATES in FULL IMAGE**	D					0	1
	LHC	left horizontal coordinate value	M⇑	N	1	5	1 ≤ LHC ≤ HLL positive integer	1	1
	RHC	right horizontal coordinate value	M⇑	N	1	5	1 ≤ RHC ≤ HLL positive integer RHC > LHC	1	1
	TVC	top vertical coordinate value	M⇑	N	1	5	1 ≤ TVC ≤ VLL positive integer	1	1
	BVC	bottom vertical coordinate value	M⇑	N	1	5	1 ≤ BVC ≤ VLL positive integer BVC > TVC	1	1
	BBC	bounding box head position code	O⇑	A	1	1	value from **Table 59**	0	1
10.015	**FPFI**	**FACE IMAGE PATH COORDINATES in FULL IMAGE**	O					0	1
	BYC	boundary code	M⇑	A	1	1	BYC = C, E or P see **Table 19**	1	1
	NOP	number of points	M⇑	N	1	2	2 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	2	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	2	NOP

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
10.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
10.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
10.018	**DIST**	**DISTORTION**	D					0	1
	IDK	distortion code	M⇑	A	6	10	IDK = Barrel or Inflated or Pincushion	1	1
	IDM	distortion measurement code	M⇑	A	1	1	IDM = E or C	1	1
	DSC	distortion severity code	M⇑	A	4	8	DSC = Mild, Moderate or Severe	1	1
10.019	**LAF**	**LIGHTING ARTIFACTS**	D					0	1
		Subfields: Repeating values	M⇑	A	1	1	value = F, H or R	1	3
10.020	**POS**	**SUBJECT POSE**	D	A	1	1	value from **Table 60**	0	1
10.021	**POA**	**POSE OFFSET ANGLE**	D	NS	1	4	$-180 \leq POA \leq 180$ integer	0	1
10.022	***LEGACY FIELD***	**See ANSI/NIST-ITL 1-2007 or ANSI/NIST-ITL 2-2008 for a description of this field**	To be used for legacy data only. It is Photo Description. It is superseded by **Field 10.026: Subject facial description / SXS** .						
10.023	**PAS**	**PHOTO ACQUISITION SOURCE**	D					0	1
	PAC	photo attribute code	M⇑	AN	6	14	value from **Table 61**	1	1
	VSD	vendor-specific description	D	U	1	64	none	0	1
10.024	**SQS**	**SUBJECT QUALITY SCORES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	QVU	quality value	M⇑	N	1	3	$0 \leq QVU \leq 100$ integer or QVU = 254 or 255	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	$0000 \leq QAV \leq FFFF$	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	QAP	algorithm product identification	M⇑	N	1	5	1 ≤ QAP ≤ 65535 positive integer	1	1
10.025	**SPA**	**SUBJECT POSE ANGLES**	D					0	1
	YAW	yaw angle	M⇑	NS	1	4	-180 ≤ YAW ≤ 180 integer	1	1
	PIT	pitch angle	M⇑	NS	1	3	-90 ≤ PIT ≤ 90 integer	1	1
	ROL	roll angle	M⇑	NS	1	4	-180 ≤ PIT ≤ 180 integer	1	1
	YAWU	uncertainty in degrees for yaw	O⇑	N	1	2	0 ≤ YAWU ≤ 90 integer	0	1
	PITU	uncertainty in degrees for pitch	O⇑	N	1	2	0 ≤ PITU ≤ 90 integer	0	1
	ROLU	uncertainty in degrees for roll	O⇑	N	1	2	0 ≤ ROLU ≤ 90 integer	0	1
10.026	**SXS**	**SUBJECT FACIAL DESCRIPTION**	D					0	1
		Subfields: repeating values	M⇑	A	3	20	value from **Table 62**	1	50
10.027	**SEC**	**SUBJECT EYE COLOR**	D	A	3	3	value from **Table 17**	0	1
10.028	**SHC**	**SUBJECT HAIR COLOR**	D					0	1
		Subfields: Repeating values	M⇑	A	3	3	value from **Table 63**	1	2
10.029	**FFP**	**2D FACIAL FEATURE POINTS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	88
	FPT	feature point type	M⇑	N	1	1	FPT = 1 or 2	1	1
	FPC	feature point code	M⇑	ANS	3	5	Format: N.N, N.NN, NN.N, NN.NN, a, aa, aaa or aaaa; values from **Figure 13**, **Figure 14**, **Figure 15**, **Table 64** and **Table 65**	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	HCX	X coordinate	M⇑	N	1	5	1 ≤ HCX ≤ HLL positive integer	1	1
	HCY	Y coordinate	M⇑	N	1	5	1 ≤ HCY ≤ VLL positive integer	1	1
10.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	entries from **Table 5**	0	1
10.031	**TMC**	**TIERED MARKUP COLLECTION**	D	N	1	3	integer see **Table 66**	0	1
10.032	**3DF**	**3D FACIAL FEATURE POINTS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	88
	FPT	feature point type	M⇑	N	1	1	FPT = 1 or 2	1	1
	FPC	feature point code	M⇑	ANS	3	5	Format: N.N, N.NN, NN.N, NN.NN, a, aa, aaa or aaaa; values from **Figure 13**, **Table 64** and **Table 65**	1	1
	HCX	x coordinate	M⇑	N	1	5	1 ≤ HCX ≤ HLL positive integer	1	1
	HCY	y coordinate	M⇑	N	1	5	1 ≤ HCY ≤ VLL positive integer	1	1
	HCZ	z coordinate	M⇑	N	1	5	1 ≤ HCZ ≤ 65535 positive integer	1	1
10.033	**FEC**	**FEATURE CONTOURS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	12
	FCC	feature contour code	M⇑	A	4	14	value from **Table 18**	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point - for a total of NOP pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
10.034-10.037		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.038	**COM**	**COMMENT**	O	U	1	126	none	0	1
10.039	**T10**	**TYPE-10 REFERENCE NUMBER**	D	N	1	3	1 ≤ T10 ≤ 255 positive integer	0	1
10.040	**SMT**	**NCIC SMT CODE**	D					0	1
		Subfields: Repeating values	M⇑	A	3	10	values from **Annex D: NCIC code table**	1	3
10.041	**SMS**	**SMT SIZE**	D					0	1
	HGT	height	M⇑	N	1	3	integer	1	1
	WID	width	M⇑	N	1	3	integer	1	1
10.042	**SMD**	**SMT DESCRIPTORS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	SMI	SMT code indicator	M⇑	A	3	8	value from "Image sub-codes" column of **Table 58**	1	1
	TAC	tattoo class	D	A	4	8	value from **Table 67**	0	1
	TSC	tattoo subclass	D	A	3	9	value from **Table 67**	0	1
	TDS	tattoo description	D	U	1	256	none	0	1
10.043	**COL**	**TATTOO COLOR**	D					0	1
	Subfields: repeating values in the same order as those of SMD							1	9
	TC1	tattoo color code 1	M⇑	A	3	7	values from **Table 68**	1	1
	TC2	tattoo color code 2	O⇑	A	3	7	values from **Table 68**	0	1
	TC3	tattoo color code 3	O⇑	A	3	7	values from **Table 68**	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	TC4	tattoo color code 4	O⇑	A	3	7	values from **Table 68**	0	1
	TC5	tattoo color code 5	O⇑	A	3	7	values from **Table 68**	0	1
	TC6	tattoo color code 6	O⇑	A	3	7	values from **Table 68**	0	1
10.044	**ITX**	**IMAGE TRANSFORM**	O					0	1
		Subfields: Repeating values	M⇑	A	3	11	values from **Table 69**	1	18
10.045	**OCC**	**OCCLUSIONS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	16
	OCY	occlusion opacity	M⇑	A	1	1	OCY = T, I, L or S see **Table 20**	1	1
	OCT	occlusion type	M⇑	A	1	1	OCT = H, S, C, R, or O **Table 21**	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point - for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
10.046-10.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.200-10.900	**UDF**	**user-defined FIELDS**	O	user-defined			user-defined	user-defined	
10.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
10.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
10.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
10.905-10.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
10.994		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
10.996	**HAS**	**HASH**	O	H	64	64	none	0	1
10.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	SRN	source representation number	M⇑	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
10.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
10.999	**DATA**	**BODY PART IMAGE**	M	B	1	*	none	1	1

8.10.1 Field 10.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.10.2 Field 10.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-10 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.10.3 Field 10.003: Image type / IMT

This mandatory field shall be used to indicate the type of image contained in this record. It shall contain a character string from the "Image Code" column of **Table 58** to indicate the appropriate image type. See **Field 10.042: SMT descriptors / SMD** for the use of the sub-codes. The 2007 and 2008 versions of this standard were restricted to FACE, SCAR, MARK and TATTOO. The sub-codes for SCAR did not exist in those versions. Cross-referencing to the NCIC codes (See **Annex D: NCIC code table**) is new for this version of the standard.

Table 58 Type-10 image types

Image code	Image sub-codes
SCAR	SCAR[49]
	PIERCING[50]
TATTOO	TATTOO
	CHEMICAL
	BRANDED
	CUT
FACE	Not applicable
FRONTAL-C[54]	
REAR-C[54]	

Image code	Image sub-codes
FRONTAL-N[54]	Not applicable
REAR-N[54]	
TORSO-BACK	
TORSO-FRONT	
CONDITION[51]	
MISSING[52]	
OTHER[53]	
CHEST	
FEET	

Image code	Image sub-codes
HANDS-PALM	Not applicable
HANDS-BACK	
GENITALS	
BUTTOCKS	
RIGHT LEG	
LEFT LEG	
RIGHT ARM	
LEFT ARM	
MARK[55]	MARK

8.10.4 Field 10.004: Source agency/ SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 10.993: Source agency name / SAN**.

8.10.5 Field 10.005: Photo capture date / PHD

This mandatory field shall contain the date that the image contained in the record was captured. See **Section 7.7.2.3** for details.

8.10.6 Field 10.006: Horizontal line length / HLL

This field is mandatory. See **Section 7.7.8.1** for details.

8.10.7 Field 10.007: Vertical line length / VLL

This field is mandatory. See **Section 7.7.8.2** for details.

[49] NCIC code SC
[50] NCIC code PRCD
[51] NCIC codes BLIND, CATA, CAUL, CLEFT, CRIP, CROSSEYED, DIMP, DISC, EXTR, FRECKLES, FRC, HUMPBACKED, MC, MOLE, POCKMARKS, PROT, SHRT
[52] NCIC code category MISS (Showing the location on the body where the part would normally be)
[53] NCIC code ART, BRAC, COLOST, DENT, GOLD, HAIR, HEAR, IMPL, INTRA, SHUNT, SKL, SLVR, STAPLES, SUTUR, TUBE, VASC PROT, TRANSSXL, TUBE, VASC, WIRE, ORTH
[54] FRONTAL-C refers to frontal and clothed; FRONTAL-N refers to frontal and nude; REAR-C is rear view and clothed; REAR-N is rear view and nude
[55] MARK is needle marks, NCIC code NM

8.10.8 Field 10.008: Scale units / SLC

This field is mandatory. See **Section 7.7.8.3** for details.

8.10.9 Field 10.009: Transmitted horizontal pixel scale / THPS

This field is mandatory. See **Section 7.7.8.4** for details.

8.10.10 Field 10.010 Transmitted vertical pixel scale / TVPS

This field is mandatory. See **Section 7.7.8.5** for details.

8.10.11 Field 10.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted color or grayscale images. See **Table 15** for a list of the codes, and **Sections 7.7.9.3** and **7.7.9.4** for a detailed description of this field. Annex E: **E.6.1 Compression algorithm** lists conditions for facial images by **SAP** level.

8.10.12 Field 10.012: Color space / CSP

This is a mandatory field. See **Section 7.7.10** for details.

8.10.13 Field 10.013: Subject acquisition profile / SAP

The Subject Acquisition Profile (**SAP**) is a mandatory field when **Field 10.003: Image type / IMT** contains "FACE". Otherwise, it shall not be entered. See **Section 7.7.5.1.**

8.10.14 Field 10.014: Face image bounding box coordinates in full image / FIP

This field[56] is only appropriate for face images (**IMT** = 'FACE') that do not comply with **SAP** Levels 30, 32, 40, 42, 50, 51 or 52, because those images shall be cropped to a "head only" or "head and shoulders" composition. This field is an alternative approach to the bounding box described in **Field 10.015: Face image path coordinates in full image / FPFI**.

If the image contains more than one face, the bounding box indicates the face of interest; otherwise, this box can be used for cropping the single facial image. All associated Type-10 fields are limited to the face defined by the bounding box in the larger image. This field has four (4) mandatory and one (1) optional information item.

- The first information item (**left horizontal coordinate value / LHC)** is the left horizontal offset of the bounding box relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts across.

[56] New for this version of the standard.

- The second information item **(right horizontal coordinate value / RHC)** is the right horizontal offset of the bounding box is relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts across.

- The third information item **(top vertical coordinate value / TVC)** is the top vertical offset of the bounding box relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts down.

- The fourth information item **(bottom vertical coordinate value / BVC)** is the bottom vertical offset of the bounding box relative to the origin positioned in the upper left corner of the image. It is expressed in pixel counts down.

- The fifth information item **(bounding box head position code / BBC)** is the bounding box type, indicating the contents of the bounding box. If this field is omitted, the default value shall be H (Head only). If entered, the value shall be from the "Code' column of **Table 59.**

8.10.15 Field 10.015: Face image path coordinates in full image / FPFI

If the face image (**IMT** = 'FACE') contains more than one face, or is not cropped to a "head only" or "head and shoulders" composition, this optional field may contain offsets to the location of the path defining a region containing the face of the subject within a larger image. This field[57] is only appropriate for images that do not comply with **SAP** Levels 30, 32, 40, 42, 50, 51, or 52 because those images shall be cropped to a "head only" or "head and shoulders" composition. See **Section 7.7.12** for a description of encoding paths. This field is an alternative approach to the bounding box described in **Field 10.014: Face image bounding box coordinates in full image / FIP.**

8.10.16 Field 10.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.10.17 Field 10.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

[57] New for this version of the standard.

Table 59 Face position values

Code	Description
S	Head and shoulders: the image within the bounding box is conformant with a “head and shoulders” composition (full frontal)
H	Head only: the image within the bounding box is conformant with a “head only” composition
F	Face only: the image within the bounding box contains a subject's two eyes, nose and mouth
N	Non-frontal head: the image within the bounding box contains the subject's entire head, but it is not frontal-facing or is otherwise not conformant with a “head only” composition
X	Partial face: the composition consists of a partial face, containing less than two eyes, nose and mouth

8.10.18 Field 10.018: Distortion / DIST

This optional field (which can be used only if **IMT** is 'FACE') contains the type of distortion, whether it is estimated or calculated, and its relative severity. This field consists of three information items, all of which are subjective in nature:

- The first information item is the **distortion code / IDK**. Allowed values are:
  “Barrel” (Image appears to be spherized), or
  “Inflated” (also known as wide angle or fisheye distortion) or
  “Pincushion” (image 'pinched' at the center or 'bowed inwards').

- The second information item is an alphabetic code, which is a **distortion measurement code / IDM**, that indicates if the distortion is estimated “E” or calculated “C”.

- The third information item is the **distortion severity code / DSC**. The allowed values are: “Mild”, “Moderate” or “Severe”.

8.10.19 Field 10.019: Lighting artifacts / LAF

This optional field (contains the type of lighting artifacts found in the Type-10 image record. It is only applicable to face images (**IMT** = 'FACE'). Multiple lighting artifacts may be repeated as separate subfields. The codes are:

F: Face shadows
H: Hot spots
R: Reflections from eye glasses

8.10.20 Field 10.020: Subject pose / POS

This optional field is to be used for the exchange of facial image data (**IMT** = 'FACE'). When included, this field shall contain one character code selected from **Table 60** to describe the pose of the subject. For the determined 3D pose entry "D", **Field 10.025: Subject pose angles / SPA** shall contain a set of determined 3D pose angles (i.e., Yaw, Pitch, and Roll angles) away from the full frontal face orientation. Note that the offset angle in **Field 10.021: Pose offset angle / POA** is opposite from the yaw angle in **Field 10.025** as indicated by a minus sign. See **E.7.2 Subject Pose (POS) and subject pose angles (SPA)** for more information about pose angles.

Table 60 Subject pose

Pose description	Pose code
Full Face Frontal	F
Right Profile (90 degree)	R
Left Profile (-90 degree)	L

Pose description	Pose code
Angled Pose	A
Determined 3D Pose	D

8.10.21 Field 10.021: Pose offset angle / POA

This shall only be used for the exchange of facial image data (**IMT** = 'FACE'). It may be used if **Field 10.020: Subject pose / POS** contains an "A" to indicate an angled pose of the subject. The field shall not be used if the entry in **POS** is an "F", "R", "L" or "D".

This field shall be omitted for a full face or a profile. This field specifies the pose direction of the subject at any possible orientation within a circle. Its value shall be to the nearest degree. The offset angle shall be measured from the full-face pose position and have a range of values from -180 degrees to +180 degrees. A positive angle is used to express the angular offset as the subject rotates from a full-face pose to their left (approaching a right profile). The allowed special character is the negative sign.

8.10.22 Field 10.023: Photo acquisition source / PAS

This optional field shall specify the classification of the source of the image contained in this record. This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater for face image records. (IMT=FACE only). When included, the first information item in this field shall contain an attribute code selected from **Table 61** to describe the source of captured image data.

When "VENDOR" is specified in **photo attribute code / PAC**, a second free-format information item (**vendor-specific description / VSD)** may be entered with up to 64 characters to describe the vendor-specific source of the captured image or to enter unlisted or miscellaneous source attributes for the facial image.

A Record Type-20 may be used to store the original reference data. For this case, **Field 10.997: Source representation / SOR** shall be contained in this record, and the corresponding Record Type-20 shall be included in the transaction.

Table 61 Acquisition source type codes

Acquisition source type attribute	Attribute code
Unspecified or unknown	UNSPECIFIED
Static photograph from an unknown source	UNKNOWN PHOTO
Static photograph from a digital still-image camera	DIGITAL CAMERA
Static photograph from a scanner	SCANNER
Single video frame from an unknown source	UNKNOWN VIDEO
Single video frame from an analog video camera	ANALOG VIDEO
Single video frame from a digital video camera	DIGITAL VIDEO
Vendor specific source	VENDOR
Record Type-20 original source representation	TYPE20
Another source image	OTHER

Note that the first seven attribute codes in the table above directly correspond to attribute codes 0 through 6 in **Table 88 Acquisition source**, which is used in **Field 20.014: Acquisition source / AQS**. "OTHER" corresponds to attribute code 31 in that table, as well as attribute code 11 (computer screen image capture). "VENDOR" corresponds to code 30. The remaining attribute codes in **Table 88** relate to audio and video capture.

8.10.23 Field 10.024: Subject quality score / SQS

This optional field shall specify quality score data for facial images (**IMT** = 'FACE') stored in this record. There may be subfields for different quality scores and algorithms. See **Section** 7.7.7.

8.10.24 Field 10.025: Subject pose angles / SPA

This field shall be present when **Field 10.020: Subject pose / POS** contains a "D" to indicate a set of determined 3D pose angles of the same subject for a facial image (**IMT** = 'FACE'). If the entry in **POS** is an "F", "L", or "R" this field shall not be used. Each angle value shall be to the nearest integer degree. When present, this information shall be entered as three or six information items. If this field is used, the first three are mandatory. See **E.7.2 Subject Pose (POS) and subject pose angles (SPA)** for more information about pose angles.

- The first information item is the **yaw angle / YAW** (Rotation about the vertical ‘y’ axis). The allowed special character is the negative sign.
- The second information item is the **pitch angle / PIT** (Rotation about the horizontal ‘x’ axis). The allowed special character is the negative sign.
- The third information item is the **roll angle / ROL** (rotation about the ‘z’ axis). The allowed special character is the negative sign.
- The fourth information item is the **uncertainty in degrees for yaw / YAWU**.
- The fifth information item is the **uncertainty in degrees for pitch / PITU**.
- The sixth information item is the **uncertainty in degrees for roll / ROLU**.

8.10.25 Field 10.026: Subject facial description / SXS

This field is mandatory if the **SAP** entry for a facial image (**Field 10.013: Subject acquisition profile / SAP**) is 40, 50 or 51. (**IMT**=FACE only). In other cases, this field is optional for facial images. When present, it shall describe attributes associated with the subject’s captured facial image. This version maintains the upper limit of 50 repeating subfields for all encodings from the 2007 version. (The 2008 version was unrestricted). The value should be selected from the “Attribute code” column of **Table 62**. For “Physical Characteristic”, enter a characteristic as listed in the NCIC code. See **Annex D: NCIC code table.** In the 2007 version, the minimum character count for this was listed as 5; however, there was an entry of “HAT” which has 3 characters. Thus, the minimum character count in this version is set at 3.

Table 62 Subject facial description codes

Facial description attribute	Attribute code
Expression unspecified	UNKNOWN
Neutral (non-smiling) with both eyes open and mouth closed	NEUTRAL
Smiling (inside of the mouth and/or teeth is not exposed - closed jaw).	SMILE
Subject having mouth open	MOUTH OPEN
Having teeth visible	TEETH VISIBLE
Raising eyebrows	RAISED BROWS
Frowning	FROWNING
Looking away from the camera	EYES AWAY
Squinting	SQUINTING
Subject wearing left eye patch	LEFT EYE PATCH

Facial description attribute	Attribute code
Subject wearing right eye patch	RIGHT EYE PATCH
Subject wearing clear glasses	CLEAR GLASSES
Subject wearing dark or visible colored glasses (medical)	DARK GLASSES
Head covering/hat	HAT
Wearing scarf	SCARF
Having mustache	MOUSTACHE
Having beard	BEARD
Ear(s) obscured by hair	NO EAR
Blinking (either or both eyes closed)	BLINK
Having distorting medical condition impacting feature point detection	DISTORTING CONDITION
Physical characteristics	From **Annex D**
Other characteristics	Alphabetic Text, up to 20 characters

8.10.26 Field 10.027: Subject eye color / SEC

This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater. For other facial images (**IMT** = 'FACE'), the field is optional. When present, it shall describe the eye color of the subject as seen in the photograph. If unknown, unusual or unnatural such as may be the case when colored contact lenses are present and the "real" eye color cannot be ascertained, then the color should be labeled as "XXX". Eye color attributes and attribute codes are given by **Table 17**. See **Section 7.7.11** for further information.

8.10.27 Field 10.028: Subject hair color / SHC

This field is mandatory if the SAP entry (**Field 10.013: Subject acquisition profile / SAP**) is "40" or greater. For other facial images (**IMT** = 'FACE'), it is optional. When present, it shall contain one or two entries from **Table 63** that describes the hair color of the subject as seen in the photograph. For unusual or unnatural colors not listed in the table, or the "real" color cannot be ascertained, the hair color should be labeled as "XXX". If the subject is completely bald, or has a completely shaved head, then the hair color shall be labeled as "BAL". When the subject is predominantly bald, but hair color is discernible, then the appropriate hair color attribute code shall follow "BAL" in a second entry. If a person has multiple hair colors (such as blue in the middle and orange on the sides), select one color for the first entry and the other for the second. For streaked hair, use "STR" in the first entry; use the second entry to describe the principal color of the hair. There need not be more than one entry.

Table 63 Hair color codes

Hair color attribute	Attribute code
Unspecified or unknown	XXX
Bald	BAL
Black	BLK
Blonde or Strawberry	BLN
Brown	BRO
Gray or Partially Gray	GRY
Red or Auburn	RED
Sandy	SDY

Hair color attribute	Attribute code
White	WHI
Blue	BLU
Green	GRN
Orange	ONG
Pink	PNK
Purple	PLE
Streaked	STR

8.10.28 Field 10.029: 2D facial feature points / FFP

The optional field shall be used for the exchange of facial image data (**IMT** = 'FACE') feature points or landmarks. When present, it shall describe special attributes of manually or automatically detected facial feature points of the captured facial image. This information shall be entered as a four-information item feature point block in a repeating subfield. Multiple facial points may be listed using these information items, each in a separate subfield. In the 2007 version of the standard, the maximum number of subfields was restricted to 88. In the 2008 version, there was no restriction on the upper limit. This version maintains the 2007 upper limit of 88 for all encodings. This field does not contain a Z coordinate, unlike **Field 10.032: 3D facial feature points/ 3DF**.

- The first information item, **feature point type / FPT** is a one character value. It is mandatory. The allowed special character is a period. It shall be either

  1 = Denoting an MPEG4 Feature point.
  2 = Anthropometric landmark. (This is new to this version).

- The second information item, **feature point code / FPC** is 3 to 5 characters. If FPT is 1, this information item shall be "A.B" with A and B defined in **Section 8.10.28.1** and illustrated in **Figure 14.** If FPT is 2, the codes are entered as shown in the "Feature Point ID" column of **Table 65.** This is one to four alphabetic characters.

- The third information item is the **x coordinate / HCX.** It is 1 to 5 characters, denoting the pixel count horizontally to the right from the upper left pixel, which is set to 0.

- The fourth information item is the **y coordinate / HCY.** It is 1 to 5 characters, denoting the pixel count vertically down from the upper left pixel, which is set to 0.

8.10.28.1 MPEG4 feature points

The **feature point code / FPC** item shall specify the feature point that is stored in the feature point block. FPT = 1 in either **Field 10.029: 2D facial feature points / FFP** or **Field 10.032: 3D facial feature points/ 3DF** denotes the codes for the feature points are taken from the MPEG4 standard and defined as MPEG4 feature points. Each feature point code is represented by a notation A.B using a major (A) and a minor (B) value. The encoding of the feature point code is given by the numeric ASCII representation of the value of A.B. The period is required, and the maximum size of this entry shall be 5 characters.

For the entire face, **Figure 14** denotes the feature point codes associated with feature points as given by Annex C of *ISO/IEC 14496-2*. For the eyes and nose, additional detail is shown in **Figure 13**. Each code is given by major value A and minor value B. For example, the code for the left corner of the left eye is given by major value 3 and minor value 7. “A” specifies the global landmark of the face to which this feature point belongs, such as nose, mouth, etc. “B” specifies the particular point. In case a Landmark Point has two symmetrical entities (left and right) the right entity always has a greater and an even minor code value. Landmark points from the left part of the face have odd minor codes, and those from the right part have even minor codes. Both A and B are in the range from 1 to 15.

8.10.28.2 Eye and nostril center feature points

The eye center feature points 12.1 (left) and 12.2 (right) are defined to be the horizontal and vertical midpoints of the eye corners (3.7, 3.11) and (3.8, 3.12) respectively. The left nostril center feature point 12.3 is defined to be the midpoint of the nose feature points (9.1, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction. Similarly, the right nostril center feature point 12.4 is defined to be the midpoint of the nose feature points (9.2, 9.15) in the horizontal direction and (9.3, 9.15) in the vertical direction. Both the eye center and nostril center Feature points are shown in **Figure 13** and values are given in **Table 64**.

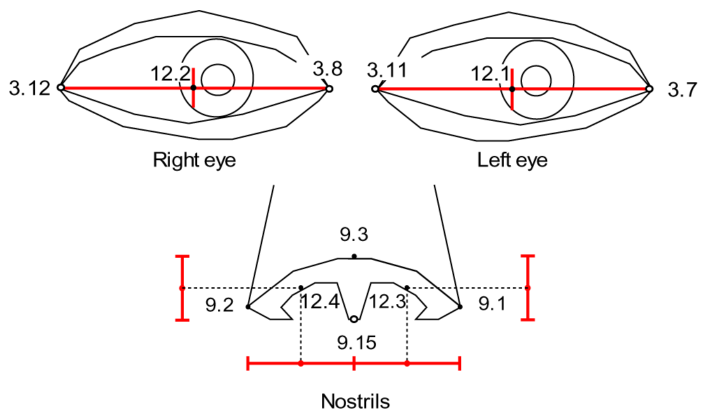

Figure 13: Eye and nostril center feature points

Table 64 Eye and nostril center feature point codes

Center Feature Point	Midpoint of Feature Points		Feature Point code
Left Eye	3.7, 3.11		12.1
Right Eye	3.8, 3.12		12.2
Left Nostril	Horizontal	Vertical	12.3
	9.1, 9.15	9.3,9.15	
Right Nostril	Horizontal	Vertical	12.4
	9.2, 9.15	9.3,9.15	

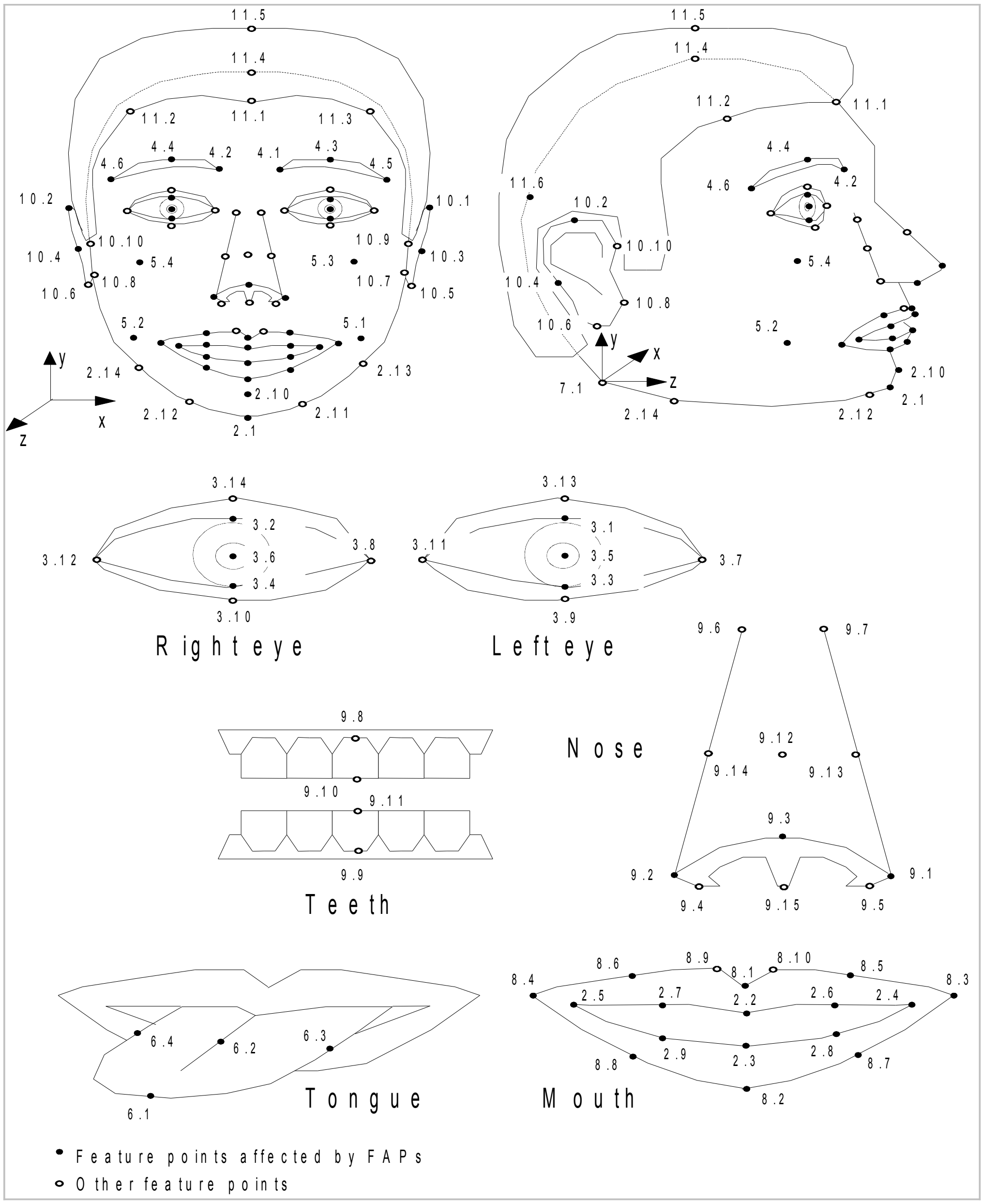

Figure 14: Feature point codes defined in ISO/IEC 14496-2

8.10.28.3 Anthropometric landmarks with and without MPEG4 counterparts

This Section[58] references the definitions specified by ISO[59]. Anthropometric landmarks extend the MPEG4 feature model with points that are used in forensics and anthropology for person identification via two facial images or image and skull. They also allow specification of points that are in use by criminal experts and anthropologists. **Figure 15**[60] and **Table 65** show the definition of the anthropometric landmarks. The set of points represents the craniofacial landmark points of the head and face. The latter are used in forensics for "Face to face" and "Skull to face" identification. In **Field 10.029: 2D facial feature points / FFP** and **Field 10.032: 3D facial feature points/ 3DF,** the **FPT** information item is coded with a value of "2". Some of these points have MPEG 4 counterparts, others not. The error of an anthropometric 3D landmark point location should be no greater than 3mm. The point on the surface is a vertex, or a point on an edge, or a point on a face of the surface.

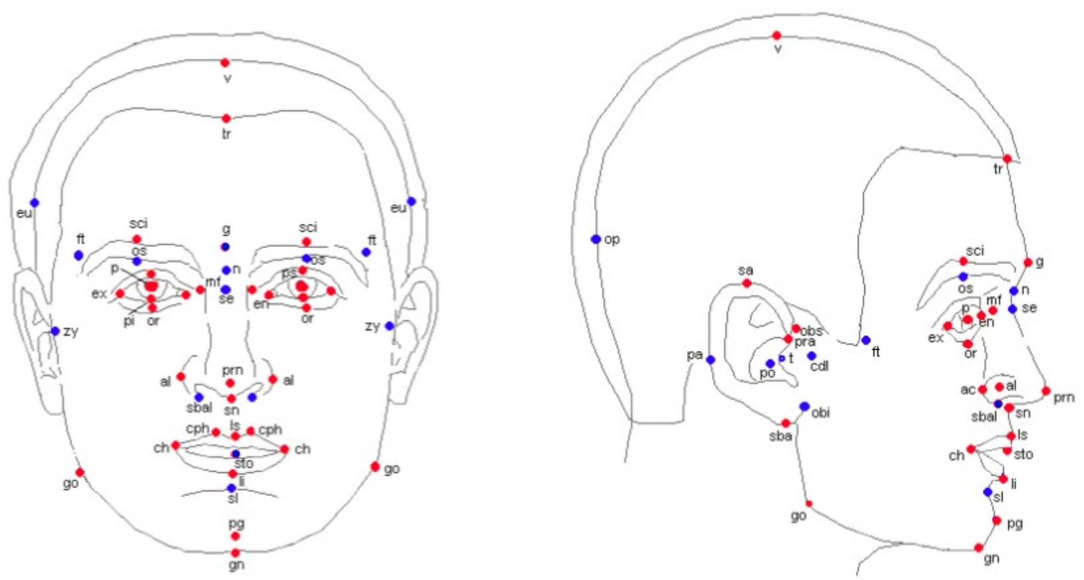

Figure 15: Anthropometric facial landmarks defined in ISO/IEC 19794-5

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[58] New for this version of the standard.

[59] See ISO/IEC 19794-5 *Information technology – Biometric data interchange formats – Part 5: Face image data*, Section 5.5.6 Anthropometric Landmarks.

[60] Red landmarks denote with MPEG4 counterparts and blue without MPEG4 counterparts.

Table 65 ISO definitions of the anthropometric landmarks

Feature Point ID	MPEG4 Feature Point	Anthropometric Point Name	Description
v	11.4	vertex	The highest point of head when the head is oriented in Frankfurt Horizon.
g		glabella	The most prominent middle point between the eyebrows
op		opisthocranion	Situated in the occipital region of the head is most distant from the glabella
eu		eurion	The most prominent lateral point on each side of the skull in the area of the parietal and temporal bones
ft		frontotemporale	The point on each side of the forehead, laterally from the elevation of the linea temporalis
tr	11.1	trichion	The point on the hairline in the midline of the forehead
zy		zygion	The most lateral point of each of the zygomatic bones
go	2.15 2.16	gonion	The most lateral point on the mandibural angle close to the bony gonion
sl		sublabiale	Determines the lower border of the lower lip or the upper border of the chin
pg	2.10	pogonion	The most anterior midpoint of the chin, located on the skin surface in the front of the identical bony landmark of the mandible
gn	2.1	menton (or gnathion)	The lowest median landmark on the lower border of the mandible
cdl		condylion laterale	The most lateral point on the surface of the condyle of the mandible
en	3.11 3.8	endocanthion	The point at the inner commissure of the eye fissure
ex	3.7 3.12	exocanthion (or ectocanthion)	The point at the outer commissure of the eye fissure
p	3.5 3.6	center point of pupil	Is determined when the head is in the rest position and the eye is looking straight forward
or	3.9 3.10	orbitale	The lowest point on the lower margin of each orbit
ps	3.1 3.2	palpebrale superius	The highest point in the mid-portion of the free margin of each upper eyelid

Feature Point ID	MPEG4 Feature Point	Anthropometric Point Name	Description
pi	3.3 3.4	palpebrale inferius	The lowest point in the mid-portion of the free margin of each lower eyelid
os		orbitale superius	The highest point on the lower border of the eyebrow
sci	4.3 4.4	superciliare	The highest point on the upper border in the mid-portion of each eyebrow
n		nasion	The point in the middle of both the nasal root and nasofrontal suture
se		sellion (or subnasion)	Is the deepest landmark located on the bottom of the nasofrontal angle (equivalent to the term "bridge of the nose")
al	9.1 9.2	alare	The most lateral point on each alar contour
prn	9.3	pronasale	The most protruded point of the apex nasi
sn	9.15	subnasale	The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet
sbal		subalare	The point at the lower limit of each alar base, where the alar base disappears into the skin of the upper lip
ac	9.1 9.2	alar curvature (or alar crest) point	The most lateral point in the curved base line of each ala
mf	9.6 9.7	maxillofrontale	The base of the nasal root medially from each endocanthi
cph	8.9 8.10	christa philtri landmark	The point on each elevated margin of the philtrum just above the vermilion line
ls	8.1	labiale (or labrale) superius	The midpoint of the upper vermillion line
li	8.2	labiale (or labrale) inferius	The midpoint of the lower vermillion line
ch	8.3 8.4	chelion	The point located at each labial commissure
sto		stomion	The imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips, with teeth shut in the natural position
sa	10.1 10.2	superaurale	The highest point of the free margin of the auricle
sba	10.5 10.6	subaurale	The lowest point of the free margin of the ear lobe

Feature Point ID	MPEG4 Feature Point	Anthropometric Point Name	Description
pra	10.9 10.10	preaurale	The most anterior point on the ear, located just in front of the helix attachment to the head
pa		postaurale	The most posterior point on the free margin of the ear
obs	10.3 10.4	otobasion superius	The point of attachment of the helix in the temporal region
obi		obotasion inferius	The point of attachment of the helix in the temporal region
po		porion (soft)	The highest point of the upper margin of the cutaneous auditory meatus
t		tragion	The notch on the upper margin of the tragus

8.10.29 Field 10.030: Device monitoring mode / DMM

This field is optional. See **Section 7.7.1.3.**

8.10.30 Field 10.031: Tiered markup collection / TMC

This optional field[61] describes the specific facial (**IMT** = 'FACE') feature points contained in **Field 10.029: 2D facial feature points / FFP** and if the value of **TMC** is 5, contours shall be contained in **Field 10.033: Feature contours / FEC**. It is selected from the "Value" column of **Table 66.**

[61] New for this version of the standard.

Table 66 Tiered markup collections (frontal)

Value	Facial feature points/Contours	Description
1	Eye centers	2D Feature Points: Centers of eyes: 12.1 and 12.2
2	Eyes, mouth	2D Feature Points: Centers of eyes: 12.1 and 12.2 Center of mouth: sto
3	Eyes, nose, mouth	2D Feature Points for: Corners of eyes: 3.7, 3.11, 3.8, 3.12 Bridge and tip of nose: Se, 9.3 Corners of mouth: 8.3, 8.4
4	Eyes, nose, mouth, and head	2D Feature Points for: Corners of eyes: 3.7, 3.11, 3.8, 3.12 Pupils: 3.5, 3.6 Edges of nostrils: 9.4, 9.5 Corners of mouth: 8.3, 8.4 Tops and bottoms of ears: 10.1, 10.5, 10.2, 10.6 Chin: 2.1 Top of head and/or hair: 11.4, 11.5
5	Facial feature points and contours for eyes, brows, nose, mouth and face outline	Top of upper lip contour Bottom of lower lip contour Left and right eyebrow contours Left and right eye contours Chin contour 2D Feature Points for: Left and right eyes: 3.7, 3.11, 12.1, 3.8, 3.12, 12.2 Nose: 9.1, 9.2, 9.3, 9.15 Mouth corners: 8.3, 8.4 Ear tops and bottoms: 10.1, 10.5, 10.2, 10.6
6-99	Reserved	Reserved for future use
100-999	User-defined	user-defined

8.10.31 Field 10.032: 3D facial feature points/ 3DF

The optional field shall describe special attributes of manually or automatically detected facial feature points of the captured facial image (**IMT** = 'FACE'). It shall be entered as a five-information item feature point block in a subfield. Multiple facial points may be listed using these information items, each in a separate subfield. The maximum number of feature points is 88. This field contains a Z coordinate, unlike **Section 8.10.28**, which is solely a 2D set of feature points.

- The first information item, **feature point type / FPT** is a one character value. It is mandatory. It shall be either:

  1 = Denoting an MPEG4 Feature point, but using a Z coordinate.
  2 = Anthropometric landmark, with a Z coordinate.

- The second information item, **feature point code / FPC** is 3 to 5 characters. If FPT is 1, this information item shall be "A.B" with A and B defined in **Section 8.10.28.1.** and illustrated in **Figure 14.** The allowed special character is a period. If FPT is 2, the codes are entered as shown in the "Feature Point ID" column of **Table 65.** Note that this entry is one to four alphabetic characters.

- The third information item is the **x coordinate / HCX.** It is 1 to 5 characters, denoting the pixel count from the upper left pixel, which is set to 0.

- The fourth information item is the **y coordinate / HCY.** It is 1 to 5 characters, denoting the pixel count from the upper left pixel, that is set to 0.

- The fifth information item is the **z coordinate / HCZ.** It is 1 to 5 characters, denoting the pixel count from the X-Y plane, which is set to 0.

8.10.32 Field 10.033: Feature contours / FEC

Each subfield (See **Section 7.7.12.2**) refers to a specific contour on the face (**IMT** = 'FACE') and contains a minimum of three points.

8.10.33 Field 10.038: Comment / COM

This is an optional field. See **Section 7.4.4.**

8.10.34 Field 10.039: Type-10 reference number / T10

This is an optional field. It is used when several images cover either the entire scar, (needle) mark, tattoo (SMT) or portions of it. The same **T10** is used when referring to a particular image. This field shall only be present if multiple Type-10 records in the transaction contain the same SMT or body part. It can be used for any image type specified in **Field**

10.003: Image type / IMT . **T10** is a positive integer. The only requirement is that a value for **T10** only links related images. An example would be to assign a value of 1 to two different Type-10 records, the first of which has an image of a tattoo over the entire chest of a male. A second image of a small portion of the tattoo on the chest showing a gang symbol is contained in another Type-10 with the same value of 1 for **T1.** No other Type-10 records (in this example) would have a value of 1 for **T10.**

8.10.35 Field 10.040: NCIC SMT code / SMT

This field shall be used only when **Field 10.003: Image type / IMT** = "SCAR", "MARK", or "TATTOO". It is not used for other images. It is used to identify a general location of the captured scar, mark, tattoo, or other characteristic (including piercings) in an image. The contents of this field shall be from the NCIC code (See **Annex D**). The captured image may encompass an area larger than that specified by a single NCIC body part code for the particular image type. This situation may be accommodated by listing multiple NCIC codes, each in a separate subfield. In this case the primary code is listed first. There need not be more than one subfield.

For the "marks" category, the NCIC manual lists the common locations for needle track marks. For other body part locations not listed under the "marks" category, use the body location codes listed for scars.

8.10.36 Field 10.041: SMT size or size of injury or identifying characteristic / SMS

This optional field shall contain the dimensions of the portion of image contained in this record (it may be the entire scar, mark, tattoo, injury or identifying characteristic). It shall consist of two information items: **height / HGT** and **width / WID**. Each dimension shall be entered to the nearest centimeter. This field shall be used only when **Field 10.003: Image type / IMT** does not equal "FACE".

8.10.37 Field 10.042: SMT descriptors / SMD

This optional field is used to describe the content of the SMT image to an extent greater than documented in **Field 10.040: NCIC SMT code / SMT**. It shall consist of one or more sets of information items. The 2007 version of the standard restricted the number of subfields to 9. It was unrestricted in the 2008 version. This version maintains the upper limit of 9 for all encodings. This field shall be used only when **Field 10.003: Image type / IMT** = "SCAR", "MARK", or "TATTOO".

- The first information item **(SMT code indicator / SMI)** shall identify the type of SMT. It shall contain *"SCAR"* to indicate healed scar tissue that was the result an accident or medical procedure. "*PIERCING*" is a deliberately made hole through body tissue, usually to wear body ornamentation. An entry of *"MARK"* shall be used for the pattern resulting from needle or track marks. For deliberately applied or drawn images, the first information item shall contain *"TATTOO"* to indicate a common tattoo or indelible image resulting from the pricking of the skin with a coloring matter; *"CHEMICAL"* if the image was created by the use of chemicals to burn the image into the skin; *"BRANDED"* if the image was burned into the skin using a branding iron or other form of heat; or *"CUT"* if the image was caused by incision of the skin. The value for this information item is selected from the "Image sub-code" column of **Table 58.**

- The second information item **(tattoo class / TAC)** shall be the general class code of tattoo chosen from the "Class Code" column of **Table 67**. This information item does not apply to scars and marks.

- The third information item **(tattoo subclass / TSC)** shall be the appropriate subclass code selected from **Table 67.** For each general class of tattoo, there are several defined subclasses. This information item does not apply to scars and marks.

- The fourth (optional) information item (**tattoo description / TDS**) shall be a text string that provides additional qualifiers to describe the image or portion of the image. For example, to fully describe a tattoo, there may be a class description of "ANIMAL", with a subclass description of "DOG", and qualified by "golden retriever with an overbite". This information item does not apply to scars and marks.

An **SMT** image consisting of several parts or sub-images shall use subfields to fully describe the various parts or features found in the total image. The first subfield shall describe the most predominant feature or sub-image contained in the **SMT** image. Subsequent repeating subfields shall describe additional portions of the image that are not part of the main or central focal point of the image. For example, a tattoo consisting of a man with a snake on the arm being followed by a dog may contain three subfields: one describing the man, a second describing the snake, and a third describing the dog.

Table 67 Tattoo classes and subclasses

Class Code	Subclass Description	Subclass Code	Class Code	Subclass Description	Subclass Code
HUMAN	Male Face	MFACE	ANIMAL	Cats & Cat Heads	CAT
	Female Face	FFACE		Dogs & Dog Heads	DOG
	Abstract Face	ABFACE		Other Domestic Animals	DOMESTIC
	Male Body	MBODY		Vicious Animals (Lions, etc.)	VICIOUS
	Female Body	FBODY		Horses (Donkeys, Mules, etc.)	HORSE
	Abstract Body	ABBODY		Other Wild Animals	WILD
	Roles (Knight, Witch, man, etc.)	ROLES		Snakes	SNAKE
	Sports Figures (Football Player, Skier, etc.)	SPORT		Dragons	DRAGON
	Male Body Parts	MBPART		Birds (Cardinal, Hawk, etc.)	BIRD

Class Code	Subclass Description	Subclass Code
	Female Body Parts	FBPART
	Abstract Body Parts	ABBPART
	Miscellaneous Human Forms	MHUMAN
	Skulls	SKULL

Class Code	Subclass Description	Subclass Code
	Spiders, Bugs, and Insects	INSECT
	Abstract Animals	ABSTRACT
	Animal Parts	PARTS
	Miscellaneous Animal Forms	MANIMAL

Class Code	Subclass Description	Subclass Code
PLANT	Narcotics	NARCOTICS
	Red Flowers	REDFL
	Blue Flowers	BLUEFL
	Yellow Flowers	YELFL
	Drawings of Flowers	DRAW
	Rose	ROSE
	Tulip	TULIP
	Lily	LILY
	Misc. Plants, Flowers, Vegetables.	MPLANT

Class Code	Subclass Description	Subclass Code
FLAG	American Flag	USA
	State Flag	STATE
	Nazi Flag	NAZI
	Confederate Flag	CONFED
	British Flag	BRIT
	Miscellaneous Flags	MFLAG

Class Code	Subclass Description	Subclass Code
OBJECT	Fire	FIRE
	Weapons (Guns, Arrows, etc.)	WEAP
	Airplanes and other Air vehicles (incl. Blimps)	PLANE
	Boats, Ships, & Other Water Vessels	VESSEL
	Trains	TRAIN
	Cars, Trucks, and other Land Vehicles (except Trains)	VEHICLE
	Mythical (Unicorns, etc.)	MYTH
	Sporting Objects (Football, Ski, Hurdles, etc.)	SPORT
	Water & Nature Scenes (Rivers, Sky, Trees, etc.)	NATURE
	Miscellaneous Objects	MOBJECTS

Class Code	Subclass Description	Subclass Code
ABSTRACT	Figure(s)	FIGURE
	Sleeve	SLEEVE
	Bracelet	BRACE
	Anklet	ANKLET
	Necklace	NECKLC
	Shirt	SHIRT
	Body Band	BODBND
	Head Band	HEDBND
	Miscellaneous Abstract	MABSTRACT

Class Code	Subclass Description	Subclass Code
SYMBOL	National Symbols	NATION
	Political Symbols	POLITIC
	Military Symbols	MILITARY
	Fraternal Symbols	FRATERNAL
	Professional Symbols	PROFESS
	Gang Symbols	GANG
	Miscellaneous Symbols	MSYMBOLS

Class Code	Subclass Description	Subclass Code
OTHER	Wording (Mom, Dad, Mary, etc.)	WORDING
	Freeform Drawings	FREEFRM
	Miscellaneous Images	MISC

8.10.38 Field 10.043: Tattoo color / COL

This field is optional, but it can only used when **Field 10.042: SMT descriptors / SMD** is in the record. It shall contain one subfield corresponding to each subfield contained in **Field 10.042: SMT descriptors / SMD**. Each subfield shall contain up to 6 information items that list the color(s) of the tattoo or part of the tattoo. For each subfield entry, the first one shall be the predominant color chosen from **Table 68**. Additional colors may be entered as optional subsequent information items of the form **tattoo color code *n* / TC*n*** (n=2 through 6). There need not be more than one information item.

Table 68 Tattoo color codes

Color description	Color code
Black	BLACK
Brown	BROWN
Gray	GRAY
Blue	BLUE
Green	GREEN
Orange	ORANGE

Color description	Color code
Purple	PURPLE
Red	RED
Yellow	YELLOW
White	WHITE
Multi-colored	MULTI
Outlined	OUTLINE

8.10.39 Field 10.044: Image transform / ITX

This optional field is used in the case when the image in this Type-10 record has been transformed from the original image. The untransformed image(s) (optionally) may be included in a Type-20 record. The information item in this field may be repeated if multiple transforms were performed. It can be used for any image type specified in **Field 10.003: Image type / IMT** .

Table 69 Image transform values

Value	Description
AGE	Age progressed
AXIS	Off-axis image rectification / Angle correction
COLORSHIFT	Color shifted
CONTRAST	Contrast stretched
CROP	Cropped
DIST	Distortion corrected (e.g. fisheye correction)
DOWNSAMPLE	Down-sampled
GRAY	Grayscale from color
ILLUM	Illumination transform
IMGFUSE	Image-level fusion of two or more images
INTERPOLATE	Up-sampled
MULTCOMP	Multiply compressed
MULTIVIEW	Multi-view image
POSE	Face-specific pose correction
ROTATE	Rotated (in-plane)
SNIR	Simulated Near IR
SUPERRES	Super-resolution image, derived from multiple lower resolution images
WHITE	White balance adjusted

8.10.40 Field 10.045: Occlusions / OCC

This optional field defines the outline and contents of any occlusions that partially or totally blocks the image of the face (**IMT** = 'FACE')**.** This is a polygon. For details on polygons, see **Section** 7.7.12**.** For details on entering data for this Field, see **Section** 7.7.12.2**.** Each point on the polygon is represented by a pair of information items. In addition to the polygon, it contains two other information items:

- The first information item contains the alphabetic code from **Table 20**
- The second information item contains the alphabetic code from **Table 21**.

8.10.41 Field 10.200-900: User-defined fields / UDF

The size and content of these fields shall be defined by the user and be in accordance with the receiving agency.

8.10.42 Field 10.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.10.43 Field 10.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.10.44 Field 10.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.10.45 Field 10.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 10.004: Source agency/ SRC** .

8.10.46 Field 10.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same ACN. See **Section 7.3.3.** Record Type-21 contains images that are NOT used to derive the biometric data in **Field 10.999: Body part image / DATA** but that may be relevant to the collection of that data, such as general scenes of the area where the body of the subject was found.

8.10.47 Field 10.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 10.999: Body part image / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.10.48 Field 10.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same SRN from which the data in **Field 10.999: Body part image / DATA** was derived. See **Section 7.3.2.**

8.10.49 Field 10.998: Geographic sample acquisition location / GEO

This optional field contains the location where the image was acquired – not where it is stored. See **Section 7.7.3**.

8.10.50 Field 10.999: Body part image / DATA

This mandatory field contains the image. See **Section 7.2** for details on the Data field entry.

8.11 Record Type-11: Reserved for voice

A committee was established at the second Workshop for this version of the standard, held March 1-3, 2011 to develop specifications for this record type.

8.12 Record Type-12: Reserved for dental records

A committee was established at the second Workshop for this version of the standard, held March 1-3, 2011 to develop specifications for this record type.

8.13 Record Type-13: Friction-ridge latent image record

The Type-13 record shall contain image data acquired from latent captures of friction ridge images. These images may be used by agencies that will automatically extract or provide human intervention and processing to extract the desired feature information from the images. Information regarding the scanning resolution used, the image size, and other parameters required to process the image, are recorded as fields within the record.

Table 70 Type-13 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
13.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
13.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
13.003	**IMP**	**IMPRESSION TYPE**	M	N	1	2	4 ≤ IMP ≤ 7 or 12 ≤ IMP ≤ 15 or IMP= 28 or 29 or 32 ≤ IMP ≤ 39 integer see **Table 7**	1	1
13.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	None	1	1
13.005	**LCD**	**LATENT CAPTURE DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
13.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	2	5	10 ≤ HLL ≤ 99999 positive integer	1	1
13.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	2	5	10 ≤ VLL ≤ 99999 positive integer	1	1
13.008	**SLC**	**SCALE UNITS**	M	N	1	1	SLC = 0, 1 or 2	1	1
13.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	M	N	1	5	integer	1	1
13.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	M	N	1	5	integer	1	1
13.011	**CGA**	**COMPRESSION ALGORITHM**	M	AN	3	5	value from **Table 15**	1	1
13.012	**BPX**	**BITS PER PIXEL**	M	N	1	2	positive integer	1	1
13.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M					1	1
		Subfields: Repeating values	M⇑	N	1	2	integers from **Table 8**	1	6
13.014	**SPD**	**SEARCH POSITION DESCRIPTORS**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	PDF	probable decimal finger position code	M⇑	N	1	2	integers 0 ≤ PDF ≤ 10, or PDF = 16 or 17 from **Table 8**	1	1
	FIC	finger image code	M⇑	AN	3	3	EJI, TIP, FV1, FV2,FV3, FV4, PRX, DST or MED from Table 9	1	1
13.015	**PPC**	**PRINT POSITION COORDINATES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	12
	FVC	full finger view	M⇑	AN	2	3	FVC = NA, TIP, FV1, FV2, FV3 or FV4 See **Table 9**	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	LOS	location of a segment	M⇑	A	2	3	LOS = NA, PRX, DST or MED See Table 9	1	1
	LHC	left horizontal coordinate	M⇑	N	1	5	0 ≤ LHC ≤ HLL positive integer	1	1
	RHC	right horizontal coordinate	M⇑	N	1	5	LHC ≤ RHC ≤ HLL positive integer	1	1
	TVC	top vertical coordinate	M⇑	N	1	5	0 ≤ TVC ≤ VLL positive integer	1	1
	BVC	bottom vertical coordinate	M⇑	N	1	5	TVC ≤ BVC ≤ VLL positive integer	1	1
13.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
13.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
13.018-13.019		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
13.021-13.023		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.024	**LQM**	**LATENT QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	FRMP	friction ridge metric position	M⇑	N	1	2	integers from Table 8	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor ID	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
13.025-13.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
13.200-13.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
13.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
13.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
13.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
13.905-13.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
13.994		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
13.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	ACN	associated context number	M⇑	N	1	3	$1 \leq ACN \leq 255$ integer	1	1
	ASP	associated segment position	O⇑	N	1	2	$1 \leq ASP \leq 99$ positive integer	0	1
13.996	**HAS**	**HASH**	O	H	64	64	none	0	1
13.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	SRN	source representation number	M⇑	N	1	3	$1 \leq SRN \leq 255$ positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	$1 \leq RSP \leq 99$ positive integer	0	1
13.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	$-90 \leq LTD \leq 90$	0	1
	LTM	latitude minute value	D	NS	1	8	$0 \leq LTM < 60$	0	1
	LTS	latitude second value	D	NS	1	8	$0 < LTS < 60$	0	1
	LGD	longitude degree value	D	NS	1	10	$-180 \leq LGD \leq 180$	0	1
	LGM	longitude minute value	D	NS	1	8	$0 \leq LGM < 60$	0	1
	LGS	longitude second value	D	NS	1	8	$0 < LGS < 60$	0	1
	ELE	elevation	O	NS	1	8	$-422.000 < ELE < 8848.000$ real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
13.999	**DATA**	**LATENT FRICTION RIDGE IMAGE**	M	B	1	*	none	1	1

8.13.1 Field 13.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.13.2 Field 13.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-13 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section** 7.3.1**.**

8.13.3 Field 13.003: Impression type / IMP

This mandatory field shall indicate the manner by which the latent print was obtained. See **Section 7.7.4.1** for details. Valid values are 4 through 7, 12 through 15, 28 or 29, and 32 through 39.

8.13.4 Field 13.004: Source agency/ SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 13.993: Source agency name / SAN**.

8.13.5 Field 13.005: Latent capture date / LCD

This mandatory field shall contain the date that the latent biometric data contained in the record was captured. See **Section 7.7.2.3** for details.

8.13.6 Field 13.006: Horizontal line length / HLL

This field is mandatory. See **Section 7.7.8.1** for details.

8.13.7 Field 13.007: Vertical line length / VLL

This field is mandatory. See **Section 7.7.8.2** for details.

8.13.8 Field 13.008: Scale units / SLC

This field is mandatory. See **Section 7.7.8.3** for details.

8.13.9 Field 13.009: Transmitted horizontal pixel scale / THPS

This field is mandatory. See **Section 7.7.8.4** for details.

8.13.10 Field 13.010: Transmitted vertical pixel scale / TVPS

This field is mandatory. See **Section 7.7.8.5** for details.

8.13.11 Field 13.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 15** for a list of the codes, and **Section 7.7.9.1** for a detailed description of this field.

8.13.12 Field 13.012: Bits per pixel / BPX

This field is mandatory. See **Section 7.7.8.6** for details.

8.13.13 Field 13.013: Friction ridge generalized position / FGP

This field is mandatory. Each subfield shall contain one possible finger, palm or plantar position that may match the latent image, up to a maximum of 6 possibilities. The code "0" shall be used to reference every finger position from 1 to 10, 16 and 17. The code "20" for "Unknown palm" shall be used to reference every listed palmprint position. The code "60" for "Unknown sole" shall be used for every listed plantar position. Code "18" shall be used if it is unknown whether the print is from a hand or foot. Code "19" shall be used for a latent image that includes substantive portion of of the medial or proximal segments of a finger, or the extreme tip of a fingerprint. If code 19 is used, fields **13.014** and **13.015** shall be used. See **Section 7.7.4.2** and **Table 8** for details.

8.13.14 Field 13.014: Search position descriptors / SPD

This field shall be present if and only if the finger position code "19" appears in **Field 13.013: Friction ridge generalized position / FGP**.

- The first information item is the **probable decimal finger position code / PDF** taken from **Table 8**, with integers 0 through 10, 16 or 17 allowed.
- The second information item is **finger image code / FIC.** Latent images of full-length fingers use codes FV1 through FV4, as described in **Section 7.7.4.3**. Other allowable codes are EJI, TIP, PRX, DST and MED. See **Table 9**.

8.13.15 Field 13.015: Print position coordinates / PPC

This field may be present if and only if the finger position code "19" appears in **Field 13.013: Friction ridge generalized position / FGP**. It is an optional field. Individual full finger or segment definitions may be entered as separate subfields. See **Section 7.7.4.4** for details. For the case of a fingertip, the first information item shall be "TIP", and the second information item shall be "NA". The next four information items are as described in **Section 7.7.4.4.**

8.13.16 Field 13.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.13.17 Field 13.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

8.13.18 Field 13.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.13.19 Field 13.024: Latent quality metric / LQM

This optional field is used to specify one or more different metrics of latent image quality score data for the image stored in this record. Each subfield is comprised of four information items. The first information item is the entry in **Field 13.013: Friction ridge generalized position / FGP**, as chosen from **Table 8**. This information item is called the **friction ridge metric position / FRMP** to differentiate it from **FGP.** See **Section 7.7.7** for a description of the remaining three information items.

8.13.20 Fields 13.200 – 13.900 : user-defined fields / UDF

These fields shall be defined by the user. Their size and content shall be in accordance with the receiving agency.

8.13.21 Field 13.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1**

8.13.22 Field 13.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.13.23 Field 13.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.13.24 Field 13.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 13.004: Source agency/ SRC** .

8.13.25 Field 13.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same **ACN**. Record Type-21 contains images that are NOT used to derive the biometric data in **Field 13.999: Latent friction ridge image / DATA** but that may be relevant to the collection of that data, such as general scenes of the area where a latent print was found. See **Section 7.3.3.**

8.13.26 Field 13.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 13.999: Latent friction ridge image / DATA**, calculated using SHA-256. See **Section 7.5.2**.

8.13.27 Field 13.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN** from which the data in **Field 13.999: Latent friction ridge image / DATA** was derived. See **Section 7.3.2**..

8.13.28 Field 13.998: Geographic sample acquisition location / GEO

This optional field contains the location where the latent sample was acquired – not where it is stored. See **Section 7.7.3**.

8.13.29 Field 13.999: Latent friction ridge image / DATA

This mandatory field contains the latent image. See **Section 7.2** for details.

8.14 Record Type-14: Fingerprint image record

The Type-14 record shall contain and be used to exchange exemplar fingerprint image data, such as a rolled tenprint, an identification flat, or a complete friction ridge exemplar. All fingerprint impressions shall be acquired from a card, a single or multiple-finger flat-capture device, contactless fingerprint sensor that outputs 2D fingerprint images, or a live-scan device. Captured images may be transmitted to agencies that will automatically extract the desired feature information from the images for matching purposes. Textual information regarding the scanning resolution, the image size and other parameters or comments required to process the image are recorded as fields within the record.

The Type-14 record is also used to exchange identification flats of multiple fingers (simultaneous plain impressions captured on a platen). Two of the image record codes contain the left and right simultaneous four fingers (may include extra digits, if applicable), and a third contains the two thumbs. There are also codes for two and three finger combinations. Offsets to the locations of image segments containing the individual fingers are included with the image records for individual flat prints resulting from segmentation of a multi-finger slap image.

This standard allows simultaneous capture of fingerprint images from adjacent platens that share a common plane and a common side if the relative position of the fingers is maintained and has fidelity to the subject's finger orientations and relative length. Simultaneous capture of multiple fingers from non-adjacent platens or platens that do not share a single plane is also allowed, but the images should be separately transmitted. **Field 14.026: Simultaneous capture / SCF** has been added as an optional field to this version of the standard to specifically indicate that the images were simultaneously captured.

A new field **Field 14.027: Stitched image flag / SIF** has been added to designate an image that was artificially created by placing together two or more separate images, either captured separately or captured simultaneously on non-adjacent platens. It is strongly encouraged not to stitch together such images. This field shall be used to mark such stitched images that have already been captured and entered into existing databases, prior to transmission using this standard.

Additional fields are defined to contain the NIST Fingerprint Image Quality (NFIQ) metric, alternate image quality metrics, and metrics for predicting the correctness of the segmentation.

Table 71 Type-14 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
14.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
14.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	$0 \le$ IDC ≤ 99 integer	1	1
14.003	**IMP**	**IMPRESSION TYPE**	M	N	1	2	$0 \le$ IMP ≤ 3 IMP = 8 $20 \le$ IMP ≤ 29 integer see **Table 7**	1	1
14.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
14.005	**FCD**	**FINGERPRINT CAPTURE DATE**	D	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
14.006	**HLL**	**HORIZONTAL LINE LENGTH**	D	N	2	5	$10 \le$ HLL ≤ 99999 positive integer	0	1
14.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	$10 \le$ VLL ≤ 99999 positive integer	0	1
14.008	**SLC**	**SCALE UNITS**	D	N	1	1	$0 \le$ SLC ≤ 2 integer	0	1
14.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
14.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
14.011	**CGA**	**COMPRESSION ALGORITHM**	D	AN	3	5	value from **Table 15**	0	1
14.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	positive integer	0	1
14.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M					1	1
		Subfields: Repeating values	M	N	1	2	$0 \le FGP \le 19$ or or FGP = 33 or FGP = 36 or $40 \le FGP \le 50$ integer[62] see **Table 8**	1	1
14.014	**PPD**	**PRINT POSITION DESCRIPTORS**	D					0	1
	DFP	decimal finger position code	M⇑	N	1	2	$1 \le DFP \le 10$ or DFP = 16 or 17 (from **Table 8**)	1	1
	FIC	finger image code	M⇑	AN	3	3	EJI, TIP, FV1, FV2,FV3, FV4, PRX, DST or MED from **Table 9**	1	1
14.015	**PPC**	**PRINT POSITION COORDINATES**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	12
	FVC	full finger view	M⇑	AN	2	3	FVC = NA, FV1, FV2, FV3, FV4 or TIP see **Table 9**	1	1
	LOS	location of a segment	M⇑	A	2	3	LOS = NA, PRX, DST or MED see **Table 9**	1	1
	LHC	left horizontal coordinate	M⇑	N	1	5	$0 \le LHC \le HLL$ positive integer	1	1

[62] Codes 33 and 36 are included for the rolled hypothenar (even though they are palm codes), since it is considered as part of the extended fingerprint set.

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	RHC	right horizontal coordinate	M⇑	N	1	5	LHC < RHC ≤ HLL positive integer	1	1
	TVC	top vertical coordinate	M⇑	N	1	5	0 ≤ TVC ≤ VLL positive integer	1	1
	BVC	bottom vertical coordinate	M⇑	N	1	5	TVC < BVC ≤ VLL positive integer	1	1
14.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
14.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
14.018	**AMP**	**AMPUTATED OR BANDAGED**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRAP	friction ridge amputated or bandaged position	M⇑	N	1	2	1 ≤ FRAP ≤ 10 or FRAP = 16 or 17 see Table 8	1	1
	ABC	amputated or bandaged code	M⇑	A	2	2	ABC = XX or UP	1	1
14.019		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
14.021	**SEG**	**FINGER SEGMENT POSITION**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRSP	friction ridge segment position	M⇑	N	1	2	value from **Table 8**	1	1
	LHC	left horizontal coordinate value	M⇑	N	1	5	0 ≤ LHC ≤ HLL positive integer	1	1
	RHC	right horizontal coordinate value	M⇑	N	1	5	LHC < RHC ≤ HLL positive integer	1	1
	TVC	top vertical coordinate value	M⇑	N	1	5	0 ≤ TVC ≤ VLL positive integer	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	BVC	bottom vertical coordinate value	M⇑	N	1	5	TVC < BVC ≤ VLL positive integer	1	1
14.022	**NQM**	**NIST QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRNP	friction ridge NIST quality position	M⇑	N	1	2	1 ≤ FRNP ≤ 10 or FRNP = 16 or 17 see **Table 8**	1	1
	IQS	NIST image quality score	M⇑	N	1	3	1 ≤ IQS ≤ 5 or IQS = 254 or 255 integer	1	1
14.023	**SQM**	**SEGMENTATION QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRQP	friction ridge segment quality position	M⇑	N	1	2	1 ≤ FRQP ≤ 10 or FRQP = 16 or 17 see **Table 8**	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1 ≤ QAP ≤ 65535 positive integer	1	1
14.024	**FQM**	**FINGERPRINT QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRMP	friction ridge metric position	M⇑	N	1	2	1 ≤ FRMP ≤ 10 or FRMP = 16 or 17 see Table 8	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
14.025	**ASEG**	**ALTERNATE FINGER SEGMENT POSITION(S)**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRAS	friction ridge alternate segment position	M⇑	N	1	2	1 ≤ FRAS ≤ 10 or FRAS = 16 or 17 see Table 8	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point - FOR A TOTAL OF **NOP** PAIRS								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
14.026	**SCF**	**SIMULTANEOUS CAPTURE**	O	N	1	3	1 ≤ SCF ≤ 255 positive integer	0	1
14.027	**SIF**	**STITCHED IMAGE FLAG**	D	A	1	1	SIF = Y	0	1
14.028-14.029		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	value from **Table 5**	0	1
14.031	**FAP**	**SUBJECT ACQUISITION PROFILE – FINGERPRINT**	O	N	2	2	FAP = 10,20,30,40, 45, 50 or 60 integer	0	1
14.032-14.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.200 – 14.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
14.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
14.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
14.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
14.905-14.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
14.994		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**							
14.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
14.996	**HAS**	**HASH**	O	H	64	64	none	0	1
14.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M					1	255

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	SRN	source representation number	M⇑	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
14.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
14.999	**DATA**	**FINGERPRINT IMAGE**	D	B	1	*	none	0	1

8.14.1 Field 14.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.14.2 Field 14.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-14 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section** 7.3.1.

8.14.3 Field 14.003: Impression type / IMP

This mandatory field shall indicate the manner by which the fingerprint image was obtained. See **Section** 7.7.4.1 for details.

8.14.4 Field 14.004: Source agency / SRC

This is a mandatory field. See **Section** 7.6 for details.The source agency name may be entered in **Field 14.993: Source agency name / SAN**.

8.14.5 Field 14.005: Fingerprint capture date / FCD

This mandatory field shall contain the local date that the fingerprint data contained in the record was captured. See **Section** 7.7.2.3 for details.

8.14.6 Field 14.006: Horizontal line length / HLL

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section** 7.7.8.1 for details.

8.14.7 Field 14.007: Vertical line length / VLL

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section** 7.7.8.2 for details.

8.14.8 Field 14.008: Scale units / SLC

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section 7.7.8.3** for details.

8.14.9 Field 14.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section 7.7.8.4** for details.

8.14.10 Field 14.010: Transmitted vertical pixel scale / TVPS

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section 7.7.8.5** for details.

8.14.11 Field 14.011: Compression algorithm / CGA

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 15** for a list of the codes, and **Section 7.7.9.1** for a detailed description of this field.

8.14.12 Field 14.012: Bits per pixel / BPX

This field is mandatory if an image is present in **Field 14.999**. Otherwise it is absent. See **Section 7.7.8.6** for details.

8.14.13 Field 14.013: Friction ridge generalized position / FGP

This field is mandatory. See **Section 7.7.4.2** for details. In the 2007 and 2008 versions of the standard, this field had a repeating subfield that could occur up to 6 times. Since only one image is sent per record, the maximum should have been 1. To maintain backward compatibility, the subfield structure has been retained, but with a maximum occurrence of one.

8.14.14 Field 14.014: Print position descriptors / PPD

This field shall be present if and only if the finger position code "19" appears in **Field 14.013: Friction ridge generalized position / FGP**. See **Section 7.7.4.3** for details.

8.14.15 Field 14.015: Print position coordinates / PPC

This field may be present if and only if the finger position code "19" appears in **Field 14.013: Friction ridge generalized position / FGP**. It is an optional field. See **Section 7.7.4.4** for details.

8.14.16 Field 14.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.14.17 Field 14.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

8.14.18 Field 14.018: Amputated or bandaged / AMP

This optional field shall specify if one or more fingers are amputated or bandaged. This field shall consist of one subfield for each amputated or missing finger. Each subfield shall contain two information items.

- The first item is the **friction ridge amputated or bandaged position / FRAP** between 1 and 10 or 16 or 17 as chosen from **Table 8**. This information item is the **friction ridge amputation position / FRAP,** to differentiate it from **FGP.**
- The second item is the **amputated or bandaged code / ABC,** also known as the AMPCD. **Table 72** is a list of allowable indicators for the AMPCD.

Table 72 Amputation / bandaged fingerprinting codes

Descriptor	AMPCD
Partial print due to amputation	XX
Unable to print (e.g., bandaged)	UP

Multiple amputated or unprintable finger positions may each be entered as a separate repeating subfield. This field is to be used anytime there are fewer than expected printable fingers in a submission (e.g., less than four in a left or right slap or less than two in a two-thumb slap). A partially scarred finger should be printed. XX shall be used only when a partial print exists due to amputation; therefore it contains *some* friction ridge detail. UP shall be used with the complete block where an image was to be transmitted, but there is no image due to amputation or total lack of friction ridge detail (such as with a bandage). An image with a scar should not be marked XX or UP.

8.14.19 Field 14.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.14.20 Field 14.021: Finger segment position / SEG

This optional field shall contain offsets to the locations of image segments containing the individual fingers within the flat images of simultaneous fingers from each hand or the two simultaneous thumbs. This field shall only be present if **FGP** = 13, 14, 15 or 40-50 from **Table 8** as entered in **Field 14.013: Friction ridge generalized position / FGP**. The subfield occurs at least once, and may be repeated if more than one algorithm is used to segment the image. Each subfield contains five information items.

- The first information item is the **friction ridge segment position / FRSP** with values of 1 to 10 or 16 or 17, selected from **Table 8**. This information item is called the **friction ridge segment position / FRSP** to differentiate it from **FGP.**

- The second information item is the **left horizontal coordinate value / LHC**. It is the horizontal offset in pixels to the left edge of the bounding box relative to the origin positioned in the upper left corner of the image.

- The third information item is the **right horizontal coordinate value / RHC**. It is the horizontal offset in pixels to the right edge of the bounding box relative to the origin positioned in the upper left corner of the image.

- The fourth information item is the **top vertical coordinate value / TVC** is the vertical offset (pixel counts down) to the top of the bounding box.

- The fifth information item is the **bottom vertical coordinate value / BVC**. It is the vertical offset from the upper left corner of the image down to the bottom of the bounding box. It is counted in pixels.

8.14.21 Field 14.022: NIST quality metric / NQM

This optional field shall contain the NIST Fingerprint Image Quality (NFIQ) scores for the individual finger(s) derived from the slap impressions or individual rolled fingerprints. It consists of two information items.

- The first item is the **friction ridge NIST quality position / FRNP** between one and ten or 16 or 17, as chosen from **Table 8.** This information item is called the **friction ridge NIST quality position / FRNP** to differentiate it from **FGP.**

- The second item is the **NIST image quality score / IQS** which is a quantitative expression of the predicted AFIS matcher accuracy performance of the fingerprint image. The scores range from “1” for the best quality image, to “5” for the worst quality image. A “254” indicates that no score was ever computed while an entry of “255” shall indicate a failed attempt to calculate the image quality metric.

8.14.22 Field 14.023: Segmentation quality metric / SQM

This optional field provides a measure of estimated correctness regarding the accuracy of the location of the segmented finger within the right or left four finger image (which may include extra digits, if applicable) or the two thumb image. A subfield shall exist for each segmented finger. Each subfield consists of four information items.

The first information item is the **friction ridge segment quality position / FRQP** between one and ten or 16 or 17, as chosen from **Table 8**. This information item is called the **friction ridge segment quality position / FRQP** to differentiate it from **FGP.** See **Section 7.7.7** for the other information items. The **FRQP** values shall be in the list of either the **FRSP** or **FRAS** values contained in this record.

8.14.23 Field 14.024: Fingerprint quality metric / FQM

This optional field shall specify one or more different metrics of fingerprint image quality score data for the image stored in the record. A subfield shall exist for each segmented finger in the image. Each subfield consists of four information items.

The first information item is the **friction ridge metric position / FRMP** between one and ten or 16 or 17, as chosen from **Table 8**. This information item is called the **friction ridge metric position / FRMP** to differentiate it from **FGP.** For information on the other three information items, see **Section 7.7.7.**

8.14.24 Field 14.025: Alternate finger segment position(s) / ASEG

This optional field is an alternate approach to describing the locations for each of the image segments of each of the individual fingers within a flat image containing the capture of four (or more if extra digits exist on the hand) simultaneous fingers or two simultaneous thumbs. This field uses an n-vertex polygon to encompass each finger image segment, where "n" is between 3 and 99. A minimum of three points is required to describe a finger location. The order of the vertices shall be in their consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. No two vertices may occupy the same location. The polygon side defined by the last vertex and the first vertex shall complete the polygon. The polygon shall be a simple, plane figure with no sides crossing and no interior holes.

This field shall consist of up to five subfields: the segmentation for each finger is represented in a different subfield. The first information item (**friction ridge alternate segment position / FRAS**) is the finger number from **Table 8**. This information item is called the **friction ridge alternate segment position / FRAS** to differentiate it from **FGP.** See **Section 7.7.12**. The number of information items within each subfield depends on the number of vertices.

8.14.25 Field 14.026: Simultaneous capture / SCF

This optional field allows the user to link together fingerprint images that were captured simultaneously. Note that this is different from the **IDC**. This is used, for instance, when individual flat prints are captured on different platens simultaneously. Such images should not be stitched together for transmission as a single multiple-finger print image, but they should be coded with the same **SCF** value to indicate that they were captured simultaneously, and that there is little possibility of a mistaken fingerprint code. The **SCF** is a 1-based numeric index that is incremented for each simultaneously captured set of images, and shall be omitted otherwise. See **Section 7.3.5.**

8.14.26 Field 14.027: Stitched image flag / SIF

This field signifies that images captured separately were stitched together to form a single image. This field is mandatory if an image has been stitched, and the value shall be set to 'Y'. Otherwise, this field shall not appear in the record. Examples:

- If the right and left thumb images were captured separately, but combined prior to transmission to create a single artificial two-thumb image (using **FGP** = 15 in **Field 14.013: Friction ridge generalized position / FGP)** then this field shall appear with a value of 'Y'. It is recommended that stitching not be done, and that the separately captured thumb images be transmitted as separate Type-14 records using **FGP** codes 11 and 12.

- If a two-finger capture device is used to simultaneously capture the index and middle fingers and separately capture the ring and pinky of the same hand simultaneously, but the two images were stitched to create an artificial 'four finger slap image' then this field shall be in the record with a value of 'Y'. It is recommended that instead of creating an artificial 'four finger slap image' (**FGP** = 13 or 14 in **Field 14.013: Friction ridge generalized position / FGP)** that **FGP** codes 43 and 45 (for the left hand) or **FGP** codes 40 and 42 (for the right hand) be used to separately transmit the two-finger images without stitching.

- A device may capture individual finger images from non-adjacent platens simultaneously. In that case, **Field 14.026: Simultaneous capture / SCF** shall be used to designate such a capture. It is recommended that the images be transmitted in separate Type-14 records (having **FGP** codes 2, 3, 4 and 5 or codes 7, 8, 9 and 10), using the same value for **SCF** value. If, however, the images had been stitched together to create a single artificial 'four finger slap image' (**FGP** = 13 or 14 in **Field 14.013: Friction ridge generalized position / FGP**), then this field shall appear with a value of 'Y'.

8.14.27 Field 14.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

8.14.28 Field 14.031: Subject acquisition profile – fingerprint / FAP

This optional field lists the **FAP** levels associated with fingerprint acquisition devices. See **Section7.7.5.2** for details. This field is new for this version of the standard.

8.14.29 Fields 14.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.14.30 Field 14.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.14.31 Field 14.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.14.32 Field 14.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.14.33 Field 14.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 14.004: Source agency / SRC**.

8.14.34 Field 14.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same **ACN**. See **Section 7.3.3.** Record Type-21 contains images that are NOT used to derive the biometric data in **Field 14.999: Fingerprint image / DATA** but that may be relevant to the collection of that data.

8.14.35 Field 14.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 14.999: Fingerprint image / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.14.36 Field 14.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN** from which the data in **Field 14.999: Fingerprint image / DATA** was derived. See **Section 7.3.2.**

8.14.37 Field 14.998: Geographic sample acquisition location / GEO

This optional field contains the location where the fingerprint sample was acquired – not where it is stored. See **Section 7.7.3**.

8.14.38 Field 14.999: Fingerprint image / DATA

This field contains the fingerprint image. See **Section 7.2** for details. It shall contain an image, unless **Field 14.018: Amputated or bandaged / AMP** has a value of "UP". In the latter case, the field is optional. Some domains and application profiles may still require an image in this field (such as of the word "Amputated"). Note that in previous versions of the standard that this field was mandatory in all circumstances.

8.15 Record Type-15: Palm print image record

The Type-15 record shall contain and be used to exchange palm print image data together with fixed and user-defined textual information fields pertinent to the digitized image. Information regarding the scanning resolution used, the image size, and other parameters or comments required to process the image are recorded as fields within the record. Palm and wrist print images transmitted to other agencies will be processed by the recipient agencies to extract the desired feature information required for matching purposes.

The image data shall be acquired directly from a subject using a live-scan device, a palmprint card, or other media that contains the subject's palm and / or wrist prints. Any method used to acquire the palm print images shall be capable of capturing a set of images for each hand. This set may include the writer's palm as a single scanned image, and the entire area of the full palm extending from the wrist bracelet to the tips of the fingers as one or two scanned images. (See **Figure 3**) he wrist bracelet is the series of lines/creases below and parallel to the carpal delta and thenar /hyperthenar areas of the palm.

If two images are used to represent the full palm, the lower image shall extend from the wrist bracelet to the top of the interdigital area (third finger joint) and shall include the thenar, and hypothenar areas of the palm. The upper image shall extend from the bottom of the interdigital area to the upper tips of the fingers. This provides an adequate amount of overlap between the two images.

The standard also has provision for encoding the interdigital, thenar, and hypothenar areas separately for each palm.

As a palmprint transaction may be used for different purposes, it may contain one or more unique image areas recorded from the palm or hand or wrist.

For some agencies, a complete palmprint record set for one individual will normally include the writer's palm and the full palm image(s) from each hand. A single Type-15 record will be required for each writer's palm and one to three Type-15 records for each full palm. Four to eight Type-15 records may be required to represent the subject's palmprints in a transaction.

Table 73 Type-15 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
15.001		RECORD HEADER	M	encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	1	1
15.002	IDC	INFORMATION DESIGNATION CHARACTER	M	N	1	2	0 ≤ IDC ≤ 99 positive integer	1	1
15.003	IMP	IMPRESSION TYPE	M	N	2	2	IMP = 10 or 11 or 28 or 29 see Table 7	1	1
15.004	SRC	SOURCE AGENCY	M	U	1	*	none	1	1
15.005	PCD	PALMPRINT CAPTURE DATE	M	See Section 7.7.2.3 Local date encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			See Section 7.7.2.3 Local date encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	1	1
15.006	HLL	HORIZONTAL LINE LENGTH	D	N	2	5	10 ≤ HLL ≤ 99999 integer	0	1
15.007	VLL	VERTICAL LINE LENGTH	D	N	2	5	10 ≤ VLL ≤ 99999 integer	0	1
15.008	SLC	SCALE UNITS	D	N	1	1	0 ≤ SLC ≤ 2 integer	0	1
15.009	THPS	TRANSMITTED HORIZONTAL PIXEL SCALE	D	N	1	5	integer	0	1
15.010	TVPS	TRANSMITTED VERTICAL PIXEL SCALE	D	N	1	5	integer	0	1
15.011	CGA	COMPRESSION ALGORITHM	D	AN	3	5	value from Table 15	0	1
15.012	BPX	BITS PER PIXEL	D	N	1	2	positive integer	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
15.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	N	2	2	20 ≤ FGP ≤ 38 or 81 ≤ FGP ≤ 84 see **Table 8**	1	1
15.014-15.015		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
15.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
15.018	**AMP**	**AMPUTATED OR BANDAGED**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	FRAP	friction ridge amputated or bandaged position	M⇑	N	1	2	21 ≤ FRAP ≤ 38 or 81 ≤ FRAP ≤ 84 See Table 8	1	1
	ABC	amputated or bandaged code	M⇑	A	2	2	ABC = XX or UP	1	1
15.019		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
15.021-15.023		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.024	**PQM**	**PALM QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	FRMP	friction ridge metric position	M⇑	N	1	2	20 ≤ FRC ≤ 38 or 81 ≤ FRC ≤ 84 positive integer	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
15.025-15.029		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	Value from **Table 5**	0	1
15.031-15.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.200 – 15.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
15.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
15.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
15.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
15.905-15.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
15.994		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
15.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	$1 \leq ACN \leq 255$ positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	$1 \leq ASP \leq 99$ positive integer	0	1
15.996	**HAS**	**HASH**	O	H	64	64	none	0	1
15.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	SRN	source representation number	M⇑	N	1	3	$1 \leq SRN \leq 255$ positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	$1 \leq RSP \leq 99$ positive integer	0	1
15.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	$-90 \leq LTD \leq 90$	0	1
	LTM	latitude minute value	D	NS	1	8	$0 \leq LTM < 60$	0	1
	LTS	latitude second value	D	NS	1	8	$0 < LTS < 60$	0	1
	LGD	longitude degree value	D	NS	1	10	$-180 \leq LGD \leq 180$	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
15.999	**DATA**	**PALMPRINT IMAGE**	D	B	1	*	none	0	1

8.15.1 Field 15.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.15.2 Field 15.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-15 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section** 7.3.1**.**

8.15.3 Field 15.003: Impression type / IMP

This mandatory field shall indicate the manner by which the palm print was obtained. See **Section** 7.7.4.1 for details.

8.15.4 Field 15.004: Source agency / SRC

This is a mandatory field. See **Section** 7.6 for details. The source agency name may be entered in **Field 15.993: Source agency name / SAN**.

8.15.5 Field 15.005: Palmprint capture date / PCD

This mandatory field shall contain the date that the palm biometric data contained in the record was captured. See **Section** 7.7.2.3 for details.

8.15.6 Field 15.006: Horizontal line length / HLL

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.1 for details.

8.15.7 Field 15.007: Vertical line length / VLL

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.2 for details.

8.15.8 Field 15.008: Scale units / SLC

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.3 for details.

8.15.9 Field 15.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.4 for details.

8.15.10 Field 15.010: Transmitted vertical pixel scale / TVPS

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.5 for details.

8.15.11 Field 15.011: Compression algorithm / CGA

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 15** for a list of the codes, and **Section 7.7.9.1.**

8.15.12 Field 15.012: Bits per pixel / BPX

This field is mandatory if an image is present in **Field 15.999**. Otherwise it is absent. See **Section** 7.7.8.6 for details.

8.15.13 Field 15.013: Friction ridge generalized position / FGP

This mandatory field shall contain the palm print position that matches the palmprint image. Valid codes range from 20 to 38, or 81 to 84. See **Table 8**. See **Section 7.7.4.2** for details.

8.15.14 Field 15.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.15.15 Field 15.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

8.15.16 Field 15.018: Amputated or bandaged / AMP

This optional field shall specify if a hand is amputated or bandaged. Multiple subfields may be entered and each shall contain two information items.

- The first item is the **friction ridge amputated or bandaged position / FRAP** between 21 and 38 or 81 through 84 as chosen from **Table 8**. This information item is called the **friction ridge amputated or bandaged position / FRAP** to differentiate it from **FGP.**
- The second item is the **amputated or bandaged code / ABC,** also known as the AMPCD. **Table 72** is a list of allowable indicators for the AMPCD.

If an entire hand is missing, either 83 (right full palm, including writer's palm) or 84 (left full palm, including writer's palm) shall be entered for **FRAP.** A partially scarred palm should be printed. XX shall be used only when a partial print exists due to amputation; therefore it contains *some* friction ridge detail. UP shall be used with the complete block where an image was to be transmitted, but there is no image due to amputation or total lack of friction ridge detail (such as with a bandage). An image with a scar should not be marked XX or UP.

8.15.17 Field 15.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.15.18 Field 15.024: Palm quality metric / PQM

This optional field is used to specify one or more different metrics of the print image quality score data for the image stored in this record. Each subfield is comprised of four information items. The first information shall be the **friction ridge metric position / FRMP** for the image stored in this record. Valid codes range from 20 to 38, 81, 82, 83 or 84. See **Table 8.** See **Section 7.7.7** for a description of the remaining three information items.

8.15.19 Field 15.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

8.15.20 Fields 15.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.15.21 Field 15.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.15.22 Field 15.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.15.23 Field 15.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details

8.15.24 Field 15.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 15.004: Source agency / SRC** .

8.15.25 Field 15.995: Associated context / ASC

This optional field refers to one or more Record(s) Type-21 with the same **ACN**. See **Section 7.3.3.** Record Type-21 contains images that are NOT used to derive the biometric data in **Field 15.999: Palmprint image / DATA** but that may be relevant to the collection of that data**.**

8.15.26 Field 15.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 15.999: Palmprint image / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.15.27 Field 15.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN**. See **Section 7.3.2.**

8.15.28 Field 15.998: Geographic sample acquisition location / GEO

This optional field contains the location where the palm sample was acquired – not where it is stored. See **Section 7.7.3**.

8.15.29 Field 15.999: Palmprint image / DATA

This field contains the palmprint image. See **Section 7.2** for details. It shall contain an image, unless **Field 15.018: Amputated or bandaged / AMP** has a value of "UP". In the latter case, the field is optional. Some domains and application profiles may still require an image in this field (such as of the word "Amputated"). Note that in previous versions of the standard that this field was mandatory in all circumstances.

8.16 Record Type-16: User-defined testing image record

The Type-16 record shall contain and be used to exchange image data together with textual information fields pertinent to the digitized image. This record type allows the exchange images not addressed by other record types in the standard. It is intended as the user-defined record to be used for developmental or test purposes. The image data contained in the Type-16 record may be in a compressed form. With the exception of the fields described below, the format, parameters, and types of images to be exchanged are undefined by this standard and shall be agreed upon between the sender and recipient.

Table 74 Type-16 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
16.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
16.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	$0 \leq IDC \leq 99$ integer	1	1
16.003	**UDI**	**USER-DEFINED IMAGE TYPE**	M	U	1	35	user-defined	1	1
16.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
16.005	**UTD**	**USER-DEFINED TESTING DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
16.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	2	5	10 ≤ HLL ≤ 99999 positive integer	1	1
16.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	2	5	10 ≤ VLL ≤ 99999 positive integer	1	1
16.008	**SLC**	**SCALE UNITS**	M	N	1	1	0 ≤ SLC ≤ 2 integer	1	1
16.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
16.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	M	N	1	5	positive integer	1	1
16.011	**CGA**	**COMPRESSION ALGORITHM**	M	AN	3	5	value from **Table 15** for friction ridge data or valid file suffix for other data	1	1
16.012	**BPX**	**BITS PER PIXEL**	M	N	1	2	integer	1	1
16.013	**CSP**	**COLOR SPACE**	O	A	3	4	values from **Table 16**	0	1
16.014-16.015		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
16.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
16.018-16.019		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
16.021-16.023		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
16.024	**UQS**	**USER-DEFINED TESTING IMAGE QUALITY SCORES**	O					0	1
		Subfields: Repeating sets of information items	M					1	9
	QVU	quality value	M	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
16.025-16.029		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	value from **Table 5**	0	1
16.031-16.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.200 – 16.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
16.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M					1	*
	GMT	Greenwich mean time	M	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M	U	1	64	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	OWN	algorithm owner	M	U	1	64	none	1	1
	PRO	process description	M	U	1	255	none	1	1
16.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
16.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M	U	1	50	none	1	1
	MOD	model	M	U	1	50	none	1	1
	SER	serial number	M	U	1	50	none	1	1
16.905-16.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
16.994		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
16.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M					1	255
	ACN	associated context number	M	N	1	3	$1 \leq ACN \leq 255$ positive integer	1	1
	ASP	associated segment position	O	N	1	2	$1 \leq ASP \leq 99$ positive integer	0	1
16.996	**HAS**	**HASH**	O	H	64	64	none	0	1
16.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M					1	255
	SRN	source representation number	M	N	1	3	$1 \leq SRN \leq 255$ positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	$1 \leq RSP \leq 99$ positive integer	0	1
16.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	UTE	universal time entry	O	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
16.999	**DATA**	**TEST DATA**	M	B	1	*	none	1	1

8.16.1 Field 16.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.16.2 Field 16.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-2 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.16.3 Field 16.003: User-defined image type / UDI

This mandatory field shall contain the type of user-defined image contained in this record. Its content shall be defined by the user and be in accordance with the receiving agency.

8.16.4 Field 16.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 16.993: Source agency name / SAN**.

8.16.5 Field 16.005: User-defined image test capture date / UTD

This mandatory field shall contain the date that the test image contained in the record was captured. See **Section 7.7.2.3** for details.

8.16.6 Field 16.006: Horizontal line length / HLL

This field is mandatory. See **Section 7.7.8.1**for details.

8.16.7 Field 16.007: Vertical line length / VLL

This field is mandatory. See **Section 7.7.8.2** for details.

8.16.8 Field 16.008: Scale units / SLC

This field is mandatory. See **Section 7.7.8.3** for details.

8.16.9 Field 16.009: Transmitted horizontal pixel scale / THPS

This field is mandatory. See **Section 7.7.8.4** for details.

8.16.10 Field 16.010: Transmitted vertical pixel scale / TVPS

This field is mandatory. See **Section 7.7.8.5** for details.

8.16.11 Field 16.011: Compression algorithm / CGA

This is a mandatory field. It shall specify the algorithm used to compress the transmitted images. See **Table 15** for a list of the codes and **Section 7.7.9.1** for a detailed description of this field. For other data, see **Section 7.7.9.4.**

8.16.12 Field 16.012: Bits per pixel / BPX

This field is mandatory. See **Section 7.7.8.6** for details.

8.16.13 Field 16.013: Color space / CSP

This optional field shall be completed in accordance with **Section 7.7.10.3** if entered.

8.16.14 Field 16.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.16.15 Field 16.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

8.16.16 Field 16.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.16.17 Field 16.024: User-defined image quality metric / UQS

This optional field is used to specify one or more different metrics of the image quality score data for the image stored in this record. Each subfield is comprised of three information items. See **Section 7.7.7** for a description of the three information items.

8.16.18 Field 16.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

8.16.19 Fields 16.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.16.20 Field 16.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1**

8.16.21 Field 16.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked “A”, “N” or “S” in **Table 93 Character encoding set values** are allowed.

8.16.22 Field 16.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.16.23 Field 16.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 16.004: Source agency / SRC** .

8.16.24 Field 16.995: Associated context / ASC

This optional field refers to one or more Record(s) Type-21 with the same **ACN**. Record Type-21 contains images that are NOT used to derive the biometric data in **Field 16.999: Test data / DATA** but that may be relevant to the collection of that data, such as general scenes of the area where the body of the subject was found.

8.16.25 Field 16.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 16.999: Test data / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.16.26 Field 16.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN** from which the data in **Field 16.999: Test data / DATA** was derived. See **Section 7.3.2.**

8.16.27 Field 16.998: Geographic sample acquisition location / GEO

This optional field contains the location where the sample was acquired – not where it is stored. See **Section 7.7.3**.

8.16.28 Field 16.999: Test data / DATA

This mandatory field contains the user-defined test image. See **Section 7.2** for details.

8.17 Record Type-17: Iris image record

The Type-17 record shall contain and be used to exchange generic iris image data using mandatory fields of this record type. Optional fields may be used to exchange additional information available in the *INCITS 379-2004 – Iris Image Interchange Format standard* and the *ISO/IEC 19794-6 iris image data interchange format standard*. Images may be monochrome or color with 256 or more intensity levels (gray or per-color component), and vary in size depending on field of view and compression. This record type specifies interchange formats for biometric authentication systems that utilize iris recognition.

The formats all store sampled pixel data from rectilinear images. The data shall be encoded as a raw array of intensity values, a raw array of red green blue color values, or as losslessly compressed or lossy-compressed versions thereof. Two of the formats are specialized for small record sizes; these are achieved by cropping and masking the images to support efficient compression (see **Field 17.032: Iris storage format / ISF**).

Table 75 Type-17 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
17.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
17.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
17.003	**ELR**	**EYE LABEL**	M	N	1	1	ELR = 0, 1 or 2	1	1
17.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	None	1	1
17.005	**ICD**	**IRIS CAPTURE DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
17.006	**HLL**	**HORIZONTAL LINE LENGTH**	D	N	2	5	10 ≤ HLL ≤ 99999 positive integer	0	1
17.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	10 ≤ VLL ≤ 99999 positive integer	0	1
17.008	**SLC**	**SCALE UNITS**	D	N	1	1	0 ≤ SLC ≤ 2 integer	0	1
17.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
17.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
17.011	**CGA**	**COMPRESSION ALGORITHM**	D	AN	3	4	CGA = NONE, PNG, JP2 or JP2L see **Table 15**	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
17.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	integer	0	1
17.013	**CSP**	**COLOR SPACE**	D	A	3	4	values from **Table 16**	0	1
17.014	**RAE**	**ROTATION ANGLE OF EYE**	O	H	1	4	0000 < RAE < FFFF	0	1
17.015	**RAU**	**ROTATION UNCERTAINTY**	D	H	1	4	0000 < RAU < FFFF	0	1
17.016	**IPC**	**IMAGE PROPERTY CODE**	O					0	1
	IHO	horizontal orientation code	M⇑	N	1	1	0 ≤ IHO ≤ 2 integer	1	1
	IVO	vertical orientation code	M⇑	N	1	1	0 ≤ IVO ≤ 2 integer	1	1
	IST	specific scan type	M⇑	N	1	1	IST = 0 or 1	1	1
17.017	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
17.018		**Deprecated; See ANSI/NIST-ITL 1-2007 or ANSI/NIST-ITL 2-2008 for a description of this field**	Not to be used for any new transactions claiming conformance to this version of the standard.						
17.019	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
17.020	**ECL**	**EYE COLOR**	O	A	3	3	value from **Table 17**	0	1
17.021	**COM**	**COMMENT**	O	U	1	126	none	0	1
17.022	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
17.023	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
17.024	**IQS**	**IMAGE QUALITY SCORE**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
17.025	**EAS**	**EFFECTIVE ACQUISITION SPECTRUM**	O	A	3	9	value from **Table 76**	0	1
17.026	**IRD**	**IRIS DIAMETER**	O	N	2	4	10 < IRD < 9999 positive integer	0	1
17.027	**SSV**	**SPECIFIED SPECTRUM VALUES**	D					0	1
	LOW	spectrum lower bound	M⇑	N	3	4	500 ≤ LOW positive integer evenly divisible by 10	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	HIG	spectrum upper bound	M⇑	N	3	4	510 ≤ HIG positive integer evenly divisible by 10	0	1
17.028	**DME**	**DAMAGED OR MISSING EYE**	O	A	2	2	DME = MA or UC	0	1
17.029		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	value from **Table 5**	0	1
17.031	**IAP**	**SUBJECT ACQUISITION PROFILE - IRIS**	O	N	2	2	IAP = 20, 30 or 40	0	1
17.032	**ISF**	**IRIS STORAGE FORMAT**	O	N	1	1	ISF = 1, 2, 3 or 7	0	1
17.033	**IPB**	**IRIS PUPIL BOUNDARY**	O					0	1
	BYC	boundary code	M⇑	A	1	1	BYC = C, E or P see **Table 19**	1	1
	NOP	number of points	M⇑	N	1	2	2 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	2	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	2	NOP
17.034	**ISB**	**IRIS SCLERA BOUNDARY**	O					0	1
	BYC	boundary code	M⇑	A	1	1	BYC = C, E or P See **Table 19**	1	1
	NOP	number of points	M⇑	N	1	2	2 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	2	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	2	NOP
17.035	**UEB**	**UPPER EYELID BOUNDARY**	O					0	1
	BYC	boundary code	M⇑	A	1	1	BYC = P see **Table 19**	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
17.036	**LEB**	**LOWER EYELID BOUNDARY**	O					0	1
	BYC	boundary code	M⇑	A	1	1	BYC = P see **Table 19**	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
17.037	**NEO**	**NON-EYELID OCCLUSIONS**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	OCY	occlusion opacity	M⇑	A	1	1	OCY = T, I, L or S see **Table 20**	1	1
	OCT	occlusion type	M⇑	A	1	1	OCT = L, S, C, R or O see **Table 21**	1	1
	NOP	number of points	M⇑	N	1	3	3 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path – for a total of **NOP** pairs								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
17.038-17.039		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.040	**RAN**	**RANGE**	O	N	1	7	positive integer	0	1
17.041	**GAZ**	**FRONTAL GAZE**	O	N	1	2	0 ≤ GAZ ≤ 90 positive integer	0	1
17.042-17.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.200-17.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
17.901		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
17.903-17.992		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
17.994		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
17.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
17.996	**HAS**	**HASH**	O	H	64	64	none	0	1
17.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	SRN	source representation number	M⇑	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
	GEO	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
17.998	UTE	universal time entry	O⇑	See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from Table 6	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
17.999	**DATA**	**IRIS IMAGE DATA**	D	B	1	*	none	1	1

8.17.1 Field 17.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.17.2 Field 17.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-17 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.17.3 Field 17.003: Eye Label / ELR

This mandatory field[63] shall contain an identifier for the eye represented by the image in the record. An entry of "0" in this field indicates that it is undefined which eye is present in this record. An entry of "1" in this field indicates that the image in this record is the subject's right eye. An entry of "2" in this field indicates that the image in this record is the subject's left eye.

8.17.4 Field 17.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 17.993: Source agency name / SAN**.

8.17.5 Field 17.005: Iris capture date / ICD

This mandatory field shall contain the date that the iris biometric data contained in the record was captured. See **Section 7.7.2.3** for details.

8.17.6 Field 17.006: Horizontal line length / HLL

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.1** for details.

8.17.7 Field 17.007: Vertical line length / VLL

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.2** for details.

8.17.8 Field 17.008: Scale units / SLC

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.3** for details.

[63] In prior versions of this standard, this field was named **Feature identifier / FID**.

8.17.9 Field 17.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.4** for details.

8.17.10 Field 17.010: Transmitted vertical pixel scale / TVPS

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.5** for details.

8.17.11 Field 17.011: Compression algorithm / CGA

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent.It shall specify the algorithm used to compress the transmitted color or grayscale images. See **Section 7.7.9.2** for a detailed description of this field. The baseline JPEG algorithm (*ISO/IEC 10918*) shall not be used for Type-17 iris images. It has been shown that both false non-match and false match rates increase due to the presence of tiling artifacts introduced by JPEG's discrete cosine transform. While JPEG was allowed in prior versions of this standard, it shall not be allowed for new images. Implementers may want to support JPEG decoding for handling legacy images. If legacy images were stored in JPEG, they should be converted to PNG prior to transmission, with this transformation noted in **Field 17.902: Annotation information / ANN**.

8.17.12 Field 17.012: Bits per pixel / BPX

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.6** for details.

8.17.13 Field 17.013: Color space / CSP

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.10** for details. If **Field 17.025: Effective acquisition spectrum / EAS** is set to "NIR" this field shall be set to "GRAY".

8.17.14 Field 17.014: Rotation angle of eye / RAE

This optional field shall indicate the in-plane rotation angle of the iris. Such rotation can be caused by head tilt, camera tilt, and also by the common natural rotation of the eye itself. The rotation angle of the eye encoded in this field is defined here in terms of roll of the subject's head. The angle is defined, and measured in degrees, as the angle between a line joining the pupil or iris centers of the left and right eyes, and the horizontal axis of the imaging system. As shown in **Figure 16**, an angle is positive for counter-clockwise rotation, as seen from the camera, of this line relative to the camera's horizontal axis.

The in-plane eye rotation angle shall be recorded as angle = round (65535 * angle / 360) modulo 65535[64]. The value "FFFF" indicates that rotation angle of eye is undefined. This

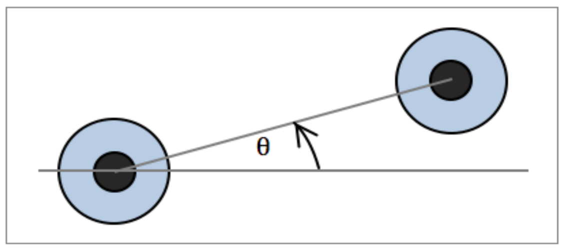
[64] In the 2007 and 2008 versions of the standard, there was a typographical error of 65536.

is encoded as a hexadecimal value. As an (unrealistic) example of a 90 degree value:

round(65535 * 90 / 360) modulo 65535 equals 16384.
This is 4000 when converted to hexadecimal.

For encoding angular orientation of an eye not directed toward the camera, see **Field 17.041: Frontal gaze / GAZ**. It may be difficult to estimate rotation using a monocular camera. In such cases, the rotation uncertainty encoded in **Field 17.015: Rotation uncertainty / RAU** will be appropriately larger.

Figure 16: Coordinate system for eye rotation angle



Right eye **Left eye**

8.17.15 Field 17.015: Rotation uncertainty / RAU

This optional field shall indicate the uncertainty in the in-plane eye rotation given in Field 17.014: Rotation angle of eye / RAE. This field is mandatory if **Field 17.014: Rotation angle of eye / RAE** is present. The rotation uncertainty is non-negative and equal to [round (65535 * uncertainty / 180)][64]. The uncertainty is measured in degrees and is the absolute value of maximum error. The value "FFFF" indicates that uncertainty is undefined. Note that this is encoded as a hexadecimal value.

8.17.16 Field 17.016: Image property code / IPC

This optional field shall contain the image property code. It shall contain three information items.

- The first information item is the **horizontal orientation code / IHO**. Values for Horizontal Orientation shall be one of: "0" for Undefined, "1" for Base, or "2" for Flipped. "Base" orientation refers to images corresponding to the view facing the subject, where the nasal side of subject's left eye or outer edge of the subject's right eye is on the left side the of image. "Flipped" orientation refers to images where the orientation is opposite from that described for "Base".

- The second information item is the **vertical orientation code / IVO**. Values for Vertical Orientation shall be one of: "0" for Undefined, "1" for Base, or "2" for Flipped. "Base" orientation refers to images where the superior (top) edge of the eye is at the top of the image. "Flipped" orientation refers to images where the orientation is opposite from that described for "Base".
- The third information item is the **specific scan type / IST**. Values for Scan Type shall be one of: "0" for Undefined and "1" for Progressive. "Progressive" indicates that the image was captured using progressive scanning, in which case all image lines are generated sequentially.

Prior versions of the standard allowed **IST** "2" for Interlace Frame, or "3" for Interlace Field. These values shall not be used in records claiming conformance to this version of the standard. Implementers may want to support interlaced imagery for handling legacy images. The deprecated values were defined as follows:

- "Interlace Frame" indicates that the image was captured using interlaced scanning, in which two fields are generated in sequence, the first composed of odd-numbered lines and the second of even-numbered lines.
- "Interlace Field" indicates that the image was captured using interlaced scanning, in which only one field is generated, and then each line is duplicated to produce a full size image.

8.17.17 Field 17.017: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.17.18 Field 17.019: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.17.19 Field 17.020: Eye color / ECL

This is an optional field that shall specify the subject's eye color, or 'XXX' if it is unknown from the image (as is the case with infra-red images). See **Section 7.7.11** and **Table 17** for details on entering values to this field. Estimating eye color labeling is extremely subjective, and of very limited reliability despite its intuitive use in a policing context, for example. Eye color is determined by the amount of melanin pigmentation, and by the spectrum of the incident light and other factors. Eye color has not historically been available to or used by recognition algorithms.

8.17.20 Field 17.021: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.17.21 Field 17.022: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section** **7.7.8.7** for details.

8.17.22 Field 17.023: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section** **7.7.8.8** for details.

8.17.23 Field 17.024: Image quality score / IQS

This optional field shall be used to specify one or more different metrics of image quality score data for the image stored in this record. Each set of three information items shall be contained in a separate subfield. See **Section** **7.7.7** for details on the information items.

8.17.24 Field 17.025: Effective acquisition spectrum / EAS

This optional field indicates the acquisition spectrum used in capturing the iris image. The acquisition spectrum is the effective acquisition spectrum, which is limited by both the lighting spectrum and the spectrum limitations of the acquisition device: it is defined by the overlap of the two spectra. This field contains an alphabetic entry selected from the column "Value" in **Table 76.**

Table 76 Effective acquisition spectrum codes

Value	Description	Spectrum
NIR	Near-infrared acquisition	Approx. 700–900[65] nm
DEFINED	Defined acquisition spectrum, in range of nanometers rounded to the nearest 10nm, e.g. 800 to 830. This option provides the means to specify the acquisition spectrum when known with precision. When this value is used, **Field 17.027: Specified spectrum values / SSV** shall accompany it. The format of the two information items in that field shall be a 3 or 4-digit integer specifying the minimum of the spectrum range in nanometers, followed by a 3 or 4-digit integer specifying the maximum of the spectrum range in nanometers. The minimum value shall be less than or equal to the maximum value.	
VIS	Visible full-spectrum acquisition NOTE: Visible images cannot usually be matched against near-infrared images because either no detail, or different detail, of the iris texture is present in a visible light image. Interoperability between VIS and NIR images remains a research issue. VIS images are supported by this standard for supplemental, forensic, and research purposes only. Such use	Approx. 380–750 nm

[65] The 2007 and 2008 versions of the standard had a range of 700-850 for NIR; 380 to 740 for VIS. RED was not specified in earlier versions of the standard.

Value	Description	Spectrum
	cases may extend to the peri-ocular region.	
RED	Red portion of visible full-spectrum illumination NOTE: Red light visible images cannot usually be matched against near-infrared images because no detail, noisy detail, or different detail, of the iris texture is present in a red light image. Interoperability between VIS and RED images remains a research issue. RED images are supported by this standard for supplemental, forensic, and research purposes only. Such use cases may extend to the peri-ocular region.	Approx. 620–750 nm
UNDEFINED	This value shall be used when the effective spectrum is unknown or unavailable, and is not better described by one of the other values.	

8.17.25 Field 17.026: Iris diameter / IRD

This optional field shall specify the expected iris diameter in pixels. The diameter of the iris should not be less than 140 pixels.

8.17.26 Field 17.027: Specified spectrum values / SSV

This field shall only be present if **Field 17.025: Effective acquisition spectrum / EAS** has a value of 'DEFINED' It is comprised of two information items:

The first information item is is **spectrum lower bound / LOW**. It is a three or four digit entry indicating the lower frequency bound in nm. (rounded to the nearest 10 nm.).

The second information item is **spectrum upper bound / HIG**. It is a three or four digit entry indicating the upper frequency bound in nm. (rounded to the nearest 10 nm.).

8.17.27 Field 17.028: Damaged or missing eye / DME

This optional field shall specify if one or both eyes are unable to provide usable iris images. The eye position is specified in **Field 17.003: Eye Label / ELR .** This field shall contain a code from **Table 77**. “UC” should be entered if the eye is physically present, but a usable iris image cannot be captured. An example is when the eye is swollen shut due to injury.

Table 77 Missing and damaged eye codes

Descriptor	Code
Missing or artificial eye	MA
Unable to capture image	UC

8.17.28 Field 17.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

8.17.29 Field 17.031: Subject acquisition profile – iris / IAP

This optional field lists the IAP level associated with the iris acquisition device. See **Section 7.7.5.3** for details.

8.17.30 Field 17.032: Iris storage format / ISF

This optional field, when used, shall indicate the storage format of the iris image[66].

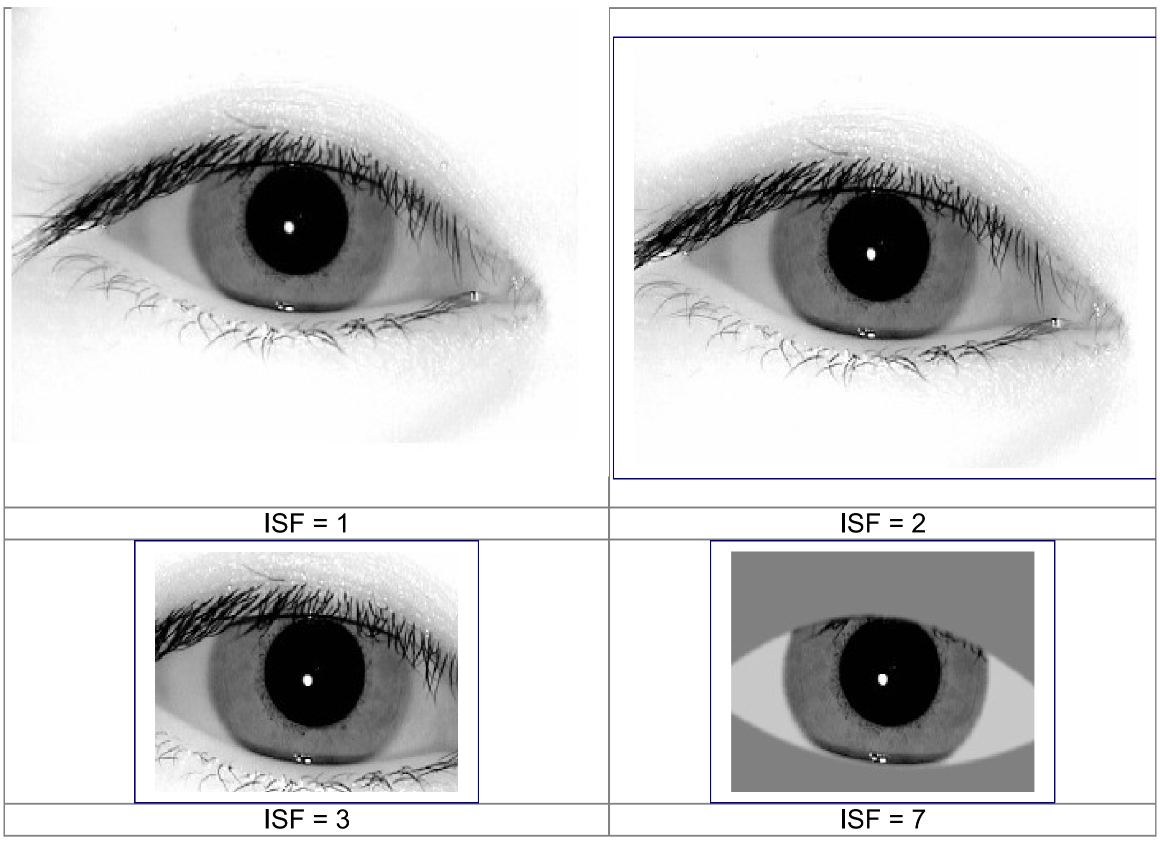


Figure 17: Examples of ISF image formats

The codes are shown in **Figure 17** and **Table 78.** The value shall be a single digit corresponding to the column "ISF code". Image storage formats 1 and 2 might be the native output of an iris camera. ISF format code 1 is designated for high resolution outputs. ISF level 2 is the format output in most commercial iris acquisition systems and corresponds to the dimensions of the Video Graphics Array (VGA). Image storage formats 3 and 7 are typically prepared by client software: ISF 3 images are cropped; and ISF 7 images are both cropped and masked. These operations, used in conjunction with

[66] This is a new field with this version of the standard. All new applications should use this field.

the standardized compression schemes, afford reduced record sizes. All of the formats establish geometric specifications. For ISF = 1 and 2, there are minimum margin requirements specified in terms of the estimated iris radius, R (see **Table 78**). For ISF = 3 and 7, there are exact margin requirements. These requirements support accurate localization of the iris boundaries.

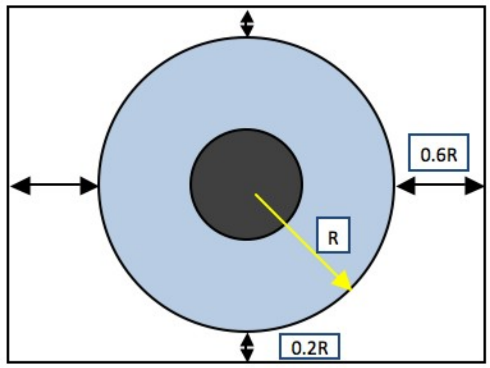


Figure 18: Iris margin specification

Table 78 Iris storage formats

ISF code	Description	Iris Centering	Iris margin requirement (R is radius of the iris)	
			Horizontal	Vertical
1	Unconstrained image size	Recommended	≥ 0.6R	≥ 0.2R
2	Raw: 640x480	Recommended	≥ 0.6R	≥ 0.2R
3	Cropped	Required	= 0.6R	= 0.2R
7	Cropped and Masked	Required	= 0.6R	= 0.2R

8.17.31 Field 17.033: Iris pupil boundary / IPB

This optional field defines the pupillary boundary, between the iris and pupil. See **Section 7.7.12** for a description of encoding paths.

8.17.32 Field 17.034: Iris sclera boundary / ISB

This optional field defines the limbic boundary, between the iris and sclera. See **Section 7.7.12** for a description of encoding paths.

8.17.33 Field 17.035: Upper eyelid boundary / UEB

This optional field defines the boundary between the upper eyelid and the eye. See **Section 7.7.12** for a description of encoding paths. This is an open path.

–

8.17.34 Field 17.036: Lower eyelid boundary / LEB

This optional field defines the boundary between the lower eyelid and the eye. See **Section 7.7.12** for a description of encoding paths. This is an open path.

8.17.35 Field 17.037: Non-eyelid occlusions / NEO

This optional field defines the outline and contents of any non-eyelid occlusions that partially or totally blocks the image of the iris. It is a polygon. (See **Section 7.7.12** for a description of a polygon). For details on entering data for this Field, see **Section 7.7.12.2 .** Each point on the polygon is represented by a pair of information items. In addition to the information items for the points on the polygon:

- The first information item contains the alphabetic code from **able 20**
- The second information item contains the alphabetic code from **Table 21**.

8.17.36 Field 17.040: Range / RAN

This optional field contains the estimated distance from the lens of the camera to the iris. It shall be measured in centimeters.

8.17.37 Field 17.041: Frontal gaze / GAZ

This optional field describes the metric that estimates the degree of eye(s) sight-angle relative to the camera. The angle shall be reported in degrees and defined as between:

- The optical axis of the eye, and
- A line connecting the optical center of the eye and the optical center of the camera.

This measure is inclusive of both head angular orientation and eye-gaze angle relative to the head. The inclusive approach for gaze direction is not intended to be representative of the possible difficulty with iris segmentation due to non-frontal head orientation. Hence, two images with the same frontal gaze, but significantly different frontal head orientation may perform differently with different segmentation and matching algorithms.

Note that iris image recognition systems typically rely upon having a small gaze angle in the image. While not prohibited in this standard, it is strongly discouraged that gaze angles greater than 15 degrees be used for enrollment or matching.

8.17.38 Fields 17.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.17.39 Field 17.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.17.40 Field 17.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 17.004: Source agency / SRC.**

8.17.41 Field 17.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same ACN. See **Section 7.3.3.** Record Type-21 contains images that are NOT used to derive the biometric data in **Field 17.999: Iris image data / DATA** but that may be relevant to the collection of that data, such as general scenes of the area where the body of the subject was found.

8.17.42 Field 17.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 17.999: Iris image data / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.17.43 Field 17.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same SRN from which the data in **Field 17.999: Iris image data / DATA** was derived. See **Section 7.3.2.**

8.17.44 Field 17.998: Geographic sample acquisition location / GEO

This optional field contains the location where the iris sample was acquired – not where it is stored. See **Section 7.7.3**.

8.17.45 Field 17.999: Iris image data / DATA

This field contains the iris image. See **Section 7.2** for details. It is mandatory unless an eye is missing or is unable to provide a usable iris image, (i.e. if **Field 17.028: Damaged or missing eye / DME** is in this record), in which case **DATA** is optional. Some domains and application profiles may require a field with a 'substitute' image' such as of the words 'Missing Eye'.

8.18 Record Type-18: DNA record

The Type-18 record shall contain and be used to exchange DNA data. This shall be used to exchange Autosomal Short Tandem Repeat (STR), X-Short Tandem Repeat (X-STR) Y-Short Tandem Repeat (Y-STR), Mitochondrial DNA (mtDNA), Pedigree, and electropherogram images of DNA data. This record type is based upon standardized and commonly used DNA analysis and data reporting conventions.

With full consideration to privacy, this standard only uses the non-coding regions of DNA. The regions of the DNA that contain information on a subject's genetic characteristics or traits are deliberately avoided.

Table 79 Type-18 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
18.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
18.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
18.003	**DLS**	**DNA LABORATORY SETTING**	M					1	1
	UTY	unit type	M	N	1	1	1 ≤ UTY ≤ 4 integer	1	1
	LTY	lab type	D	A	1	1	LTY = G, I, O or U	0	1
	ACC	accreditation information	D	ANS	1	35	numeric (0,1,2,3,4,5,6 or 255). It may be followed by an alpha string (N, M, D and/or O). That may be followed by up to 5 more such strings, each separated by a comma. The entire string is treated as a single information item.	0	1
	NOO	name of the organization	O	U	1	*	none	0	1
	POC	point of contact	O	U	1	200	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	CSC	code of sending country	O	AN	2	3	value from *ISO-3166-1*	0	1
	ION	international organization name	O	U	1	100	none	0	1
18.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
18.005	**NAL**	**NUMBER OF ANALYSES FLAG**	M	N	1	1	NAL = 0 or 1	1	1
18.006	**SDI**	**SAMPLE DONOR INFORMATION**	M					1	1
	DSD	DNA sample donor	M	N	1	1	DSD = 0, 1 or 2	1	1
	GID	gender ID	O	A	1	1	GID = M, F, or U	0	1
	DLC	date of last contact	O	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules**	0	1
	DOB	date of birth	O	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules**	0	1
	EGP	ethnic group	O	U	1	50	none	0	1
	DRA	dental records available	D	N	1	1	DRA = 0, 1 or 2 integer	0	1
	LLC	sample collection location description	O	U	1	4000	none	0	1
	SDS	sample donor status	O	N	1	1	SDS = 0, 1 or 2 integer	0	1
18.007	**COPR**	**CLAIMED OR PURPORTED RELATIONSHIP**	D	N	1	1	$1 \leq$ COPR ≤ 7 positive integer	0	1
18.008	**VRS**	**VALIDATED RELATIONSHIP**	D	N	1	1	$1 \leq$ VRS ≤ 7 positive integer	0	1
18.009	**PED**	**PEDIGREE INFORMATION**	O					0	1
	PID	pedigree ID	M⇑	U	1	24	none	1	1
	PMI	pedigree member ID	M⇑	U	1	6	none	1	1
	PMS	pedigree member status	M⇑	A	1	1	PMS = K or U	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	SID	sample identifier	M⇑	U	1	24	none	1	1
	FID	father identifier	O⇑	N	1	3	none	0	1
	MID	mother identifier	O⇑	N	1	3	none	0	1
	PCM	pedigree comment	O⇑	U	1	2000	none	0	1
18.010	**STY**	**SAMPLE TYPE**	M					1	1
	SCT	sample cellular type	M	N	1	2	0 ≤ SCT ≤ 11 positive integer	1	1
	SMO	sample origin	O	A	2	2	SMO = NS, WB or BP	0	1
18.011	**STI**	**SAMPLE TYPING INFORMATION**	M					1	1
		Subfields: Repeating values	M	N	1	1	0 ≤ value ≤ 4 integer	1	5
18.012	**SCM**	**SAMPLE COLLECTION METHOD**	O	U	1	255	none	0	1
18.013	**SCD**	**SAMPLE COLLECTION DATE**	M	encoding specific: see Annex B or Annex C			encoding specific: see Annex B or Annex C	1	1
18.014	**PSD**	**PROFILE STORAGE DATE**	M	encoding specific: see Annex B or Annex C			encoding specific: see Annex B or Annex C	1	1
18.015	**DPD**	**DNA PROFILE DATA**	M					1	1
	PTP	profile type	M	N	1	1	PTP = 0 or 1 integer	1	1
	RES	result	O	N	1	2	0 ≤ RES ≤ 10 integer	0	1
	PRF	profile ID	M	U	1	64	none	1	1
	SUP	supplemental message	O	U	1	100	none	0	1
	DPC	DNA profile comment	O	U	1	100	none	0	1
18.016	**STR**	**AUTOSOMAL STR, X-STR and Y-STR**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	Unlimited
	DST	DNA STR type	M⇑	N	1	1	DST = 0, 1 or 2 integer	1	1
	DLR	DNA locus reference	M⇑	N	1	3	1 ≤ DLR ≤ 200 positive integer	1	1
	ALL	allele indicator	M⇑	N	1	1	ALL = 0 or 1 integer	1	1
	LAI	locus analysis indicator	M⇑	N	1	1	LAI = 0 or 1 integer	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	PCDT	precise call determination	M⇑	N	1	1	PCDT = 0 or 1 integer	1	1
	AL1	allele call 1	D	NS	1	4	integer > 0; or real number with one digit to right of decimal	0	1
	AL2	allele call 2	D	NS	1	4	integer > 0; or real number with one digit to right of decimal	0	1
	AL3	allele call 3	D	NS	1	4	integer > 0; or real number with one digit to right of decimal	0	1
	BID	batch ID	O⇑	U	1	32	none	0	1
	ECR	electropherogram cross reference	O⇑	U	1	8	none	0	1
	LCR	ladder cross reference	O⇑	U	1	8	none	0	1
	KID	kit ID	M⇑	N	1	3	0 ≤ KID ≤ 999 integer	1	1
	KNM	kit name	D	U	1	32	none	0	1
	KMF	manufacturer	D	U	1	32	none	0	1
	KDS	description of the kit (with part or catalog number)	D	U	1	128	none	0	1
18.017	**DMD**	**MITOCHONDRIAL DNA DATA**	D					0	1
	MT1	mito control region 1	M⇑	AS	546	646	character string where each value is from **Table 84** or a sequence value: A, G, C or T	1	1
	MT2	mito control region 2	M⇑	AS	576	976	character string where each value is from **Table 84** or a sequence value: A, G, C or T	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	BSP	base composition starting point	M⇑	N	1	5	positive integer	1	1
	BEP	base composition ending point	M⇑	N	1	5	positive integer BEP > BSP	1	1
	BCA	base composition A length	M⇑	N	1	2	positive integer	1	1
	BCG	base composition G length	M⇑	N	1	2	positive integer	1	1
	BCC	base composition C length	M⇑	N	1	2	positive integer	1	1
	BCT	base composition T length	M⇑	N	1	2	positive integer	1	1
18.018	**UDP**	**DNA USER-DEFINED PROFILE DATA**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	USER-DEFINED	user-defined information items (there may be multiple items)	M⇑	user-defined			user-defined	1	1
18.019	**EPD**	**ELECTROPHEROGRAM DESCRIPTION**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	EIR	electropherogram image reference	M⇑	U	1	8	none	1	1
	EST	electropherogram storage type	M⇑	U	1	4	none	1	1
	IDD	image data descriptor	M⇑	U	1	200	none	1	1
	ELPD	electropherogram data	M⇑	Base-64	2	*	none	1	1
	EPS	electropherogram screenshot	O⇑	Base-64	2	*	none	0	1
18.020	**DGD**	**DNA GENOTYPE DISTRIBUTION**	O	N	1	1	DGD = 0 or 1 integer	0	1
18.021	**GAP**	**DNA GENOTYPE ALLELE PAIR**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GLR	genotype locus reference	M⇑	N	1	3	1≤ GLR ≤ 200 positive integer	1	1
	ALP	allele pair	M⇑	NS	3	9	digits, one comma and up to 2 periods allowed	1	1
	GNW	genotype numerical weight	M⇑	NS	1	5	0 ≤ GNW ≤ 1 non-negative real number up to 5 characters, which may have a period	1	1
18.022	**COM**	**COMMENT**	O	U	1	126	none	0	1
18.023	**EPL**	**ELECTROPHEROGRAM LADDER**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	LIR	ladder image reference	M⇑	U	1	8	none	1	1
	LST	ladder storage type	M⇑	U	1	4	none	1	1
	LDD	ladder image data descriptor	M⇑	U	1	200	none	1	1
	LEPD	ladder electropherogram data	M⇑	Base-64	2	*	none	1	1
	LES	ladder electropherogram screenshot	O⇑	Base-64	2	*	none	0	1
18.024-18.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.200-18.900	**UDF**	**USER-DEFINED**	O	user-defined			user-defined	user-defined	
18.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
18.903-18.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
18.994		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
18.996 – 18.997		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
18.999		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						

8.18.1 Field 18.001: Record Header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.18.2 Field 18.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-18 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section 7.3.1**.

8.18.3 Field 18.003: DNA laboratory setting / DLS

This field is mandatory. The first information item is mandatory.

- The first information item **unit type / UTY** is mandatory and contains a numeric value selected from the following table:

Table 80 DNA laboratory setting (DLS)

Value	Description
1	Laboratory DNA processing unit
2	Rapid DNA / mobile processing unit
3	Other
4	Unknown

- The second information item is the **lab type / LTY**. It is mandatory if the value for UTY is 1 or 2. It is not entered otherwise. When present, this information item contains a single character describing the laboratory that processed the DNA:

  G = Government
  I = Industry
  O = Other laboratory
  U = Unknown

- The third information item is the **accreditation information / ACC**. It is mandatory if the value for **UTY** is 1 or 2. It shall not be entered otherwise. When present, this information item shall contain a minimum of one numeric character if the value is 0 or a minimum of two characters (one numeric followed immediately by one alpha character if the lab is accredited). If the laboratory has an unknown accreditation status, three numeric characters '255' are entered. The values in this information item shall be separated individually by commas between accreditation and scope pairings. More than one accreditation and scope of accreditation is permitted.

  Allowable numeric values are:

  0 = No Accreditation
  1 = ISO Accreditation
  2 = GLP Accreditation
  3 = AABB Accreditation
  4 = ISO/ILAC Guide 19 Accreditation
  5 = ASCLD Lab Accreditation
  6 = Other
  255 = Unknown

  The scope of accreditation is incorporated as an alphabetic code immediately following the accreditation body / source numeric value. The scope of accreditation is for what type of DNA technology that the laboratory is accredited. These are:

  N = Nuclear
  M = Mitochondrial
  D = Database
  O = Other

  The following is an example of a string for this information item:

  1NM,2N,3NM,5O

  This example demonstrates that the laboratory is accredited by ISO (indicated by the number 1) to process Nuclear DNA (indicated by the letter N). This lab is also accredited by ISO as a Mitochondrial DNA lab (indicated by the letter M). The next occurrence of a numeric indicates the next accreditation type (or the use of a comma separated variable), which in this example is a GLA accreditation with a scope of accreditation for Nuclear DNA only (indicated by the number 2 followed by the letter N). This laboratory is also accredited by AABB for Nuclear and Mitochondrial DNA (indicated by the 3 and the letters N and M respectively). Finally, this example shows that the laboratory is accredited by ASCLD laboratory in an 'Other' scope (indicated by the number 5 followed by the letter O). Specific ordering of the alpha character is not required.

- The fourth information item is the **name of the organization / NOO** that originally processed the DNA data. (This may be different from the entry in **Field 18.004: Source agency / SRC** . This is an optional information item is in Unicode characters and is unlimited in length.

- The fifth information item is the **point of contact / POC** who composed the DNA record metadata. This is an optional information item that could include the name, telephone number and e-mail address of the person responsible for this record submission. This information item may be up to 200 Unicode characters.

- The sixth information item is optional. It is the *ISO-3166-1* **code of the sending country / CSC**. This is the code of where the DNA was processed -- not necessarily the nation of the agency entered in **Field 18.004: Source agency / SRC** . All three formats specified in *ISO-3166-1* are allowed (Alpha2, Alpha3 and Numeric). A country code is either 2 or 3 characters long.

- The seventh information item is optional. It is the **international organization name / ION** of the submitting organization. This is completed if the DNA was processed by an organization that is not affiliated with a country (such as a multi-national organization). This optional information item is the name/acronym of organizations, and may be up to 100 Unicode characters.

8.18.4 Field 18.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 18.993: Source agency name / SAN**.

8.18.5 Field 18.005: Number of analyses flag / NAL

This mandatory field indicates whether the DNA record contains multiple or single data analyses. Possible entries are:

0 = “Multiple” or
1 = “Single”.

8.18.6 Field 18.006: Sample donor information / SDI

This field is mandatory. It indicates if the DNA information is from the subject described in Record Type-2 or if it is from another person, which is being sent to assist in establishing or verifying the identity of the subject of the transaction. Note that multiple Type-18 records may be included in a single transaction; only one record may have a value of 0 for the first information item.

- The allowed numeric values for the first mandatory information item **DNA sample donor / DSD** are:

  0 = Subject of the transaction
  1 = Claimed, purported or validated relative
  2 = Unknown source

- The second information item is the **gender ID / GID**. This is an optional single character identifier of "M" or "F" or "U". "U" indicates unknown. **GID** may be set based on self-assignment by the specimen donor. The **GID** may not match the results from the Amelogenin or for other valid cases.

- The third information item, **date of last contact / DLC** is an optional date field. See Section 7.7.2.3 for the format. For example, in a missing persons case, it is the date that the person was last seen.

- The fourth information item, **date of birth / DOB**, is an optional date field. **Section 7.7.2.3** for the format.

- The fifth information item is the **ethnic group / EGP**. It is an optional string of 50 Unicode characters used to describe the ethnic group to which the subject belongs.

- The sixth information item is optional and indicates if dental records are available for the subject (**dental records available / DRA**). This information item shall be entered only if DSD=0. Allowed numeric values are:

  0 = No
  1 = Yes
  2 = Unknown

- The seventh optional information item is the **sample collection location description / LLC**. It is an optional string of up to 4000 Unicode characters. An example is “2 centimeter x 2 centimeter x 3 centimeter deep sample cut from tissue of leg of the unidentified body”. Another example is “Grid 3 Sector 2 Disaster site 32”.

- The eighth optional information item is the **sample donor status / SDS**. This information item will include whether or not the sample donor is deceased, missing or unknown. Allowed numeric values are:

  0 = Deceased
  1 = Missing Person
  2 = Unknown

Normally, this item would only be used for the sample associated with the subject of the transaction (**SDI** = 0), but it could be possible to use it in other cases, such as a hair sample from a deceased relative. It could also be 'unknown' for the purported relative's status, but DNA samples were available for that individual (such as blood sample previously collected).

8.18.7 Field 18.007: Claimed or purported relationship / COPR

This field is mandatory if the value for **DSD** is equal to 1. It is selected from **Table 81**. It is a numeric value selected from the "Relationship code" column.

Table 81 Relationship table

Relationship code	Relationship Description
1	Biological child
2	Biological father
3	Biological mother
4	Biological sibling
5	Maternal relative
6	Paternal relative
7	Other / unknown

8.18.8 Field 18.008: Validated relationship / VRS

This field is optional and is a numeric value selected from the "Relationship Code" column of **Table 81.** This information item is completed based upon a comparison of the subject's DNA with the DNA of the person with whom the relationship is claimed or purported. It is only filled in if **DSD** = 1.

8.18.9 Field 18.009: Pedigree information / PED

This optional field contains information and structure associated with the pedigree.

- The first information item is the **pedigree ID** / **PID**. It is a character string of up to 24 Unicode characters. It is mandatory if this field is used and it indicates the identity of the pedigree determined and held at the laboratory that originates the pedigree.

- The second information item is the **pedigree member ID / PMI**. It is a unique reference within the pedigree. It is mandatory if this field is used. This information item refers to the subject of the transaction. It is a character string of up to 6 Unicode characters. This information item shall also provide the ability to link pedigree information.

- The third information item is the **pedigree member status / PMS**. It is mandatory if this field is used. It is a single-character containing one of the following values: [This information item refers to DNA associated with this record] :

  K = Known
  U = Unknown

- The fourth information item is the DNA **sample identifier / SID** for the transaction. It is not an identifier within the pedigree chain, unlike the following two identifiers or the PID. It is a character string of 24 Unicode characters or less. This information item relates the sample in this record to the pedigree.

- The fifth information item is the **father identifier / FID**. It is optional and is a numeric value of 3 digits or less that is unique within the pedigree. This information item is the father identified as related to the sample indicated in the PMI item.

- The sixth information item is the **mother identifier / MID**. It is optional and is a numeric value of 3 digits or less that is unique within the pedigree. This information item is the mother identified as related to the sample indicated in the PMI item.

- The seventh optional information item is the **pedigree comment / PCM**. It is up to 2000 Unicode characters.

8.18.10 Field 18.010: Sample type / STY

This mandatory field contains two information items. The first represents the origination cell type from where the sample was collected (**sample cellular type / SCT)**. It is mandatory and shall contain a numeric value selected from the 'Cellular code' column of **Table 82**. The second information item is the **sample origin / SMO.** It is an optional item of a string of 2 alphabetic characters describing where the sample was obtained. It contains one of the following values:

NS = Not Specified
WB = Whole Body
BP = Body Part

Table 82 DNA sample cellular types

Cellular code	Cellular type
0	Blood
1	Bone
2	Co-mingled Biological Material
3	Hair
4	Saliva
5	Semen
6	Skin
7	Sweat or Fingerprint
8	Tissue
9	Tooth
10	Other
11	Unknown

8.18.11 Field 18.011: Sample typing information / STI

This mandatory field represents the technology utilized to type the DNA sample. A repeating subfield shall comprise this field. Each subfield shall contain a number from the following list:

0= Nuclear
(indicates presence of **Field 18.016: Autosomal STR, X-STR and Y-STR / STR**)

1 = mtDNA
(indicates presence of **Field 18.017: Mitochondrial DNA data / DMD**)

2 = electropherogram data
(indicates presence of **Field 18.019: Electropherogram description / EPD**)

3 = electropherogram ladder
(indicates presence of **Field 18.023: Electropherogram ladder / EPL**)

4 = user-defined profile data
(indicates the presence of **Field 18.018: DNA user-defined profile data / UDP**)

8.18.12 Field 18.012: Sample collection method / SCM

This optional field contains a description of the method used to collect the DNA sample. It is a character string up to 255 Unicode characters.

8.18.13 Field 18.013: Sample collection date / SCD

This mandatory field contains the date and time that the sample was collected. See **Section 7.7.2.2 Coordinated universal time** for details.

8.18.14 Field 18.014: Profile storage date / PSD

This mandatory field contains date and time the sample was stored. See **Section 7.7.2.2.**

8.18.15 Field 18.015: DNA profile data / DPD

This is a mandatory field. It contains information and structure associated with the DNA profile data. It is comprised of the following information items.

- The first information item is mandatory. It is the **profile type / PTP**. It is a numerical value. Allowable values are:

  0 = Person (DNA sample collected from an identified or referenced individual) or
  1 = Stain (DNA sample collected from an unknown human remain or piece of evidence).

- The second information item is optional and is the **result / RES**. It is entered with a numeric value selected from **Table 83**.

Table 83 DNA result codes

Code	Description
0	Unable to process
1	No hit
2	Hit
3	Hit, high/exact
4	Hit, moderate
5	Hit, low
6	Additional results / details
7	user-defined 2
8	user-defined 3
9	user-defined 4
10	user-defined 5

- The third information item is mandatory and is the **profile ID / PRF**. It is a character string with a unique party identification. This information item is used to uniquely identify the profile or sample for which the transaction is based. It is a maximum of 64 Unicode characters.

- The optional fourth information item is a **supplemental message / SUP**. This information item states if this transaction is a supplemental message to a previous transmission. It is up to 100 Unicode characters.

- The optional fifth information item is a **DNA profile comment / DPC**. It is up to 100 Unicode characters.

8.18.16 Field 18.016: Autosomal STR, X-STR and Y-STR / STR

This optional field may be comprised of as many subfields as there are combinations of data type and locus type reported. This field is only present if **Field 18.011: Sample typing information / STI** has a subfield with the value 0.

- The first information item is mandatory. It is the **DNA STR type / DST**. It has one of the following numeric values:

  0= Autosomal STR Profile
  1= X-STR Profile
  2= Y-STR Profile

- The second information item is mandatory. It is the **DNA locus reference / DLR**. The current valid loci for Autosomal, Y and X-STRs are maintained by NIST and are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. This information item is an integer entry with up to 3 characters per locus.

- The third information item, **allele indicator / ALL,** is mandatory. It is a numeric entry containing a zero if no allele is found. Otherwise it is filled with a 1.

- The fourth information item is mandatory. It is the **locus analysis indicator / LAI**. It is a numeric entry, containing a zero if not analyzed. Otherwise it contains a 1.

- The fifth information item is mandatory. It is the **precise call determination / PCDT**. It is a numeric entry containing a zero if the precise call cannot be determined, due to an uncertainty in the call. Otherwise it contains a 1.

- The sixth information item shall have a value if **ALL** is 1. It shall be empty if **ALL** is 0. It is the **allele call 1 / AL1**. This is the allele call for the locus reference as indicated by the value of **DLR**. It contains up to 4 characters, such as “11” or “23.3”.

- The seventh information item is conditional upon the value of **ALL** being 1. It is the **allele call 2 / AL2**. This is the allele call for the locus reference as indicated by the value of **DLR**. It contains up to 4 characters, such as "11" or "23.3". It may appear only if **AL1** is used; since there are cases with only one allele in a call, it is possible that **AL1** will have a value in this field and **AL2** will not have a value. It shall be empty if **AL1** is empty.

- The eighth information item is optional but shall not appear unless ALL = 1. It is the **allele call 3 / AL3**. This is the allele call for the locus reference **DLR**. It contains up to 4 characters, such as "11" or "23.3". This is not used for mixtures, but is for the rare case of a tri-allele. The information item **allele call 3 / AL3** shall only appear if information items **AL1** and **AL2** are present.

- The ninth information item is the **batch ID / BID**. This optional information item shall contain an identifier for the batch to which a locus belongs. This may be referred to as the gel or plate identifier. A specimen may have loci from multiple batches. The **BID** shall be up to 32 Unicode characters.

- The tenth information item is optional. It is called the **electropherogram cross reference / ECR** and has the same value as the **electropherogram image reference / EIR** from the appropriate subfield of **Field 18.019: Electropherogram description / EPD** that is associated with the information in this field and particular subfield instance (if there is such an electropherogram present in this instance of the record).

- The eleventh information item is optional. It is called the **ladder cross reference / LCR** and has the same value as the **ladder image reference / LIR** from the appropriate subfield of **Field 18.023: Electropherogram ladder / EPL** that is associated with the information in this field and particular subfield instance (if there is such a ladder present in this instance of the record).

- The twelfth information item is the **kit ID / KID**. This mandatory information item contains a number that references the kit used to process the DNA described in this record. The numeric values for specific kits are contained in the list of kits maintained by NIST at: http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. The values to be entered are those in the "Reference Number" column. The **KID** value shall be represented as 0 for a non-listed kit. If a non-listed kit is used (**KID** = 0), then the eleventh, twelfth and thirteenth information items are mandatory.

- The thirteenth information item is the **kit name / KNM**. This is an alphanumeric value of up to 32 Unicode characters. **KNM** shall be entered if **KID** = 0.

- The fourteenth information item is the **manufacturer / KMF**. It is an alphanumeric value of up to 32 Unicode characters. **KMF** shall be entered if **KID** = 0.

- The fifteenth information item is the **description of the kit (with part or catalog number) / KDS**. This is up to 128 Unicode characters. **KDS** shall be entered if **KID** = 0.

8.18.17 Field 18.017: Mitochondrial DNA data / DMD

To accommodate the differences in how mtDNA types are derived (differences from reference), the interpretation issue is avoided in this standard by dividing the control region into 2 regions (even though HV3 exists) to ensure any insertions / deletions/ C-stretches are included. This method enables any receiver of the data to use it in a way to which they are accustomed (either using the full sequence or interpreting the full sequence according to their own methodology). The resultant data use would then be fully consistent with the receiver's database and enable processing. This is an optional field, but if it is entered, all information items are mandatory. This field is only present if **Field 18.011: Sample typing information / STI** has a subfield with the value 1.

- The first information item is the **mito control region 1 / MT1**. It is defined as inclusive of HV1, starting at 16024 and ending at 16569. The string shall be 646 characters. This string length allows for insertions in HV1. Each character is an IUPAC value from **Table 84** or a sequence value: A, G, C or T.

- The second information item is the **mito control region 2 / MT2** is defined as inclusive of HV2 and HV3, starting at 1 and ending at 576. With insertions in HV2 and HV3, there may be up to 976 characters in **MT2**. Each character is an IUPAC value from **Table 84**.

- The third information item is the **base composition starting point / BSP**. This entry is numeric, up to 5 digits. *Starting point* is the base position (rCRS) where the primer pair starts interrogating the mitochondrial DNA.

- The fourth information item is the **base composition ending point / BEP**. This entry is numeric, up to 5 digits. *Ending point* is the base position (rCRS) where the primer pair stops interrogating the mitochondrial DNA.

- The fifth information item is the **base composition A length / BCA**. It is a numerical value of up to two digits. A represents the number of adenines in the region being amplified.

- The sixth information item is the **base composition G length / BCG**. It is a numerical value of up to two digits. G represents the number of guanines in the region being amplified.

- The seventh information item is the **base composition C length / BCC**. It is a numerical value of up to two digits. C represents the number of cytosines in the region being amplified.

- The eighth information item is the **base composition T length / BCT**. It is a numerical value of up to two digits. T represents the number of thymines in the region being amplified.

When interrogating mtDNA, depending on primers and sequencing, the ordering of content is impacted.

Table 84 IUPAC DNA codes

IUPAC Code	Definition
R	G, A
Y	T, C
M	A, C
K	G, T
S	G, C
W	A, T
H	A, C, T
B	G, T, C
V	G, A, C
D	G, A, T
N	G, A, T, C
-	Deletion

8.18.18 Field 18.018: DNA user-defined profile data / UDP

This optional field is user-defined, when data other than Autosomal STR, X-STR, Y-STR, mtDNA or an electropherogram is included as part of the transaction. The sender shall provide the receiver with a description of the field contents. This field is only present if **Field 18.011: Sample typing information / STI** has a subfield with the value 4.

8.18.19 Field 18.019: Electropherogram description / EPD

This optional field contains a subfield for each electropherogram. This field is only present if **Field 18.011: Sample typing information / STI** has a subfield with value 2.

Each subfield is comprised of the following information items, the first four of which are mandatory if this field is used:

- The first information item is the **electropherogram image reference / EIR**. It shall contain an alphanumeric reference up to 8 characters, which is unique for each image. If none has been assigned, enter 999. This is a unique identifier.

- The second information item is the **electropherogram storage type / EST**. This is a string of up to 4 characters, representing the file type suffix for the electropherogram. The data is stored in “fsa”, “hid” or “----” The dashes may be substituted with character strings for other format types as they become available.

- The third information item is the **image data descriptor / IDD** of the electropherogram contained in this subfield. If the data is stored externally, enter the filename. This is a Unicode string of up to 200 characters. An example is “NIST Run 5 Well A06 12 Jan 11”

- The fourth information item is the **electropherogram data/ ELPD**. This shall be stored in base-64 format.

- The fifth information item is optional. It is the **electropherogram screenshot / EPS**. This may be an image captured during the analysis. This shall be stored in base-64 format.

8.18.20 Field 18.020: DNA genotype distribution / DGD

This field contains informative genotype representation type of DNA information. It is an optional field. The entry is numeric:

0 = Likelihood
1 = Probability

8.18.21 Field 18.021: DNA genotype allele pair / GAP

This field is only present if **Field 18.020: DNA genotype distribution / DGD** has a value. It is used for low-template, mixture or stain scenarios only. It is comprised of a repeating subfield that occurs once for each allele pair. Allele calls are captured in **Field 18.016: Autosomal STR, X-STR and Y-STR / STR.** Each subfield contains the following information items.

- The first information item is the **genotype locus reference / GLR**. The current valid loci for Autosomal, Y and X-STRs are maintained by NIST and are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm . The GLR is a numeric entry with up to 3 characters per locus. The maximum value of 200 listed in Table 79 is to allow for potential additions to the loci reference table.

- The second information item is the **allele pair / ALP**. This is a numeric information item containing the allele pair data of up to 9 numeric characters separated by a comma between values. An example is “14,23.3” or “22.1,23.3”.

- The third information item is the **genotype numerical weight / GNW**. It is a non-negative real number up to 5 characters (including a period) ranging from 0 to 1. An example is “0.114”.

8.18.22 Field 18.022: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.18.23 Field 18.023: Electropherogram ladder / EPL

This optional field contains a repeating subfield for a ladder / control sample. This field is only present if **Field 18.011: Sample typing information / STI** has a subfield with the value 3. Each subfield is comprised of the following information items, the first four of which are mandatory if this field is used:

- The first information item is the **ladder image reference / LIR**. It shall contain an alphanumeric reference up to 8 characters, which is unique for each image. If none has been assigned, enter 999. This is a unique identifier.

- The second information item is the **ladder storage type / LST**. This is a string of up to 4 characters, representing the file type suffix for the electropherogram. The data is stored in "fsa", "hid" or "----" The dashes may be substituted with character strings for other format types as they become available.

- The third information item is the **ladder image data descriptor / LDD** of the electropherogram contained in this subfield. If the data is stored externally, enter the filename. This is an alphanumeric string with special characters allowed. An example is "NIST Run 5 Well A07 12 Jan 11"

- The fourth information item is the **ladder electropherogram data/ LEPD**. This shall be stored in base-64 format.

- The fifth information item is optional. It is the **ladder electropherogram screenshot / LES.** This may be an image captured during the analysis. This shall be stored in base-64 format.

8.18.24 Fields 18.200-18.900: user-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.18.25 Field 18.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.18.26 Field 18.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 18.004: Source agency / SRC .**

8.18.27 Field 18.995: Associated context / ASC

This optional field refers to one or more Record(s) Type-21. See **Section 7.3.3.**

8.18.28 Field 18.998: Geographic sample acquisition location / GEO

This optional field contains the location where the DNA was acquired – not where it is stored. See **Section 7.7.3**.

8.19 Record Type-19: Plantar image record

The Type-19 record shall contain and be used to exchange plantar print image data together with fixed and user-defined textual information fields pertinent to the digitized image. Information regarding the scanning resolution used, the image size, and other parameters or comments required to process the image are recorded as fields within the record. Plantar print images transmitted to other agencies will be processed by the recipient agencies to extract the desired feature information required for matching purposes. Plantars are defined in this standard to be friction ridge prints from the foot. The areas are the individual toes, ball/inter-digital area, arch, and heel for each foot. It is recommended to capture foot friction ridge data at 1000 ppi.

Table 85 Type-19 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
19.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
19.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	$0 \leq IDC \leq 99$ integer	1	1
19.003	**IMP**	**IMPRESSION TYPE**	M	N	2	2	$28 \leq IMP \leq 31$ see **Table 7**	1	1
19.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
19.005	**PCD**	**PLANTAR CAPTURE DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
19.006	**HLL**	**HORIZONTAL LINE LENGTH**	D	N	2	5	$10 \leq HLL \leq 99999$ positive integer	0	1
19.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	$10 \leq VLL \leq 99999$ positive integer	0	1
19.008	**SLC**	**SCALE UNITS**	D	N	1	1	$0 \leq SLC \leq 2$ integer	0	1
19.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
19.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
19.011	**CGA**	**COMPRESSION ALGORITHM**	D	AN	3	5	value from **Table 15**	0	1
19.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	positive integer	0	1
19.013	**FGP**	**FRICTION RIDGE (PLANTAR) GENERALIZED POSITION**	M	N	2	2	$60 \leq FGP \leq 79$	1	1
19.014-19.015		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
19.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	O	N	1	5	positive integer	0	1
19.018	**AMP**	**AMPUTATED OR BANDAGED**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	8

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	FRAP	friction ridge amputated or bandaged position	M⇑	N	1	2	FRAP = 61 or 62 or 64 ≤ FRAP ≤ 79 See Table 8	1	1
	ABC	amputated or bandaged code	M⇑	A	2	2	ABC = XX or UP	1	1
19.019	**FSP**	**FRICTION RIDGE – PLANTAR SEGMENT POSITION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	5
	FRSP	friction ridge segment position	M⇑	N	1	2	64 ≤ FRSP ≤ 73 positive integer	1	1
	NOP	number of points	M⇑	N	1	2	3 ≤ NOP ≤ 99 positive integer	1	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point - FOR A TOTAL OF NOP PAIRS								
	HPO	horizontal point offset	M⇑	N	1	5	0 ≤ HPO ≤ HLL positive integer	3	NOP
	VPO	vertical point offset	M⇑	N	1	5	0 ≤ VPO ≤ VLL positive integer	3	NOP
19.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
19.021-19.023		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.024	**FQM**	**FRICTION RIDGE - PLANTAR PRINT QUALITY METRIC**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	FRMP	friction ridge metric position	M⇑	N	2	2	60 ≤ FRMP ≤ 79 positive integer	1	1
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	QAP	algorithm product identification	M⇑	N	1	5	1≤ QAP ≤ 65535 positive integer	1	1
19.025-19.029		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	values from **Table 5**	0	1
19.031-19.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.200 – 19.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
19.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
19.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
19.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
19.905-19.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
19.994		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
19.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
19.996	**HAS**	**HASH**	O	H	64	64	none	0	1
19.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	SRN	source representation number	M⇑	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
19.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
19.999	**DATA**	**PLANTAR IMAGE DATA**	D	B	1	*	none	0	1

8.19.1 Field 19.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.19.2 Field 19.002: information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-19 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section 7.3.1.**

8.19.3 Field 19.003: Impression type / IMP

This mandatory field shall indicate the manner by which the plantar print was obtained. See **Section 7.7.4.1** for details.

8.19.4 Field 19.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 19.993: Source agency name / SAN**.

8.19.5 Field 19.005: Plantar capture date / PCD

This mandatory field shall contain the date that the plantar biometric data contained in the record was captured. See **Section 7.7.2.3** for details.

8.19.6 Field 19.006: Horizontal line length / HLL

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.1** for details.

8.19.7 Field 19.007: Vertical line length / VLL

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.2** for details.

8.19.8 Field 19.008: Scale units / SLC

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.3** for details.

8.19.9 Field 19.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.4** for details.

8.19.10 Field 19.010: Transmitted vertical pixel scale / TVPS

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.5** for details.

8.19.11 Field 19.011: Compression algorithm / CGA

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 15** for a list of the codes, and **Section 7.7.9.1** for a detailed description of this field.

8.19.12 Field 19.012: Bits per pixel / BPX

This field is mandatory if an image is present in **Field 17.999**. Otherwise it is absent. See **Section 7.7.8.6** for details.

8.19.13 Field 19.013: Friction ridge (plantar) generalized position / FGP

This mandatory field shall contain the plantar print position that matches the plantar print image. Valid codes range from 60 to 79. See **Table 8**. See **Section 7.7.4.2** for details.

8.19.14 Field 19.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7** for details.

8.19.15 Field 19.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8** for details.

8.19.16 Field 19.018: Amputated or bandaged / AMP

This optional field shall specify if a foot is amputated or bandaged. Multiple subfields may be entered and each shall contain two information items.

- The first item is the **friction ridge amputated or bandaged position / FRAP.** It shall have a value of 61 or 62 or between 64 and 79 as chosen from **Table 8**. This information item is called the **friction ridge amputated or bandaged position / FRAP** to differentiate it from **FGP.**
- The second item is the **amputated or bandaged code / ABC,** also known as the AMPCD. **Table 72** is a list of allowable indicators for the AMPCD.

If an entire foot is missing, either 61 (sole and toes – right foot) or 62 (sole and toes – left foot) shall be entered for **FRAP.** A partially scarred foot should be printed. XX shall be used only when a partial print exists due to amputation; therefore it contains *some* friction ridge detail. UP shall be used with the complete block where an image was to be transmitted, but there is no image due to amputation or total lack of friction ridge detail (such as with a bandage). An image with a scar should not be marked XX or UP.

8.19.17 Field 19.019: Friction ridge - toe segment position(s) / FSP

This is an optional field. It describes the locations for each of the image segments of up to five individual toes within a flat image. This field shall consist of up to five repeating subfields, one for each segment. There need not be more than one subfield present. Additional toes (beyond five per foot) shall be grouped together with either the big toe or the little toe, depending upon the side of the foot upon which they appear.

The first information item is called the **friction ridge segment position / FRSP** to differentiate it from **FGP.**

8.19.18 Field 19.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.19.19 Field 19.024: Friction ridge - plantar print quality metric / FQM

This optional field is used to specify one or more different metrics of plantar print image quality score data for the image stored in this record. Each subfield is comprised of four information items. The first information shall be the **friction ridge metric position / FRMP** for the image stored in this record. Valid codes range from 60 to 79. See **Table 8.** See **Section 7.7.7** for a description of the remaining three information items.

8.19.20 Field 19.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

8.19.21 Fields 19.200-900: User-defined fields / UDF

These fields are user-defined fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.19.22 Field 19.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.19.23 Field 19.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.19.24 Field 19.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.19.25 Field 19.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 19.004: Source agency / SRC**.

8.19.26 Field 19.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same ACN. See **Section 7.3.3.** Record Type-21 contains images that are NOT used to derive the biometric data in **Field 19.999: Plantar image / DATA** but that may be relevant to the collection of that data, such as general scenes of the area where the body of the subject was found.

8.19.27 Field 19.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 19.999: Plantar image / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.19.28 Field 19.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN**.

8.19.29 Field 19.998: Geographic sample acquisition location / GEO

This optional field contains the location where the plantar sample was acquired – not where it is stored. See **Section 7.7.3**.

8.19.30 Field 19.999: Plantar image / DATA

This field contains the plantar image. See Section **7.2** for details. It shall contain an image, unless **Field 19.018: Amputated or bandaged / AMP** has a value of "UP". In the latter case, the field is optional. Some domains and application profiles may still require an image in this field (such as of the word "Amputated"). Note that in previous versions of the standard that this field was mandatory in all circumstances.

8.20 Record Type-20: Source representation record

New to this version of the standard, the Type-20 record contains the source representation(s) from which other Record Types were derived. Examples are an image of multiple latent prints, of which one or more is of interest. Those would be segmented and prepared for sending in a Type-13 record. An audio/visual record may provide both facial images for Type-10 record. They are many more occasions when it might be appropriate to use a Type-20 record.

Table 86 Type-20 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
20.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
20.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
20.003	**CAR**	**SRN CARDINALILTY**	M	A	1	1	SDE = S, D, or M	1	1
20.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	None	1	1
20.005	**SRD**	**SOURCE REPRESENTATION DATE**	O	See **Section 7.7.2.4 Local date & time** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See **Section 7.7.2.4 Local date & time** **encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules**	0	1
20.006	**HLL**	**HORIZONTAL LINE LENGTH**	D	N	2	5	10 ≤ HLL ≤ 99999 positive integer	0	1
20.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	10 ≤ VLL ≤ 99999 positive integer	0	1
20.008	**SLC**	**SCALE UNITS**	D	N	1	1	SLC = 0, 1 or 2 integer	0	1
20.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
20.010	**TVPS**	**TRANSMITTED VERTICAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
20.011	**CGA**	**COMPRESSION ALGORITHM**	D	AN	3	5	value from **Table 15**	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
20.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	positive integer	0	1
20.013	**CSP**	**COLOR SPACE**	D	A	3	4	value from **Table 16**	0	1
20.014	**AQS**	**ACQUISITION SOURCE**	M					1	1
		Subfields: Repeating sets of information items	M					1	9
	AQT	acquisition source type	M	N	1	2	value from **Table 88**	1	1
	A2D	analog to digital conversion	D	U	1	200	none	0	1
	FDN	radio transmission format description	D	U	1	200	none	0	1
	AQSC	acquisition special characteristics	O	U	1	200	none	0	1
20.015	**SFT**	**SOURCE REPRESENTATION FORMAT**	M					1	1
	FTY	file type	M	U	3	6	none	1	1
	DEI	decoding instructions	O	U	1	1000	none	0	1
20.016	**SEG**	**SEGMENTS**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	RSP	reference segment position	M⇑	N	1	2	$1 \leq RSP \leq 99$ positive integer	1	1
	IPT	internal file reference pointer	M⇑	ANS	1	15	none	1	1
	NOP	number of points	O⇑	N	1	2	$3 \leq NOP \leq 99$ positive integer	0	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point – for a total of NOP pairs								
	HPO	horizontal point offset	D	N	1	5	$0 \leq HPO \leq HLL$ positive integer	0	NOP
	VPO	vertical point offset	D	N	1	5	$0 \leq VPO \leq VLL$ positive integer	0	NOP
20.017	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
20.018	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
20.019	**TIX**	**TIME INDEX**	D					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
		Subfields: Repeating sets of information items	M⇑					1	99
	TIS	time index start	M⇑	NS	12	12	TIS ≥ 0	1	1
	TIE	time index end	M⇑	NS	12	12	TIE > TIS	1	1
20.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
20.021	**SRN**	**SOURCE REPRESENTATION NUMBER**	M	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
20.022 – 20.099		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
20.100-20.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
20.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
20.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
20.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
20.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
20.905 - 20.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
20.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
20.994	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
20.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	$1 \leq ACN \leq 255$ positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	$1 \leq ASP \leq 99$ positive integer	0	1
20.996	**HAS**	**HASH**	O	H	64	64	none	0	1
20.997		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
20.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or**Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	$-90 \leq LTD \leq 90$	0	1
	LTM	latitude minute value	D	NS	1	8	$0 \leq LTM < 60$	0	1
	LTS	latitude second value	D	NS	1	8	$0 < LTS < 60$	0	1
	LGD	longitude degree value	D	NS	1	10	$-180 \leq LGD \leq 180$	0	1
	LGM	longitude minute value	D	NS	1	8	$0 \leq LGM < 60$	0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	LGS	longitude second value	D	N	1	2	0 ≤ LGS < 60 positive integer	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
20.999	**DATA**	**SOURCE REPRESENTATION DATA**	D	B	1	*	none	0	1

8.20.1 Field 20.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section 7.1**.

8.20.2 Field 20.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-20 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section 7.3.1**.

8.20.3 Field 20.003: SRN cardinality / CAR

This mandatory field indicates how this record is being used,with a value from **Table 87**. It describes the cardinality: one to one (S), one to many (D), or many-to-one (M) of how the source representation record relates to other record(s) within the transaction.

Table 87 CAR values

Value	Description
S	The representation in this Type-20 record is the source of another Type-20 record
D	The representation in this Type-20 record is the source of one or more biometric type records, excluding Type-4 and Type-9, which have been derived from it
M	A single biometric type record, excluding Type-4 and Type-9, has been prepared from multiple Type-20 records

8.20.4 Field 20.004: Source agency / SRC

This is a mandatory field. See **Section** 7.6 for details. The source agency name may be entered in **Field 20.993: Source agency name / SAN**.

8.20.5 Field 20.005: Source representation date / SRD

This optional field shall contain the date and time that the source representation contained in the record was captured. See **Section** 7.7.2.4 **Local date and time** for details.

8.20.6 Field 20.006: Horizontal line length / HLL

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.1 for details.

8.20.7 Field 20.007: Vertical line length / VLL

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.2 for details.

8.20.8 Field 20.008: Scale units / SLC

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.3 for details.

8.20.9 Field 20.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.4 for details.

8.20.10 Field 20.010: Transmitted vertical pixel scale / TVPS

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.5 for details.

8.20.11 Field 20.011: Compression algorithm / CGA

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.9 for details.

8.20.12 Field 20.012: Bits per pixel / BPX

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.6 for details.

8.20.13 Field 20.013: Color space / CSP

This field is mandatory if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.10.3 for details.

8.20.14 Field 20.014: Acquisition source / AQS

This mandatory field shall specify and describe the acquisition source. The following information items may be repeated for up to 9 sources.

- The first information item, **Acquisition source type / AQT,** is mandatory and it shall be a numeric entry selected from the "attribute code' column of **Table 88**.

Table 88 Acquisition source

Acquisition source type	Attribute code
Unspecified or unknown	0
Static digital image from an unknown source	1
Static digital image from a digital still-image camera	2
Static digital image from a scanner	3
Single video frame from an unknown source	4
Single video frame from an analog video camera	5
Single video frame from a digital video camera	6
Video sequence from an unknown source	7
Video sequence from an analog video camera, stored in analog format	8
Video sequence from an analog video camera, stored in digital format	9
Video sequence frame from a digital video camera	10
Computer screen image capture	11
Analog audio recording device; stored in analog form (such as a phonograph record)	12

Acquisition source type	Attribute code
Analog audio recording device; converted to digital	13
Digital audio recording device	14
Landline telephone – both sender and receiver	15
Mobile telephone – both sender and receiver	16
Satellite telephone – both sender and receiver	17
Telephone – unknown or mixed sources	18
Television – NSTC	19
Television – PAL	20
Television - Other	21
Voice-over-internet protocol (VOIP)	22
Radio transmission: short-wave (specify single side band or continuous wave in FDN)	23
Radio transmission: amateur radio (specify lower side band or continuous wave in FDN)	24
Radio transmission: FM (87.5 MHz to 108 MHz)	25
Radio transmission: long-wave (150 kHz to 519 kHz)	26
Radio transmission: AM (570 kHz to 1720 kHz)	27
Radio transmission: Aircraft frequencies	28
Radio transmission: Ship and coastal station frequencies	29
Vendor specific capture format	30
Other	31

- The second information item is mandatory if the acquisition source is analog, and the data is stored in digital format. It is a text field, **analog to digital conversion / A2D**, that describes the analog to digital equipment used to transform the source. This field should address parameters used, such as sample rate, if known.

- The third information item is mandatory if the **AQT** is 23 or 24. It is a text field, **radio transmission format description / FDN**. It is optional for other radio transmission codes.

- The fourth information item is optional. It is a free text field, **acquisition special characteristics / AQSC** that is used to describe any specific conditions not mentioned in the table. An example would be a near-infrared camera outputting images in visible wavelengths.

8.20.15 Field 20.015: Source representation format / SFT

This is a mandatory field comprised of two information items.

- The first information item is mandatory. It is **file type / FTY**. If the source representation is a digital file, this shall contain the suffix indicating the file type (such as JPG). If it is an analog file, enter 'ANALOG'. For digital data stored in other formats (such as digital tape), enter 'OTHER'.

- The second information item is **decoding instructions / DEI**. It is optional and contains free text up to 1000 characters.

8.20.16 Field 20.016: Segments / SEG

This optional field shall consist of a subfield for each segment of a 2D image to be defined. Each subfield consists of a series of information items. See **Section** 7.7.12.2 for details.

8.20.17 Field 20.017: Scanned horizontal pixel scale / SHPS

This field is optional if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted. See **Section** 7.7.8.7 for details.

8.20.18 Field 20.018: Scanned vertical pixel scale / SVPS

This field is optional if a 2D still image is contained in this instance of the record. Otherwise it shall be omitted . See **Section** 7.7.8.8 for details.

8.20.19 Field 20.019: Time index / TIX

This is a conditional field. If the record contains video or audio, it shall contain the start and end times of segments within the file. For instance, if **AQT** has a value between 1 and 7 or equal to 11, this field would not be used. See **Section** 7.7.2.5 for details.

8.20.20 Field 20.020: Comment / COM

This optional field may be used to insert comments or other text information with the representation data. See **Section** 7.4.4.

8.20.21 Field 20.021: Source representation number / SRN

This mandatory field contains a reference number for the source representation stored in this record. Note that the segment references are contained in **Field 20.016: Segments / SEG** if they exist. The value for **SRN** in **Field 20.021** corresponds to the **SRN** that may be referenced as the first information item in the **SOR** field of other Record Types. See **Section** 7.3.2. The **SRN** is a positive integer that uniquely refers to a particular instance of Record Type-20. It is an integer, numbered sequentially beginning at one and incremented for each instance of Record Type-20.

8.20.22 Fields 20.100-900: User-defined fields / UDF

The size and content shall be defined by the user and be in accordance with the receiving agency.

8.20.23 Field 20.902: Annotation information / ANN

This optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section** 7.4.1.

8.20.24 Field 20.903: Device unique identifier / DUI

This is an optional field. See **Section** 7.7.1.1 for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.20.25 Field 20.904: Make/model/serial number / MMS

This is an optional field. See **Section** 7.7.1.2 for details.

8.20.26 Field 20.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 20.004: Source agency / SRC.**

8.20.27 Field 20.994: External file reference / EFR

This conditional field shall be used to enter the URL / URI or other unique reference to a storage location for all source representations, if the data is not contained in **Field 20.999.** 2D still images shall not be referenced to an external file. For 2D images, they shall be included in this record in **Field 20.999: Source representation data / DATA**.

If this field is used, **Field 20.999** shall not be set. However, one of the two fields shall be present in all instances of this record type. A non-URL reference might be similar to: "Case 2009:1468 AV Tape 5". It is highly recommended that the user state the format of the external file in **Field 20.020: Comment / COM .**

8.20.28 Field 20.995: Associated context / ASC

This is an optional field. See **Section** 7.3.3 for details.

8.20.29 Field 20.996: Hash/ HAS

This is an optional field. It shall contain the hash value of the source representation in the external file reference in **Field 20.994: External file reference / EFR** or the 2D still image or other biometric data in **Field 20.999: Source representation data / DATA** of this record, calculated using SHA-256. **See Section** 7.5.2.

8.20.30 Field 20.998: Geographic sample acquisition location / GEO

This optional field contains the location where the original source was acquired – not where it is stored. See **Section** 7.7.3.

8.20.31 Field 20.999: Source representation data / DATA

If this field is used, **Field 20.994: External file reference / EFR** shall not be set. However, one of the two fields shall be present in all instances of this record type. See **Section** 7.2 for details this field entry. In Traditional format, this field shall be the last field in the record layout. It is mandatory for a 2D still image.

8.21 Record Type-21: Associated context record

The Type-21 record contains an associated context record. This information does NOT contain information used to derive biometric information contained in other records. Record Type-20 serves that function. Record Type-21 may be used to convey contextual information, such as an image of the area where latent fingerprints were captured.

Table 89 Type-21 record layout

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
21.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
21.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
21.003		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
21.005	**ACD**	**ASSOCIATED CONTEXT DATE**	O	See **Section 7.7.2.4 Local date & time** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See **Section 7.7.2.4 Local date & time** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
21.006 – 21.014		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.015	**AFT**	**ASSOCIATED CONTEXT FORMAT**	M					1	1
	FTY	file type	M	U	3	6	none	1	1
	DEI	decoding instructions	O	U	1	1000	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
21.016	**SEG**	**SEGMENTS**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	ASP	associated segment position	M⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	1	1
	IPT	internal file reference pointer	M⇑	ANS	1	15	none	1	1
	NOP	number of points	O⇑	N	1	2	3 ≤ NOP ≤ 99 positive integer	0	1
	Note: The following two information items are repeated as pairs, in order by point following the path, up to the final point – for a total of **NOP** pairs								
	HPO	horizontal point offset	D	N	1	5	positive integer	0	NOP
	VPO	vertical point offset	D	N	1	5	positive integer	0	NOP
21.017-21.018		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.019	**TIX**	**TIME INDEX**	D					0	1
		Subfields: Repeating sets of information items	M⇑					1	99
	TIS	time index start	M⇑	NS	12	12	TIS ≥ 0	1	1
	TIE	time index end	M⇑	NS	12	12	TIE > TIS	1	1
21.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
21.021	**ACN**	**ASSOCIATED CONTEXT NUMBER**	M	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
21.022-21.099		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.100-21.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
21.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	Unlimited

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	GMT	Greenwich mean time	M⇑	See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules			See Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT encoding specific: see Annex B: Traditional encoding or Annex C: NIEM-conformant encoding rules	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1	255	none	1	1
21.903 – 21.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
21.994	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
21.995		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.996	**HAS**	**HASH**	O	H	64	64	none	0	1
21.997		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	$-90 \leq LTD \leq 90$	0	1
	LTM	latitude minute value	D	NS	1	8	$0 \leq LTM < 60$	0	1
	LTS	latitude second value	D	NS	1	8	$0 < LTS < 60$	0	1
	LGD	longitude degree value	D	NS	1	10	$-180 \leq LGD \leq 180$	0	1
	LGM	longitude minute value	D	NS	1	8	$0 \leq LGM < 60$	0	1
	LGS	longitude second value	D	N	1	2	$0 \leq LGS < 60$ positive integer	0	1
	ELE	elevation	O	NS	1	8	$-422.000 < ELE < 8848.000$ real number	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 6**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
21.999	**DATA**	**ASSOCIATED CONTEXT DATA**	D	B	1	*	none	0	1

8.21.1 Field 21.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.21.2 Field 21.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-21 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section** 7.3.1**.**

8.21.3 Field 21.004: Source agency / SRC

This is a mandatory field. See **Section** 7.6 for details. The source agency name may be entered in **Field 21.993: Source agency name / SAN**.

8.21.4 Field 21.005: Associated context date / ACD

This optional field shall contain the date and time that the context representation contained in the record was captured. See **Section** 7.7.2.4 l**ocal date and time** for details.

8.21.5 Field 21.015: Associated context format / AFT

This is a mandatory field comprised of two information items.

- The first information item is mandatory. It is **file type** / **FTY**. If the associated context file is a digital file, this shall contain the suffix indicating the file type. If it is an analog file, enter 'ANALOG'. For digital data stored in other formats (such as digital tape), enter 'OTHER'.

- The second information item is **decoding instructions** / **DEI**. It is optional and contains free text up to 1000 characters.

8.21.6 Field 21.016: Segments / SEG

This is an optional field. See **Section** 7.7.12.2 for details.

8.21.7 Field 21.019: Time index / TIX

This field is mandatory for records containing video or audio, but not 2D still images. See **Section 7.7.2.5** for details.

8.21.8 Field 21.020: Comment / COM

This optional field may be used to insert comments or other text information with the representation data. See **Section 7.4.4.**

8.21.9 Field 21.021: Associated context number / ACN

This mandatory field contains a reference number for the context representation stored in this record. Note that the segment references are contained in **Field 21.016: Segments / SEG**, if they exist. This number corresponds to the **ACN** that may be referenced as the first information item in the **ASC** field of other Record Types**. See Section 7.3.3**.

The **ACN** is a positive integer that uniquely refers to a particular instance of Record Type-21. It is a positive integer, numbered sequentially beginning at one and incremented for each instance of Record Type-21.

8.21.10 Field 21.100 through 21.900: User-defined fields

Individual fields shall conform to the specifications set forth by the agency to which the transmission is being sent, to the domain listed in **Field 1.013 Domain name / DOM**, the application profiles listed in **Field 1.016 Application profile specifications / APS** and to the requirements specified in **Section 5.1.**

8.21.11 Field 21.902: Annotation information / ANN

This is an optional field, describing the operations performed on the data contained in this record. See **Section 7.4.1.**

8.21.12 Field 21.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 21.004: Source agency / SRC.**

8.21.13 Field 21.994: External file reference / EFR

This conditional field shall be used to enter the URL / URI or other unique reference to a storage location for all associated context files EXCEPT 2D still images. If this field is used, **Field 21.999: Associated context data / DATA** shall not be set. However, one of the two fields shall be present in all instances of this record type. It is an alphanumeric entry, with special characters allowed. A non-URL reference might be similar to: "Case 2009:1468 AV Tape 5". It is highly recommended that the user state the format of the external file in **Field 21.020: Comment / COM .**

8.21.14 Field 21.996: Hash/ HAS

This optional field shall contain the hash value of the context representation in the external file reference in **Field 21.994: External file reference / EFR** or the 2D still image or other data stored in **Field 21.999: Associated context data / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.21.15 Field 21.998: Geographic sample acquisition location / GEO

This optional field contains the location where the context information was acquired – not where it is stored. See **Section 7.7.3**.

8.21.16 Field 21.999: Associated context data / DATA

If this field is used, **Field 21.994: External file reference / EFR** shall not be set. However, one of the two fields shall be present in all instances of this record type. See **Section 7.2** for details on this field entry. It is mandatory for a 2D still image.

8.22 Record Type-98: Information assurance record

The Type-98 record shall contain security information that assures the authenticity and/or integrity of the transaction, possibly utilizing such techniques as binary data hashes, and/or digital signatures. Two mandatory fields in the Information Assurance (IA) Header are **Field 98.003: IA data format owner / DFO** and **Field 98.005: IA data format type / DFT** . The **IA data format owner** field denotes the vendor, standards body, working group, or industry consortium that has defined the format of the IA data. The values in the **IA data format type** field are assigned by the format owner and represent a specific IA Data format as specified by the format owner. This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body. It is the combined **IA Data Format Owner / IA Data Format Type** value that uniquely identifies the IA Data format. There may be many instances of this Record Type per transaction. The records that are protected by a Type-98 are all records other than the Type-98 itself.

Table 90 Type-98 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
98.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
98.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
98.003	**DFO**	**IA DATA FORMAT OWNER**	M	H	4	4	none	1	1
98.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
98.005	**DFT**	**IA DATA FORMAT TYPE**	M	U	1	20	none	1	1
98.006	**DCD**	**IA DATA CREATION DATE**	M	encoding specific: see Annex B or Annex C			encoding specific: see Annex B or Annex C	1	1
98.007-98.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
98.200-98.899	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
98.900	**ALF**	**AUDIT LOG**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	Unlimited
	EVT	event	M⇑	A	5	9	EVT = Added, Modified, Deleted or Corrupted	1	1
	EVR	event reason	O⇑	U	1	200	none	0	1
	IID	information identifier	M⇑	ANS	15	30	field number exists, repeat count valid for the field number, mnemonic exists	1	1
	AGT	agent	M⇑	U	1	200	none	1	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
	OLD	old reference	O⇑	dependent upon the format of the location referenced by IID			value of datum prior to the EVT in the location referenced by IID	0	1
98.901	**ARN**	**AUDIT REVISION NUMBER**	D	N	1	3	1 ≤ ARN ≤ 999 positive integer	0	1
98.902-992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
98.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
98.994-999		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						

8.22.1 Field 98.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.22.2 Field 98.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-98 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT**. See **Section** 7.3.1**.**

8.22.3 Field 98.003: IA data format owner / DFO

This mandatory field shall contain a four-digit hex value which denotes the vendor, standards body, working group, or industry consortium that has defined the format of the information assurance data. NIST maintains a voluntary list of format owners and the four-digit hex values that they have chosen. This list is available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

The **IA data format owner** and **Field 98.005: IA data format type / DFT** , when used in combination with one another uniquely identify the specific format of the IA content. This IA data format definition may be published (public) or unpublished (non-public).

8.22.4 Field 98.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 98.993: Source agency name / SAN.**

8.22.5 Field 98.005: IA data format type / DFT

This mandatory field shall be used to identify the value assigned by the format owner (**DFO**) to represent the specific IA data format as specified by the format owner. This may be a nonstandard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body.

8.22.6 Field 98.006: IA data creation date / DCD

This mandatory field shall contain the date and time that IA data was created. The date and time shall appear as GMT format. See **Section 7.7.2.2** for details.

8.22.7 Fields 98.200-899: User-defined fields / UDF

These fields are user-definable fields. Their size and content shall be defined by **Field 98.005: IA data format type / DFT** .

8.22.8 Field 98.900: Audit log / ALF

This optional field contains a series of repeating subfields. One complete audit statement (subfield of **ALF**) shall be completed for each modified datum. If this field appears, then **Field 98.901 Audit revision number / ARN** shall also be in the record. Each repeating subfield shall be composed of the following information items:

- **event / EVT** is the first information item. It is mandatory and shall contain textual information describing the event that occurred to the *ANSI/NIST-ITL* record/field, and shall be chosen from the following controlled vocabulary:
    - Added
    - Modified
    - Deleted
    - Corrupted

- **event reason / EVR** is the second information item. It states the rationale behind the Event that occurred. This information item is optional and should be populated with alphanumeric text with special characters up to 200 characters.

- **information identifier / IID** is the third information item. It is mandatory and identifies the field/subfield/information item that has been affected by the Event. It is defined as the concatenation of the **IDC**, a comma, the Field Number in the standard, a comma, the repeat count of the subfield (default = NA), a comma, and the information item mnemonic (if it exists).

If a repeating subfield or information item does not exist, enter a "NA". Examples:

- 17,10.014,NA,BBC
- 3,9.373,4,NA
- 8,10.024,2,QVU

  For the case when a repeated subfield is removed, the entry for the repeat field number is the original repeat set count, preceded by a negative; the information item mnemonic is entered as "NA". When an information item is removed, the mnemonic is preceded by a negative. When an optional field is removed, the field number is preceded by a minus. Even though subfields and information items may have been in the field, the field number is followed by "NA,NA" so that the subfields and information items do not have to be individually listed.

- 12,10.024,-2,NA
- 6,18.016,NA,-AL3
- 5,-14.024,NA,NA

- **agent / AGT** is the fourth information item. It is mandatory and shall contain information describing the entity (Agent) responsible for the **EVT** that affected the object identified by the **IID**. It is an alphanumeric entry of up to 200 characters with special characters allowed.

- **old value / OLD** is the fifth information item. It is optional. When used, it shall contain the original value of the location in the transaction referenced in **IID** before it was affected by the event (**EVT**).

8.22.9 Field 98.901 Audit revision number / ARN

This field is mandatory if Field 98.900: Audit log / ALF appears in the record. It contains a unique reference to the revision within the revision history. It is numeric, with up to 3 digits. For example, Revision 1 shall be encoded as 1; Revision 88 as 88. Revision "x" may contain multiple events, each of which is recorded as a discrete modification (requiring a separate subfield in **ARN**). Thus, a different revision, with its corresponding log of modifications (recorded in **ARN)** requires a separate instance of Record Type-98.

8.22.10 Field 98.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 98.004: Source agency / SRC**.

8.23 Record Type-99: CBEFF biometric data record

The Type-99 record shall contain and be used to exchange biometric data that is not supported by other ANSI/NIST-ITL records. This data is exchanged in a format that conforms to *INCITS 398-2005, the Common Biometric Exchange Formats Framework*.

The CBEFF conformant Biometric Information Record (BIR) used by the Type-99 record includes a common Header and a Biometric Data Block (BDB). Two mandatory fields in the CBEFF Header are Format Owner and Format Type. The Format Owner field denotes the vendor, standards body, working group, or industry consortium that has defined the format of the biometric data (the data contained in the BDB). A CBEFF requirement is that format owners register with the IBIA for an assigned identifier of the format owner.

The BDB format is specified by the format owner. This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body. It is the combined CBEFF Format Owner/Format Type value that uniquely identifies the BDB format. The Type-99 record provides the CBEFF fields necessary for users to send, receive, and interpret biometric data in any registered BDB format (with the exception of biometric data which is exchanged using the other records in this standard). The data carried in **Field 99.999: Biometric data block / DATA** is the BDB. The field's BDB Format Owner identifies the format of that data and BDB Format Type as described by the CBEFF standard.

Table 91 Type-99 record layout

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
99.001		**RECORD HEADER**	M	encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
99.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	$0 \leq IDC \leq 99$ integer	1	1
99.003		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
99.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
99.005	**BCD**	**BIOMETRIC CAPTURE DATE**	M	See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.3 Local date** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
99.006-99.099		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used T=5; X=4 [33]						
99.100	**HDV**	**CBEFF HEADER VERSION**	M	N	T=4; X=3 [67]	4	HDV = 0101	1	1
99.101	**BTY**	**BIOMETRIC TYPE**	M	N	T=8; X=1 [67]	8	value From **Table 92**	1	1
99.102	**BDQ**	**BIOMETRIC DATA QUALITY**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	9
	QVU	quality value	M⇑	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or 255 integer	1	1
	QAV	algorithm vendor identification	M⇑	H	4	4	0000 ≤ QAV ≤ FFFF	1	1
	QAP	algorithm product identification	M⇑	N	1	5	1 ≤ QAP ≤ 65535 positive integer	1	1
99.103	**BFO**	**BDB FORMAT OWNER**	M	H	4	4	none	1	1
99.104	**BFT**	**BDB FORMAT TYPE**	M	H	4	4	none	1	1
99.105-99.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						

[67] Traditional encoding (T) requires a leading zero. XML encoding (X) does not. See Section **8**.

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
99.200-99.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
99.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
99.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	*
	GMT	Greenwich mean time	M⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	1	1
	NAV	processing algorithm name / version	M⇑	U	1	64	none	1	1
	OWN	algorithm owner	M⇑	U	1	64	none	1	1
	PRO	process description	M⇑	U	1		none	1	1
99.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P	0	1
99.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M⇑	U	1	50	none	1	1
	MOD	model	M⇑	U	1	50	none	1	1
	SER	serial number	M⇑	U	1	50	none	1	1
99.905-99.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
99.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
99.994		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
99.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1

Field Number	Mnemonic	Content Description	Cond code	Character Type	Character Min #	Character Max #	Value Constraints	Occurrence Min #	Occurrence Max #
		Subfields: Repeating sets of information items	M⇑					1	255
	ACN	associated context number	M⇑	N	1	3	1 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O⇑	N	1	2	1 ≤ ASP ≤ 99 positive integer	0	1
99.996	**HAS**	**HASH**	O	H	64	64	none	0	1
99.997	**SOR**	**SOURCE REPRESENTATION**	O					0	1
		Subfields: Repeating sets of information items	M⇑					1	255
	SRN	source representation number	M⇑	N	1	3	1 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O⇑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
99.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O⇑	See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**			See Section **7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT** encoding specific: see **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**	0	1
	LTD	latitude degree value	D	NS	1	9	-90 ≤ LTD ≤ 90	0	1
	LTM	latitude minute value	D	NS	1	8	0 ≤ LTM < 60	0	1
	LTS	latitude second value	D	NS	1	8	0 < LTS < 60	0	1
	LGD	longitude degree value	D	NS	1	10	-180 ≤ LGD ≤ 180	0	1
	LGM	longitude minute value	D	NS	1	8	0 ≤ LGM < 60	0	1
	LGS	longitude second value	D	NS	1	8	0 < LGS < 60	0	1
	ELE	elevation	O	NS	1	8	-422.000 < ELE < 8848.000 real number	0	1

Field Number	Mnemonic	Content Description	Cond code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	GDC	geodetic datum code	O	AN	3	6	value from Table 6	0	1
	GCM	geographic coordinate universal transverse Mercator zone	O	AN	2	3	one or two integers followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1
	GCN	geographic coordinate universal transverse Mercator northing	D	N	1	8	integer	0	1
	GRT	geographic reference text	O	U	1	150	none	0	1
	OSI	geographic coordinate other system identifier	O	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
99.999	**DATA**	**BIOMETRIC DATA BLOCK**	M	B	1	*	none	1	1

8.23.1 Field 99.001: Record header

The content of this mandatory field is dependent upon the encoding used. See the relevant annex of this standard for details. See **Section** 7.1.

8.23.2 Field 99.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this Type-98 record as listed in the information item **IDC** for this record in **Field 1.003 Transaction content / CNT.** See **Section** **7.3.1.**

8.23.3 Field 99.004: Source agency / SRC

This is a mandatory field. See **Section** 7.6 for details. The source agency name may be entered in **Field 99.993: Source agency name / SAN**.

8.23.4 Field 99.005: Biometric capture date / BCD

This is a mandatory field. See **Section** 7.7.2.2 for details.

8.23.5 Field 99.100: CBEFF header version / HDV

This mandatory ASCII field shall be used to identify the version of CBEFF specification to which this record conforms (See **Section 3 Normative references)**. The format is two characters for major version number followed by two characters for minor version. The version of CBEFF in *INCITS 398-2005* (See **Section 3 Normative references)** is represented by the string '0101' (major version '01' and minor version '01'). See **Section 8** for information concerning leading zeros.

8.23.6 Field 99.101: Biometric type / BTY

This mandatory field adopts the values presented in CBEFF with the addition of two leading zeros for future expansion. **Table 92** lists the current biometric type codes for modalities not covered in this standard with specific Record Types assigned to them.[68] See **Section 8** for information concerning leading zeros.

Table 92 CBEFF biometric type

Biometric Type Name	Biometric Type Code
No Information Given	'00000000'
Multiple Biometrics Used	'00000001'
Voice	'00000004'
Retina	'00000020'
Hand Geometry	'00000040'
Signature Dynamics	'00000080'
Keystroke Dynamics	'00000100'
Lip Movement	'00000200'
Thermal Face Image	'00000400'
Thermal Hand Image	'00000800'
Gait	'00001000'
Body Odor	'00002000'
Ear Shape	'00008000'
Finger Geometry	'00010000'
Vein Pattern	'00040000'

8.23.7 Field 99.102: Biometric data quality / BDQ

This optional field is used to specify a quality score for the biometric data stored in the BDB in this record. This field is comprised of three information items. See **Section 7.7.7**.

8.23.8 Field 99.103: BDB format owner / BFO

This mandatory field shall be used to denote the vendor, standards body, working group, or industry consortium that has defined the format of the biometric data (in the BDB). In

[68] Previous versions of the standard included biometric types with record types now included in the standard. For those Biometric Type Codes, see *ANSI/NIST-ITL 1-2007*, Table 39.

a CBEFF structure the BDB Format Owner and Format Type, when used in combination, uniquely identify the specific format of the BDB content. The format and content of the BDB is "owned" by the CBEFF Client (see Section 6.1 of the CBEFF standard). This BDB format definition may be published (public) or unpublished (non-public).

A CBEFF requirement is that format owners register with IBIA for an assigned identifier of the format owner. The number is guaranteed to be unique. Refer to the CBEFF standard (See **Section 3 Normative references)**, Section 6, "CBEFF Patrons and Clients," for registration information.

The four hex digits assigned by IBIA shall be represented by a string of four characters, available at http://www.ibia.org/cbeff/ patron.php

8.23.9 Field 99.104: BDB format type / BFT

This mandatory field shall be used to identify the value assigned by the format owner to represent the specific BDB Format as specified by the format owner. This may be a non-standard, unpublished data format or a data format that has been standardized by an industry group, consortium, or standards body. The registration of the Format Type value is recommended but not required. Refer to the CBEFF standard(See **Section 3 Normative references)**, Section 6, "CBEFF Patrons and Clients," for registration information. The four hex digits assigned by the format owner shall be represented by a string of four characters, available at http://www.ibia.org/cbeff/ bdb.php

8.23.10 Fields 99. 200-900: User-defined fields / UDF

These fields are user-definable fields. Their size and content shall be defined by the user and be in accordance with the receiving agency.

8.23.11 Field 99.902: Annotation information / ANN

This is an optional field, listing the operations performed on the original source in order to prepare it for inclusion in a biometric record type. See **Section 7.4.1.**

8.23.12 Field 99.903: Device unique identifier / DUI

This is an optional field. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 93 Character encoding set values** are allowed.

8.23.13 Field 99.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.23.14 Field 99.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. It is the name of the agency referenced in **Field 99.004: Source agency / SRC**.

8.23.15 Field 99.995: Associated context / ASC

This optional field refers to one or more Record Type-21 with the same **ACN**. See **Section** **7.3.3.**

8.23.16 Field 99.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 99.999: Biometric data block / DATA** of this record, calculated using SHA-256. See **Section** **7.5.2**.

8.23.17 Field 99.997: Source representation / SOR

This optional field refers to a representation in Record Type-20 with the same **SRN**. See **Section** **7.3.2.**

8.23.18 Field 99.998: Geographic sample acquisition location / GEO

This optional field contains the location where the biometric sample was acquired – not where it is stored. See **Section** **7.7.3**.

8.23.19 Field 99.999: Biometric data block / DATA

This mandatory field shall contain the CBEFF Biometric Data Block (BDB). See **Section** **7.2** for details on the Data field entry. In Traditional encoding, this shall be the last physical field in the record.

Annex A: Character encoding information

Normative

Field 1.015 Character encoding / DCS allows the user to specify the character set for certain fields and record types, as described in **Section 5.5.** This Annex lists the codes for the different characters commonly used.

Several fields in the standard require Hexadecimal or Base-64 representations, which are also described in this annex.

A.1: 7-bit ASCII

7-bit ASCII is required for all fields in **Record Type-1: Transaction information record.** If **Field 1.015 Character encoding / DCS** is not included in the transaction, the default character set encoding is 7-bit ASCII with the leftmost (eighth) bit padded with zero. ASCII is defined in *ANSI X3.4-1986 (R1992)* (See **Section 3 Normative references**). See **Table 93** for the allowed values.

A.2: Unicode and UTF encoding

Field 1.015 Character encoding / DCS allows the user to select an alternate character encoding listed in **Table 4 Character encoding**. UTF-8 and UTF-16 allow for the special national characters such as ü, é. ß and ñ. They also allow for certain other character sets, such as Cyrillic and Arabic.

Table 93 does not list all of these characters, only including a few examples. In **Table 93**, the character ç is in only the 8-bit Latin set, unlike the English language characters, which are in both the 7-bit (default) character encoding set and the 8-bit set. The Chinese character 白 is not in the 8-bit Latin character set, but it is in UTF-8. When using these extended character sets, they shall only appear where the record layout tables specify 'U' or 'user-defined' for the character type.

UTF-8 encoding is variable width. The first 128 characters use one byte and are equivalent to US-ASCII. The next 1,920 characters require two bytes to encode. Three and four bytes are also possible for certain, more rare characters. Note that the UTF-8 and UTF-16 encodings are substantially different. Note: **Table 93** shows UTF-16BE (Big Endian) values. It is recommended that UTF-8 be used in preference to UTF-16 or UTF-32.

Table 93 Character encoding set values

Character Name	Type (A, N, S, U)	ASCII Code point Hex	ASCII Left 0 + 7-bit Binary	Unicode Code point Hex	UTF-8 Byte encoding Hex	UTF-16BE Byte encoding Hex
Start-of-text “STX”	Reserved	0x02	0 0000010	U+0002	02	00 02
End-of-text “ETX”	Reserved	0x03	0 0000011	U+0003	03	00 03
$^{F}{}_{S}$	Reserved	0x1C	0 0011100	U+001C	1C	00 1C
$^{G}{}_{S}$	Reserved	0x1D	0 0011101	U+001D	1D	00 1D
$^{R}{}_{S}$	Reserved	0x1E	0 0011110	U+001E	1E	00 1E
$^{U}{}_{S}$	Reserved	0x1F	0 0011111	U+001F	1F	00 1F
Space	A	0x20	0 0100000	U+0020	20	00 20
!	S	0x21	0 0100001	U+0021	21	00 21
“	S	0x22	0 0100010	U+0022	22	00 22
#	S	0x23	0 0100011	U+0023	23	00 23
$	S	0x24	0 0100100	U+0024	24	00 24
%	S	0x25	0 0100101	U+0025	25	00 25
&	S	0x26	0 0100110	U+0026	26	00 26
‘	S	0x27	0 0100111	U+0027	27	00 27
(	S	0x28	0 0101000	U+0028	28	00 28
)	S	0x29	0 0101001	U+0029	29	00 29
*	S	0x2A	0 0101010	U+002A	2A	00 2A
+	S	0x2B	0 0101011	U+002B	2B	00 2B
,	S	0x2C	0 0101100	U+002C	2C	00 2C

Character Name	Type (A, N, S, U)	ASCII Code point Hex	ASCII Left 0 + 7-bit Binary	Unicode Code point Hex	UTF-8 Byte encoding Hex	UTF-16BE Byte encoding Hex
-	S	0x2D	0 0101101	U+002D	2D	00 2D
.	S	0x2E	0 0101110	U+002E	2E	00 2E
/	S	0x2F	0 0101111	U+002F	2F	00 2F
0	N	0x30	0 0110000	U+0030	30	00 30
1	N	0x31	0 0110001	U+0031	31	00 31
2	N	0x32	0 0110010	U+0032	32	00 32
3	N	0x33	0 0110011	U+0033	33	00 33
4	N	0x34	0 0110100	U+0034	34	00 34
5	N	0x35	0 0110101	U+0035	35	00 35
6	N	0x36	0 0110110	U+0036	36	00 36
7	N	0x37	0 0110111	U+0037	37	00 37
8	N	0x38	0 0111000	U+0038	38	00 38
9	N	0x39	0 0111001	U+0039	39	00 39
:	S	0x3A	0 0111010	U+003A	3A	00 3A
;	S	0x3B	0 0111011	U+003B	3B	00 3B
<	S	0x3C	0 0111100	U+003C	3C	00 3C
=	S	0x3D	0 0111101	U+003D	3D	00 3D
>	S	0x3E	0 0111110	U+003E	3E	00 3E
?	S	0x3F	0 0111111	U+003F	3F	00 3f
@	S	0x40	0 1000000	U+0040	40	00 40
A	A	0x41	0 1000001	U+0041	41	00 41
B	A	0x42	0 1000010	U+0042	42	00 42
C	A	0x43	0 1000011	U+0043	43	00 43
D	A	0x44	0 1000100	U+0044	44	00 44
E	A	0x45	0 1000101	U+0045	45	00 45
F	A	0x46	0 1000110	U+0046	46	00 46
G	A	0x47	0 1000111	U+0047	47	00 47
H	A	0x48	0 1001000	U+0048	48	00 48

Character Name	Type (A, N, S, U)	ASCII Code point Hex	ASCII Left 0 + 7-bit Binary	Unicode Code point Hex	UTF-8 Byte encoding Hex	UTF-16BE Byte encoding Hex
I	A	0x49	0 1001001	U+0049	49	00 49
J	A	0x4A	0 1001010	U+004A	4A	00 4A
K	A	0x4B	0 1001011	U+004B	4B	00 4B
L	A	0x4C	0 1001100	U+004C	4C	00 4C
M	A	0X4D	0 1001101	U+004D	4D	00 4D
N	A	0x4E	0 1001110	U+004E	4E	00 4E
O	A	0x4F	0 1001111	U+004F	4F	00 4F
P	A	0x50	0 1010000	U+0050	50	00 50
Q	A	0x51	0 1010001	U+0051	51	00 51
R	A	0x52	0 1010010	U+0052	52	00 52
S	A	0x53	0 1010011	U+0053	53	00 53
T	A	0x54	0 1010100	U+0054	54	00 54
U	A	0x55	0 1010101	U+0055	55	00 57
W	A	0x57	0 1010111	U+0057	57	00 57
X	A	0x58	0 1011000	U+0058	58	00 58
Y	A	0x59	0 1011001	U+0059	59	00 59
Z	A	0x5A	0 1011010	U+005A	5A	00 5A
[	S	0x5B	0 1011011	U+005B	5B	00 5B
\	S	0x5C	0 1011100	U+005C	5C	00 5C
]	S	0x5D	0 1011101	U+005D	5D	00 5D
^	S	0x5E	0 1011110	U+005E	5E	00 5E
_	S	0x5F	0 1011111	U+005F	5F	00 5F
`	S	0x60	0 1100000	U+0060	60	00 60
a	A	0x61	0 1100001	U+0061	61	00 61
b	A	0x62	0 1100010	U+0062	62	00 62
c	A	0x63	0 1100011	U+0063	63	00 63
d	A	0x64	0 1100100	U+0064	64	00 64
e	A	0x65	0 1100101	U+0065	65	00 65
f	A	0x66	0 1100110	U+0066	66	00 66
g	A	0x67	0 1100111	U+0067	67	00 67
h	A	0x68	0 1101000	U+0068	68	00 68
i	A	0x69	0 1101001	U+0069	69	00 69
j	A	0x6A	0 1101010	U+006A	6A	00 6A
k	A	0x6B	0 1101011	U+006B	6B	00 6B

Character Name	Type (A, N, S, U)	ASCII Code point Hex	ASCII Left 0 + 7-bit Binary	Unicode Code point Hex	UTF-8 Byte encoding Hex	UTF-16BE Byte encoding Hex
l	A	0x6C	0 1101100	U+006C	6C	00 6C
m	A	0x6D	0 1101101	U+006D	6D	00 6D
n	A	0x6E	0 1101110	U+006E	6E	00 6E
o	A	0x6F	0 1101111	U+006F	6F	00 6F
p	A	0x70	0 1110000	U+0070	70	00 70
q	A	0x71	0 1110001	U+0071	71	00 71
r	A	0x72	0 1110010	U+0072	72	00 72
s	A	0x73	0 1110011	U+0073	73	00 73
t	A	0x74	0 1110100	U+0074	74	00 74
u	A	0x75	0 1110101	U+0075	75	00 75
v	A	0x76	0 1110110	U+0076	76	00 76
w	A	0x77	0 1110111	U+0077	77	00 77
x	A	0x78	0 1111000	U+0078	78	00 78
y	A	0x79	0 1111001	U+0079	79	00 79
z	A	0x7A	0 1111010	U+007A	7A	00 7A
{	S	0x7B	0 1111011	U+007B	7B	00 7B
|	S	0x7C	0 1111100	U+007C	7C	00 7C
}	S	0x7D	0 1111110	U+007D	7D	00 7D
~	S	0x7E	01111110	U+007E	7E	00 7E
Special character examples		**Latin ASCII Code Point**	**Latin ASCII 8-bit Binary**			
Example: ç	U	0xE7	10000111	U+00E7	C3 A7	00 E7
Example 白	U	none	none	U+767D	E7 99 BD	76 7D
Example: 𝄞	U	none	none	U+1D11E	F0 9D 84 9E	D8 34 DD 1E

A.3: Base-64 encoding

The Base-64 Content-Transfer-Encoding is designed to represent arbitrary sequences of octets in a form that need not be humanly readable. A 65-character set is used, enabling 6 bits to be represented per printable character. The characters are the 26 letters of the English alphabet (upper and lower case), the digits 0 through 9, the special characters / and + and =.

The encoding process represents 24-bit groups as strings of 4 encoded characters. Proceeding from left to right, concatenating three 8-bit input groups forms a 24-bit group. These 24 bits are treated as 4 concatenated 6-bit groups, each of which is translated into a single digit in the Base-64 alphabet. When encoding a bit stream via the Base-64 encoding, the bit stream shall be ordered with the most significant bit first. The character "=" is used for padding. Any characters outside of the Base-64 alphabet shall be ignored in information items designated as using Base-64 input. Text line breaks in the input being translated to Base-64 shall be converted to CRLF sequences prior to Base-64 encoding. An example of Base-64 encoding is shown below.

Table 94: Base-64 conversion example

Text	M		A		ß	
Binary encoding of input (8-bits)	0 1 0 0 1 1 0 1		0 1 0 0 0 0 0 1		1 1 0 1 1 1 1 1	
6-bit binary	**0 1 0 0 1 1**	**0 1**	**0 1 0 0**	**0 0 0 1**	**1 1**	**0 1 1 1 1 1**
Base- 64 code	**19**	**20**		**7**		**31**
Base-64 value	T	U		H		f

Table 95: Base-64 alphabet

Code	Value	Code	Value	Code	Value	Code	Value
0	A	18	S	35	j	52	0
1	B	19	T	36	k	53	1
2	C	20	U	37	l	54	2
3	D	21	V	38	m	55	3
4	E	22	W	39	n	56	4
5	F	23	X	40	o	57	5
6	G	24	Y	41	p	58	6
7	H	25	Z	42	q	59	7
8	I	26	a	43	r	60	8
9	J	27	b	44	s	61	9
10	K	28	c	45	t	62	+
11	L	29	d	46	u	63	/
12	M	30	e	47	v	(pad)	=
13	N	31	f	48	w		
14	O	32	g	49	x		
15	P	33	h	50	y		
16	Q	34	I	51	z		
17	R						

Special processing is performed if fewer than 24 bits are available at the end of the data being encoded. A full encoding quantum is always completed at the end of a body. Since all base-64 input is an integral number of octets, only the following cases can arise:

(1) the final quantum of encoding input is an integral multiple of 24 bits; here, the final unit of encoded output will be an integral multiple of four characters with no "=" padding,

(2) the final quantum of encoding input is exactly 8 bits; here, the final unit of encoded output will be two characters followed by two "=" padding characters, or

(3) the final quantum of encoding input is exactly 16 bits; here, the final unit of encoded output will be three characters followed by one "=" padding character

A.4: Hexadecimal encoding

Hexadecimal refers to a base-16 representation of numbers. It is represented by the digits 0 through 9 and the letters A, B, C, D, E and F. See **Table 93** for a translation of Unicode code points to hexadecimal values used in UTF-8.

When the record layout tables at the beginning of each Section describing a Record Type indicate H in the character type column, then hexadecimal representation shall be used. This is the case, for instance, with **Fields xx.996 (**See **Section 7.5.2 Data hash / HAS).** See **Table 96** for conversion of numeric values to hexadecimal representation.

Table 96: Base 10 to hexadecimal conversion

Base-10	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Et cetera
Base-16	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	

Annex B: Traditional encoding

Normative

The format and rules for this encoding of the *ANSI/NIST-ITL 1-2011* version are consistent with *ANSI/NIST-ITL 1-2007*. The types of logical records together with the identifier and type of data for each record type are listed in **Table 97**.

Table 97 Logical record types

Record Identifier	Logical record contents	Type of data
1	Transaction information	ASCII
2	User-defined descriptive text	ASCII
3	Low-resolution grayscale fingerprint image	Deprecated
4	High-resolution grayscale fingerprint image	Binary
5	Low-resolution binary fingerprint image	Deprecated
6	High-resolution binary fingerprint image	Deprecated
7	User-defined image	Binary
8	Signature image	Binary
9	Minutiae data	ASCII
10	Facial, SMT and other body part image	ASCII/Binary
11	Voice record	Reserved for future use
12	Dental record	Reserved for future use
13	Variable-resolution latent friction ridge image	ASCII/Binary
14	Variable-resolution fingerprint image	ASCII/Binary
15	Variable-resolution palm print image	ASCII/Binary
16	User-defined variable-resolution testing image	ASCII/Binary
17	Iris image	ASCII/Binary
18	DNA data	ASCII/Binary
19	Variable-resolution plantar image	ASCII/Binary
20	Source representation	ASCII/Binary
21	Associated context data	ASCII/Binary
22-97	Reserved for future use	ASCII/Binary
98	Information assurance	ASCII/Binary
99	CBEFF biometric data record	ASCII/Binary

The first field in all records shall contain the length in bytes of the record. For all ASCII or ASCII/Binary records the first field shall also be labelled as field "1:". The length has no upper bound. The mnemonic associated with each of these fields (**xx.001)** is LEN. It is a numeric (positive integer) value. The mnemonic LEN is used in **Field 98.900: Audit log / ALF** for the information item **information identifier / IID** in order to record changes to the value in this field.

With the exception of the Type-1 record (See **Section 8.1**), the second field shall be labeled as field "2" and contain the i**nformation designation character / IDC**. See **Section 7.3.1.**

The data in the Type-1 record shall always be recorded in variable length fields using the 7-bit American Standard Code for Information Interchange (ASCII) as described in *ISO/IEC 646*[69]. For purposes of compatibility, the eighth (leftmost) bit shall contain a value of zero. All field numbers and information separators shall be recorded in 7-bit ASCII as described in *ISO/IEC 646*.

Textual fields in Record Types 2 and 9-99 may occur in any order after the first two fields and contain the information as described for that particular numbered field, except for field 999, which shall be the concluding field, when it is included in a record. The allowed character encoding sets are included in **Table 4**.

In the Type-1, Type-2, Type-9 through Type-99 records, information is delimited by the four ASCII information separators. The delimited information may be items within a field or subfield, fields within a logical record, or multiple occurrences of subfields. These information separators are defined in the referenced standard *ISO/IEC 646* with the code table shown in **Table 93 .** See also **Annex A: Character encoding information.**

These characters are used to separate and qualify information in a logical sense. Viewed in a hierarchical relationship, the File Separator "$^{F}{}_{S}$" character is the most inclusive followed by the Group Separator "$^{G}{}_{S}$", the Record Separator "$^{R}{}_{S}$", and finally the Unit Separator "$^{U}{}_{S}$" characters. The four characters are only meaningful when used as separators of data items in the ASCII fields of records. There is no specific meaning attached to these characters occurring in binary sample records and binary fields – they are just part of the exchanged data. Information separators should be functionally viewed as an indication of the type data that follows.

Multiple records within a transaction are separated by the "$^{F}{}_{S}$" character, which signals the end of a logical record. Use of separators within the Type-1, Type-2, Type-9 through Type-99 records shall always be observed. The "$^{U}{}_{S}$" separator shall separate multiple items within a field or subfield; the "$^{R}{}_{S}$" separator shall separate multiple subfields, and the "$^{G}{}_{S}$" separator shall separate information fields. The following is a detailed description of the separator characters

[69] See **Section 3 Normative references.**

FN is the number of a field (including record type) within a record, other than Types 4, 7 or 8.

IF is the information field associated with an FN.

II is the information item belonging to an IF.

SF is the subfield used for multiple entries of an II or an IF.

${}^{F}_{S}$ File separator character – separates logical records within a transaction. (Decimal value 28)

${}^{G}_{S}$ Group separator character – separates fields within a record. (Decimal value 29).

${}^{R}_{S}$ Record separator character – separates repeated subfields within a field. (Decimal value 30)

${}^{U}_{S}$ Unit separator character – separates information items within a field or subfield. (Decimal value 31).

The ${}^{G}_{S}$ is used between fields – the ${}^{F}_{S}$ between logical records:

$$\mathbf{FN_j : IF}\ {}^{G}_{S}\ \mathbf{FN_k : \ldots}\ {}^{F}_{S}\ \mathbf{FN_1 : IF}\ {}^{G}_{S}\ \mathbf{\ldots}\ {}^{F}_{S}$$

For fields with more than one information item, the ${}^{U}_{S}$ is used:

$$\mathbf{FN_j : II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{G}_{S}\ \mathbf{FN_k \ldots}\ {}^{F}_{S}$$

For fields with multiple subfields, the ${}^{R}_{S}$ is used:

$$\mathbf{FN_j : II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{R}_{S}\ \mathbf{II_a}\ {}^{U}_{S}\ \mathbf{II_b}\ {}^{G}_{S}\ \mathbf{FN_k \ldots}\ {}^{F}_{S}$$

which are expressed as:

$$\mathbf{FN_j : SF_1}\ {}^{R}_{S}\ \mathbf{SF_2}\ {}^{G}_{S}\ \mathbf{FN_k \ldots}\ {}^{F}_{S}$$

Normally, there should be no empty fields or information items and therefore only one separator character should appear between any two data items. The exception to this rule occurs for those instances where the data in fields or information items in a transaction are unavailable, missing, or optional, and the processing of the transaction is not dependent upon the presence of that particular data. In those instances, multiple and adjacent separator characters shall appear together rather than requiring the insertion of dummy data between separator characters.

Consider the definition of a field that consists of three information items. If the information for the second information item is missing, then two adjacent "${}^{U}_{S}$" information separator characters would occur between the first and third information items. If the second and third information items were both missing, then three separator characters should be used – two "$^{U}{}_{S}$" characters in addition to the terminating field or subfield separator character. In general, if one or more mandatory or optional information items are unavailable for a field or subfield, then the appropriate number of separator characters should be inserted. It is possible to have side-by-side combinations of two or more of the four available separator characters. When data are missing or unavailable for information items, subfields, or fields, there shall be one fewer separator characters present than the number of data items, subfields, or fields required.

B.1 Transmitted data conventions

B.1.1 Byte and bit ordering

Each information item, subfield, field, and logical record shall contain one or more bytes of data. Within a file, the order for transmission of both the ASCII and the binary representations of bytes shall be most significant byte first and least significant byte last otherwise referred to as Big-Endian format. Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last. **Figure 19** illustrates the order of transmission of the bytes and bits within a file.

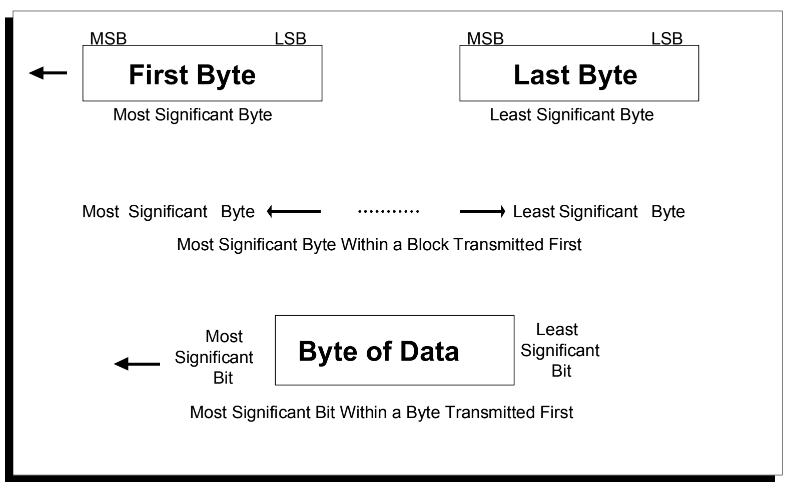


Figure 19: Byte and bit ordering

B.1.2 Date format

Dates shall appear as eight digits in the format YYYYMMDD. The YYYY characters shall represent the year of the transaction; the MM characters shall be the tens and units values of the month; and the DD characters shall be the day in the month. For example, "20070103" represents January 3, 2007. See **Section 7.7.2 Date and time.**

B.1.3 Agency Codes

The 2007 version of the standard included only agency identifier fields (See **Section 7.6).** The 2008 version added the option of entering an organization name. This capability of the 2008 version is retained in this version of the standard by adding new fields (**Field 1.017 Agency names / ANM** and **Fields xx.993 Source agency name / SAN)**

B.1.4 GMT/UTC Date/Time format

GMT/UTC shall be represented as YYYYMMDDHHMMSSZ, a 15-character string that is the concatenation of the date with the time and concludes with the character "Z". The YYYY characters shall represent the year of the transaction. The MM characters shall be the tens and units values of the month. The DD characters shall be the tens and units values of the day of the month. The HH characters represent the hour; the MM the minute; and the SS represents the second. See **Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT.**

B.1.5 Record layout

For the Type-1, Type-2, Type-9 through Type-99 records, each information field that is used shall be numbered in accordance with this standard. The format for each field shall consist of the logical record type number followed by a period ".", a field number followed by a colon ":", followed by the information appropriate to that field. The field number may be any one to nine-digit number occurring between the period "." and the colon ":". It shall be interpreted as an unsigned integer field number. This implies that a field number of "2.123:" is equivalent to and shall be interpreted in the same manner as a field number of "2.000000123:".

For purposes of illustration throughout this annex, a three-digit number shall be used for enumerating the fields contained in each of the Record Types, other than 4, 7 and 8. Field numbers will have the form of "TT.xxx:" where the "TT" represents the one- or two-character record type followed by a period. The next three characters comprise the appropriate field number followed by a colon. Descriptive ASCII information or the sample data follows the colon.

Logical Type-1, Type-2, and Type-9 records contain only ASCII textual data fields (See **Annex A: Character encoding information**). The entire length of the record (including field numbers, colons, and information separators) shall be recorded as the first ASCII field within each of these record types. The ASCII File Separator "$^{F}{}_{S}$" control character (signifying the end of the logical record or transaction) shall follow the last byte of ASCII information and shall be included in the length of the record.

The **Record Type-4: Grayscale fingerprint image**, the **Record Type-7: User-defined image record** and the **Record Type-8: Signature image record** contain only binary data recorded as ordered fixed-length binary fields. The entire length of the record shall be recorded in the first four-byte binary field of each record. For these binary records, neither the record number with its period, nor the field identifier number and its following colon, shall be recorded. Furthermore, as all the field lengths of these three records are either fixed and specified, none of the four separator characters (“$^{U}{}_{S}$”, “$^{R}{}_{S}$”, ” $^{G}{}_{S}$”, or “$^{F}{}_{S}$”) shall be interpreted as anything other than binary data. For these binary records, the “$^{F}{}_{S}$” character shall not be used as a record separator or transaction terminating character.

Each ASCII field contains a numeric field identifier and its descriptive data.

When **Field 999** is present in a record, it shall appear as the last entry in the record and shall contain the data placed immediately following the colon (“:”) of the field identifier. The record length field shall contain the length of the record. The ASCII File Separator “$^{F}{}_{S}$” control character shall follow the last byte of the compressed or uncompressed sample data. The “$^{F}{}_{S}$” character shall signify the end of the logical record or transaction and shall be included as part of the record length.

The Base-64 encoding scheme (See **Annex A: Character encoding information**) shall be used for converting non-ASCII text into ASCII form. The field number including the period and colon, for example “2.001:”, in addition to the “$^{U}{}_{S}$”, “$^{R}{}_{S}$”, “$^{G}{}_{S}$”, and “$^{F}{}_{S}$” information separators shall appear in the transaction as 7-bit ASCII characters without conversion to Base-64 encoding.

B.1.6 Switching between character encoding sets

All of the fields in the Type-1 record shall be recorded using the 7-bit ASCII code, which is the default character encoding set code within a transaction. In order to effect data and transaction interchanges between non-English speaking or foreign-based agencies, a technique is available to encode information using character encoding sets other than 7-bit ASCII. Fields from the Type-1 logical record and ASCII **Field xx.001** and **Field xx.002** text fields shall still be encoded using 7-bit ASCII, but all other designated text fields may be encoded using an alternate character encoding set, if they are shown with the character type of 'U' or 'user-defined' in the record layout tables at the beginning of each Record Type Section of this standard. One alternate character encoding set may be chosen per transaction.

To switch character encoding sets within a transaction, the Type-1 record shall contain **Field 1.015 Character encoding / DCS**. The **DCS** consists of 3 information items containing an identifying code, the name of an international character encoding set, and its version.

Retained for backward compatibility is a mechanism using codes to signal the conversion to a different international character encoding set. This mechanism is not recommended for new applications. However, these codes must be used for UTF-16 or UTF-32 data, since only UTF-8 is allowed to be used without the codes. Use of the code requires the ASCII Start-of-Text “$_{STX}$” character (0x02) followed by the equal sign “=” to signal the change to an alternate character encoding set defined by the specific **DCS** code that follows. The entire Start-of-Text sequence is terminated by a single instance of the ASCII End-of-Text “$_{ETX}$” character (0x03). This alternate character encoding set will remain active until a closing “$_{ETX}$” character is encountered or the next ASCII information separator character is encountered. All text between the STX sequence and the closing ETX character shall be encoded in Base-64 notation (See **Annex A: Character encoding information**). This is true even when the 7-bit ASCII character encoding set is specified.

Usage of UTF-8 is allowed as an alternative to the technique that requires the usage of the ASCII "$_{STX}$" and "$_{ETX}$" characters to signify the beginning or end of international characters. UTF-8 is only allowed in fields marked 'U' or 'user-defined' in the character type column of the record layout tables. Notice that this technique does not require the conversion of text to Base-64 as does the technique employing "$_{STX}$" and "$_{ETX}$".

B.2 Encoding for specific record types

The following sections provide specific detail for for certain fields within the record types to ensure clarity to programmers.

B.2.1 Type-1 record

Field 1.001 Record header shall begin with "1.001:" followed by the length of the record including every character of every field contained in the record and the information separators. The "$^{G}{}_{S}$" separator character shall separate the length code of **Field 1.001** from the next field.

The year, month, and day values in **Field 1.005 Date / DAT** are concatenated "YYYYMMDD".

In **Field 1.013 Domain name / DOM,** the default is "1.013:NORAM$^{U}{}_{S}{}^{G}{}_{S}$"

Immediately following the last information item in the Type-1 record (See **Section 8.1**), an "$^{F}{}_{S}$" separator character shall be used to separate it from the next logical record. This "$^{F}{}_{S}$" character shall replace the "GS" character that is normally used between information fields. This is the case with all Record Types.

B.2.2 Type-4 record

Table 98 provides a list of the fields for the Type-4 logical record (See **Section 8.4**). The order of fields for Type-4 records is fixed. All fields and data in this record type shall be recorded as binary information.

Table 98 Type 4 record layout

Field Number	Tag	Field Description	Byte Count	Byte Position
1	LEN	LOGICAL RECORD LENGTH	4	1-4
2	IDC	INFORMATION DESIGNATION CHARACTER	1	5
3	IMP	IMPRESSION TYPE	1	6
4	FGP	FINGER POSITION	6	7-12
5	ISR	IMAGE SCANNING RESOLUTION	1	13
6	HLL	HORIZONTAL LINE LENGTH	2	14-15
7	VLL	VERTICAL LINE LENGTH	2	16-17
8	GCA	COMPRESSION ALGORITHM	1	18
9	DATA	IMAGE DATA	<LEN> – 18	19 through <LEN>

B.2.3 Type-7 record

With the exception of the first two fields, the order of the remaining fields of the Type-7 record (See **Section** 8.7) is user-defined. All fields and data in Type-7 records shall be recorded as binary information.

The first two fields are fixed length and total five bytes. These fields shall precede one or more user-defined fields, including the image data, contained in the remainder of the record.

B.2.3.1 Logical record length / LEN

This mandatory four-byte binary field (**Field 7.001: Record header**) shall occupy bytes one through four. It shall contain the length of the logical record specifying the total number of bytes, including every byte of all the fields contained in the record.

B.2.3.2 Information designation character / IDC

This mandatory one-byte binary field (**Field 7.002: Information designation character / IDC**) shall occupy the fifth byte of a Type-7 record. It shall be used to identify the image data contained in this record. The **IDC** contained in this field shall be a binary representation of the **IDC** found in **Field 1.003 Transaction content / CNT**.

B.2.3.3 User-defined fields for Type-7 records

The remaining fields (**Section 8.7.3**) of the Type-7 logical record shall be user-defined. Individual fields required for a given transaction, such as field description, size, and content shall conform to the specifications set forth by the agency to whom the transmission is being sent.

B.2.3.4 End of Type-7 record

Since the Type-7 logical record is a defined and specified series of binary data fields, no additional bytes shall be transmitted to signify the end of this logical record type.

B.2.4 Type-8 record

Table 99 provides a list of the fields for the Type-8 logical record (See **Section 8.8**). The order of fields for Type-8 records is fixed. All fields and data in Type-8 records shall be records as binary information.

Table 99 Type-8 record layout

Field Number	Tag	Field Description	Byte Count	Byte Position
1	LEN	LOGICAL RECORD LENGTH	4	1-4
2	IDC	INFORMATION DESIGNATION CHARACTER	1	5
3	SIG	SIGNATURE TYPE	1	6
4	SRT	SIGNATURE REPRESENTATION TYPE	1	7
5	ISR	IMAGE SCANNING RESOLUTION	1	8
6	HLL	HORIZONTAL LINE LENGTH	2	9-10
7	VLL	VERTICAL LINE LENGTH	2	11-12
8	DATA	SIGNATURE IMAGE DATA	<LEN> – 12	13 through <LEN>

If the **SRT** field contains the binary value of “0” then **DATA** shall contain the uncompressed scanned binary image data for the signature. In uncompressed mode, the data shall be packed at eight pixels per byte.

If the **SRT** field contains the binary value of “1” then this field shall contain the scanned binary image data for the signature in compressed form using the ANSI/EIA-538-1988 facsimile compression algorithm.

If the **SRT** field contains the binary equivalent of "2", then **DATA** shall contain a list of vectors describing the pen position and pen pressure of line segments within the signature. Each vector shall consist of five bytes.

The first two bytes of each vector shall contain the unsigned binary X coordinate of the pen position with the high order byte containing the most significant bits. The next two bytes shall contain the unsigned Y coordinate using the same convention to denote the most significant bits. Both the X and Y coordinates shall be expressed in units of .0254 mm (.001 inches) referenced from the bottom leftmost corner of the signature. Positive values of X shall increase from left-to-right and positive values of Y shall increase from bottom-to-top.

An unsigned binary number between "0" and "255" contained in the fifth byte shall represent the pen pressure. This shall be a constant pressure until the next vector becomes active. Binary value of "1" shall represent the least recordable pressure for a particular device, while the binary equivalent of "254" shall represent the maximum recordable pressure for that device. To denote the end of the vector list the binary equivalent of "255" shall be inserted in this entry.

B.2.5 Type-9 record

Fields 9.005 through **9.012** are to be used for legacy data only. See ANSI/NIST-ITL 1-2007 for instructions on use of these fields.

Paths in EFS require a special data construct for Traditional encoding. See **Section 7.7.12.2 Type-9 extended feature set (EFS) paths**.

Polygons are used in the following EFS fields:

Field 9.302: EFS finger - palm - plantar position / FPP
Field 9.300: EFS region of interest / ROI
Field 9.324: EFS distinctive features / DIS
Field 9.357: EFS local quality issues / LQI
Field 9.360: EFS area of correspondence / AOC.

Open paths are used in the following EFS field:
Field 9.373: EFS ridge path segments / RPS.

A comma separates the X and Y coordinates for a given vertex, and a dash separating consecutive vertices. For example: X1,Y1-X2,Y2-X3,Y3

If multiple paths are present in the same field, they are stored as separate data entries (occurrences), separated by the "$^{R}{}_{S}$" character:

X1,Y1-X2,Y2-X3,Y3$^{R}{}_{S}$X4,Y4-X5,Y5-X6,Y6

B.2.6 Type-10 record

There are no special requirements for this record type.

B.2.7 Type-11 record

This Record Type is reserved for future use as Voice data.

B.2.8 Type-12 record

This Record Type is reserved for future use as Dental data.

B.2.9 Type-13 record

For **Field 13.014: Search position descriptors / SPD**, multiple portions of the EJI may be listed and separated by the "$^{R}{}_{S}$" separator character.

B.2.10 Type-14 record

There are no special requirements for this record type.

B.2.11 Type-15 record

There are no special requirements for this record type.

B.2.12 Type-16 record

There are no special requirements for this record type.

B.2.13 Type-17 record

There are no special requirements for this record type.

B.2.14 Types-18 record

There are no special requirements for this record type.

B.2.15 Type-19 record

There are no special requirements for this record type.

B.2.16 Type-20 record

There are no special requirements for this record type.

B.2.17 Type-21 record

There are no special requirements for this record type.

B.2.18 Type-98 record

There are no special requirements for this record type.

B.2.19 Type-99 record

There are no special requirements for this record type.

Annex C: NIEM-conformant encoding rules

Normative

C.1 Introduction

This annex contains a set of requirements for encoding the 2011 ANSI/NIST-ITL standard using eXtensible Markup Language (XML). This annex and its references carry forward and improve the description of XML encoding found in *ANSI/NIST-ITL 2-2008*, and revise the encoding specification to include additions to the 2011 base standard.

This annex itemizes, references, and points to additional material such as XML schema, instance examples, and transformation data. A cross-reference to traditional encoding is contained in **Annex G: Mapping to the NIEM IEPD.**

Many data interchange and processing applications have converted to or are in the process of migrating toward an XML format approach for processing data. In order to provide the ability to directly interface with such applications, this XML encoding representation of the textual, image, and other biometric information has been developed. This is an XML alternative to the "traditional" encoding format. Implementers will find that, with very few exceptions, there is a "one-to-one" correspondence of XML elements to the elements of the base specification, and to the numerically tagged (or untagged binary) traditional elements described in the **Annex B: Traditional encoding**. The repeating subfield and information items (separated by the ^{R}S and ^{U}S characters in the traditional representation) have been given named XML counterparts.

The XML encoding rules and referenced materials conform to the National Information Exchange Model (NIEM), which facilitates interoperability for information sharing among multiple government agencies. The XML encoding includes rules for how user-defined extensions may be included inside the standard XML package, but do not define how the package may be wrapped in other XML structures.

C.2 Changes in the XML encoding for ANSI/NIST-ITL 1-2011

1) The schema document ansi-nist.xsd, in the namespace http://niem.gov/niem/ansi-nist/2.0 , is not used by this version of the standard. All necessary elements in ansi-nist.xsd have been replaced by equivalent elements in a biometric *domain* file subset/niem/domains/biometrics/1.0/biometrics.xsd, in the namespace http://niem.gov/niem/biometrics/1.0 , recognized by NIEM.

2) The schema document itl-2008-Package-Annex-B.xsd in the namespace http://biometrics.nist.gov/standard/2-2008 is not used by this version of the standard. All necessary elements have been replaced by equivalent elements in the file exchange/itl.xsd in the namespace http://biometrics.nist.gov/standard/2011 . To facilitate migration from the 2-2008 version to 2011, certain biometric elements in itl-2008-Package-Annex-B.xsd have been replicated both in

exchange/itl.xsd and in the NIEM biometrics domain. The itl.xsd copies of biometric elements have been deprecated in favor of elements in the NIEM biometrics domain.

3) XML elements have been created for all of the new features of version 2011, such as new records for DNA and plantars, and new elements for extended feature set latent encoding.

4) XML elements have been removed for record types 3, 5, and 6, and field 17.018 which were deprecated in version 2011.

5) To the extent possible, element names, data type names, and structure have been retained from version 2-2008. Nevertheless, some changes were necessary to improve conformance with NIEM, or to repair errors. A list of changes expected to affect the production of XML instances and content can be found in the Change Log available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

6) Additional constraints have been added to the schema to increase the degree to which XML schema validation will test conformance to the base specification, such as enforcing that only certain kinds of images can appear in each record type.

7) The NIEM files contained in the Information Exchange Package Documentation (IEPD) are a subset of NIEM, containing only those elements used by the standard.

C.3 Scope, purpose, and conformance

There are "user-defined" elements that implementers may create to extend this specification so that it is useful in a particular application. For NIEM-conformant XML encoding, these "user-defined" elements have been created in the schema as abstract elements. Implementers may extend this standard by supplying substitution elements for these abstract elements:

<itl:DomainDefinedDescriptiveDetail>,

<itl:UserDefinedFields>,

<itl:UserDefinedImage>,

<biom:RecordMinutiae>,

<biom:DNAUserDefinedProfile>,

<biom:TransactionCategory>, and/or

<itl:OtherDescriptiveDetail>.

The implementer's substitution elements shall be created in a separate, user-declared namespace. The content of the substitution elements shall be well-formed XML and shall follow NIEM rules.

Implementers may modify or add namespace declarations and import elements to reference user-defined namespaces and extension schemas. The NIEM subset versions of biometrics.xsd, niem-core.xsd, and other NIEM schemas may be re-subsetted to facilitate use of these elements in user-defined blocks. Implementers may create constraint schemas that add any of the schemas used in this standard. These constraint schemas must follow the rules for NIEM constraint schemas as they are defined in the NIEM Naming and Design Rules[70]. They may only be used to add constraints and restrictions to components; they must not loosen the standard by allowing content that is not allowed by the schemas upon which they are based.

Implementers shall not introduce new elements inside the <itl:NISTBiometricInformationExchangePackage> complex except for the substitution elements described above. They shall not change the order or structure of elements defined by the standard.

The root element, <itl:NISTBiometricInformationExchangePackage>, may be included as a payload in a larger package.

All of this standard's required elements shall be present in a conforming instance document even if the schema referenced by this annex do not strictly enforce the requirement.

C.4 Transmitted data conventions

C.4.1 Character encoding

Each XML information element, tags and data content, shall be represented by a character set that is a subset of Unicode and that is allowable by W3C XML. For compatibility with existing implementations of the standard, implementers may wish to limit content to the 128 characters that can be represented by 7-bit ASCII. (Record Type-1 is restricted to this set of 128 characters).

Characters shall be transmitted using a Unicode encoding. These Unicode encoding formats are allowable: UTF-8, UTF-16, or UTF-32. Use of UTF-8 is encouraged. Nevertheless, senders and receivers of XML packages using this standard may agree on other subsets of Unicode, including international characters. Senders and receivers of XML packages using this standard shall agree on an encoding format. XML packages shall include an XML declaration that specifies the encoding, as in this example:

<?xml version='1.0' encoding='UTF-8'>

[70] See https://www.niem.gov/documentsdb/Documents/Technical/NIEM-NDR-1-3.pdf

It is recommended that the user enter **Field 1.015 Character encoding / DCS** with the selection for UTF-8 in order to facilitate any translation from XML to Traditional format for the transaction, should that need to occur.

Note that even though a Unicode encoding is used for the transaction, only certain fields may use the full range of characters available in Unicode. These fields are marked with 'U' or 'user-defined' in the character type column of the record layout tables.

C.4.2 Grayscale data

Binary data so constructed as to represent a grayscale image shall be converted to ASCII characters prior to transmission using Base-64 encoding. See **Annex A A.3: Base-64 encoding**.

C.4.3 Binary data

Binary image data may be constructed in either compressed or uncompressed form, then shall be converted to ASCII characters prior to transmission using Base-64 encoding. See **Annex A A.3: Base-64 encoding**. Binary data fields, other than image data, in the Type-4, 7, and 8 records have been given conventional XML element tags. For XML encoding, these data elements and their content shall be represented as ASCII characters.

C.5 Data Conventions Specific to XML

C.5.1 Record format

An exchange package shall consist of two or more logical records. See **Section 5.1 Structure of a transaction.** For each logical record contained in the package, several information elements appropriate to that record type shall be present. Complex elements may contain one or more complex or simple elements according to the rules of well-formed XML. Taken together, these items are used to convey different aspects of the data contained in a data information object. To the extent possible, the objects used have been defined as a part of the National Information Exchange Model (NIEM). Some information objects may be repeated multiple times.

The XML schema referenced for this encoding define the structure and order of the elements in the information exchange package. To the extent possible, the schema define data types and constraints that enforce the allowable content rules of the base standard. Nevertheless, the XML schema may not strictly enforce the allowable content. The base standard defines allowable content, and its requirements shall be met by implementers regardless of encoding method.

C.5.2 Information separators

All separators are defined by the W3C XML recommendations. The characters “<” and “>” are reserved exclusively for enclosing XML element names. Every element with a start tag <Name> shall have an end tag of format </Name>.

C.5.3 Record layout

For all logical records – including Types 4, 7, and 8 that do not have field tags in the traditional encoding -- data elements are tagged according to XML rules. The format for each element shall consist of a start tag enclosed in angle brackets followed by data followed by an end tag. For example: <nc:IdentificationID>6</nc:IdentificationID>.

Complex data elements contain other elements in a nested fashion; for example:

```
<biom:ImageReferenceIdentification>
        <nc:IdentificationID>6</nc:IdentificationID>
</biom:ImageReferenceIdentification>
```

The ordering of elements is strict. The schema referenced by this annex define the order and nesting structure of elements. The schema also provide a W3C representation of the order and hierarchical structure of the XML content.

C.5.4 Date format

Common dates (other than GMT) shall be represented in the form YYYY-MM-DD, YYYY-MM, or YYYY. See **Section 7.7.2 Date and time.** Examples

```
<biom:TransactionDate>
        <nc:Date>2008-02-29</nc:Date>
</biom:TransactionDate>

<biom:TransactionDate>
        <nc:YearMonth>2008-02</nc:YearMonth>
</biom:TransactionDate>

<biom:TransactionDate>
        <nc:Year>2008</nc:Year>
</biom:TransactionDate>
```

C.5.5 GMT date/time format

GMT date/time values shall be represented in the form YYYY-MM-DDThh:mm:ssZ. See **Section 7.7.2.2 Greenwich mean time (coordinated universal time – UTC) / GMT.** For example

```
<biom:TransactionUTCDate>
        <nc:DateTime>2008-02-29T05:25:00Z</nc:DateTime>
</biom:TransactionUTCDate>
```

C.5.6 Abstract elements

The abstract elements listed in Section **C.3 Scope, purpose, and conformance** allow implementers to extend the specification by supplying substitution elements of their own design. These are the only abstract elements that implementers may extend. A single example here will be illustrative. The complex element <itl:DomainDefinedDescriptiveDetail> is abstract, and as such is unusable by itself. Implementers shall define, in an extension schema, a substitution element containing user-defined child elements. A substitution element should be defined in a user's extension schema similar to this:

```
<xsd:element name="DomainDefinedDescriptiveDetail"
        substitutionGroup="itl:DomainDefinedDescriptiveDetail"
        type="user-namespace:DomainDefinedDescriptiveDetailType"/>
<xsd:complexType name="DomainDefinedDescriptiveDetailType">
        <xsd:complexContent>
                <xsd:extension base="s:ComplexObjectType">
                        <xsd:sequence>
                                <xsd:element ref="user-namespace:OneField"/>
                                <xsd:element ref="user-namespace:TwoField"/>
                        </xsd:sequence>
                </xsd:extension>
        </xsd:complexContent>
</xsd:complexType>
```

The substitution element would then appear in an instance document like this:

```
<user-namespace:DomainDefinedDescriptiveDetail>
        <user-namespace:OneField>Text</user-namespace:OneField>
        <user-namespace:TwoField>Text</user-namespace:TwoField>
</user-namespace:DomainDefinedDescriptiveDetail>
```

C.5.7 Record length

There is no corresponding XML element. See **Section 7.1.**

C.5.8 Image data

Image data shall be converted to ASCII characters using the Base-64 encoding algorithm. (See **Section 7.2**)

<nc:BinaryBase64Object>**mrHbPdrko3u1s7ahtgPBjtmO1s85tfG2U7bpofY9 4Czu2SbY7d7wF9fQ7ZptgGrtkO2a2dsJ7wZbe8BlzvAmQ7xq+Y94GoHeEsR3ikW d4DIGhzmp3k42d4DRmzs94DKveDTB3hqw6PeBLrtpPep0H+h**</nc:BinaryBase64 Object>

C.6 Missing Data for Mandatory and Optional Elements

If the base specification and schema define an element as optional, it should be omitted altogether rather than transmitting the element tags without any data content.

For mandatory elements, in all cases, the element tags shall appear in the instance package. When there is no information to be transmitted for a mandatory element, prior agreement shall be made with the recipient agency or organization before constructing and transmitting an instance package. For cases where an agreement is made to accept records with missing mandatory data, the following recommendations are made.

C.6.1 Missing Mandatory String Element Data (nc:TextType)

The content of certain elements (such as agency identifiers or types of transaction) is left to users to define. For example, it is stated in this standard that the content of the element <biom:CaptureOrganization> (or Source agency/SRC) "shall be defined by the user and be in accordance with the receiving agency." The sender and receiver may choose to establish an identifier for missing information. In this case, the preferred representation for missing data is to use the value "UNKNOWN" (provided that there is no other option available).

<biom:CaptureOrganization>UNKNOWN
</biom:CaptureOrganization>

C.6.2 Missing Mandatory Date Element Data (nc:Date)

Due to NIEM rules for date elements, the preferred representation for missing date data is to "nil" the parent element, as shown in this example:

<biom:CaptureDate xsi:nil="true"/>

Partially missing date data may be represented as follows:

```
<biom:CaptureDate>
        <nc:Year>1995</nc:Year>
</biom:CaptureDate>
or
<biom:CaptureDate>
        <nc:YearMonth>1995-05</nc:YearMonth>
</biom:CaptureDate>
```

C.6.3 Information Exchange Package Description

The base standard defines the composition of a transmission. For XML encoding, this is the complex <itl:NISTBiometricInformationExchangePackage> and its contents. In many cases, the package will be included as a payload with an XML-formatted outer wrapper for transaction or protocol purposes. The package may also be a part of a larger, user-defined data structure. This standard strictly defines, however, the content of data within the <itl:NISTBiometricInformationExchangePackage> complex element.

Certain portions of the exchange package, such as Record Type-2, shall be in accordance with definitions set according to the implementation domain or application profile (See **SectionImplementation domain and application profiles**).

This exchange package shall contain two or more logical records. One of those records shall be the Type-1 <itl:PackageInformationRecord>.

The logical records are intended to convey specific types of related information pertinent to the exchange package itself or to the subject of the package. All of the logical records belonging to a single package shall be contained within a single <itl:NISTBiometricInformationExchangePackage> element. All binary image data is converted to ASCII using Base-64 encoding.

Table 100 Record element tags for the record types

Record Category Code	Record Element Tag	Logical record contents
1	<itl:PackageInformationRecord>	Transaction information
2	<itl:PackageDescriptiveTextRecord>	User-defined descriptive text
3		**deprecated**
4	<itl:PackageHighResolutionGrayscaleImageRecord>	High-resolution grayscale fingerprint image
5		**deprecated**
6		**deprecated**
7	<itl:PackageUserDefinedImageRecord>	User-defined image
8	<itl:PackageSignatureImageRecord>	Signature image
9	<itl:PackageMinutiaeRecord>	Minutiae data
10	<itl:PackageFacialAndSMTImageRecord>	Facial, SMT and other body part image
11		Reserved for voice

Record Category Code	Record Element Tag	Logical record contents
12		Reserved for dental
13	<itl:PackageLatentImageRecord>	Variable-resolution latent image
14	<itl:PackageFingerprintImageRecord>	Variable-resolution fingerprint image
15	<itl:PackagePalmprintImageRecord>	Variable-resolution palm print image
16	<itl:PackageUserDefinedTestingImageRecord>	User-defined variable-resolution testing image
17	<itl:PackageIrisImageRecord>	Iris image
18	<itl:PackageDNARecord>	DNA data or image
19	<itl:PackagePlantarImageRecord>	Plantar image
20	<itl:PackageSourceRepresentationRecord>	Source representation
21	<itl:PackageAssociatedContextRecord>	Associated context
22-97		Reserved for future use
98	<itl:PackageInformationAssuranceRecord>	Information assurance
99	<itl:PackageCBEFFBiometricDataRecord>	CBEFF biometric data

C.7 Information exchange package format, and record "header"

The traditional-encoding data field element logical record length has been omitted from the XML encoding specification; there is no technical need for the byte count, and the value would be incompatible and meaningless for transformations between traditional and XML packages.

The first element in all XML encoded records shall be labeled <biom:RecordCategoryCode> and contain the type (category) number of the record. (See **Section 8.2.1)** The second element in every record other than the Type-1 record, shall be labeled <biom:ImageReferenceIdentification> and contain the **Information designation character / IDC** as described in **Section 7.3.1**.

The remaining XML elements in each record shall be present in the order defined by the schema and contain data described in the base standard for that particular element. Elements in the biometric domain and the ITL schema that are new for 2011 have been given an order that corresponds to the base standard as much as possible. Elements in the biometric domain and the ITL schema that are replacements for the 2008 version elements in ansi-nist.xsd retain their previous order unless otherwise noted in the Change Log (See **Section C.11 Information exchange package documentation (IEPD) artifacts.)** Note that the order of the elements for XML encoding are mandatory, unlike the order of fields in traditional encoding.

C.8 Implementation domains and application profiles

An implementation domain or an application profile (See **Section 6)** represents a group of agencies or organizations that have agreed to use specific pre-assigned data blocks for exchanging information unique to their installations, such as the Type-2 record (See **Section 8.2**), which is composed of user-defined content. Each user-defined XML element shall also have a definition and data type associated with it. Each domain or application profile created shall have a point of contact responsible for keeping the documentation on the content of the user-defined data blocks within their domain. The contact shall serve as a registrar and maintain a repository including documentation for all the common and user-specific Type-2 content contained within the substitution block for <itl:DomainDefinedDescriptiveDetail>. As additional fields are required by specific agencies for their own applications, new XML elements and definitions may be registered and reserved to have a specific meaning. When this occurs, the registrar is responsible for ensuring a single definition for each XML element used by different members of the domain or application profile. Additional content in the Type-2 record may be defined as a substitute for <itl:OtherDescriptiveDetail> by agreement of sending and receiving parties.

C.9 NIEM biometrics domain

The biometrics domain is a part of NIEM. It has its own oversight body, and is subject to NIEM governance. The oversight body for the biometrics domain is US-VISIT in the Department of Homeland Security. Although the word 'domain' is used for both 'Implementation domain' and 'Biometric domain', the concepts are not related.

C.10 Record descriptions

C.10.1 Type-1 Transaction information record

The XML name for the Type-1 record (**Section 8.1**) is <itl:PackageInformationRecord>, and its <biom:RecordCategoryCode> element shall have a value of “1”.

C.10.2 Type-2 User-defined descriptive text record

The XML name for the Type-2 record (**Section 8.2**) is <itl:PackageDescriptiveTextRecord>, and its <biom:RecordCategoryCode> element shall have a value of “2”. All other content in the Type-2 record is abstract. To use a Type-2 record, implementers shall declare substitution elements in a user-created namespace.

C.10.3 Type-3, 5, and 6 fingerprint image records

These record types are deprecated and shall not be included in a transaction conformant to this version of the standard.

C.10.4 Type-4 fingerprint image record

The XML name for the Type-4 record (**Section 8.4**) is <itl:PackageHighResolutionGrayscaleImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “4”.

Unlike traditional encoding, the elements of the Type-4 record shall have ASCII XML element tags. Unlike traditional encoding (See **Annex B: Traditional encoding**), the data values of Type-4 fields shall be expressed as ASCII characters. To be strictly consistent with traditional encoding, the <biom:FingerprintImagePosition> element may have six fixed occurrences of the <biom:FingerprintPositionCode> element.

```
<biom:FingerprintImagePosition>
        <biom:FingerPositionCode>2</biom:FingerPositionCode>
        <biom:FingerPositionCode>3</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
        <biom:FingerPositionCode>255</biom:FingerPositionCode>
</biom:FingerprintImagePosition>
```

For XML encoding, only a single occurrence of the <biom:FingerPositionCode> element is required.

C.10.5 Type-7 User-defined image record

The XML name for the Type-7 record (**Section 8.7**) is <itl:PackageUserDefinedImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “7”.

With the exception of the <biom:RecordCategoryCode> and <biom:ImageReferenceIdentification> elements, the parameters, and types of images to be exchanged are not defined by this standard. Implementers will define an XML data block that substitutes for the abstract <itl:UserDefinedImage> element provided by this standard. These required details shall be agreed upon between the sender and recipient.

C.10.6 Type-8 Signature image record

The XML name for the Type-8 record (**Section 8.8**) is <itl:PackageSignatureImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “8”.

Unlike traditional encoding, the elements of the Type-8 record have ASCII XML element tags. Unlike traditional encoding, the data values of Type-8 fields shall be expressed as ASCII characters.

For the Type-8 record, implementers may insert a <biom:SignatureImageVectorRepresentation> in place of the <nc:BinaryBase64Object> within the <biom:SignatureImage> complex element.

C.10.7 Type-9 Minutiae data record

The XML name for the Type-9 record (**Section 8.9**) is <itl:PackageMinutiaeRecord>, and its <biom:RecordCategoryCode> element shall have a value of “9”.

Implementers may use minutiae blocks defined in the schema:

- the INCITS-M1 block (biom:INCITSMinutiae)
- the EFS block (biom:ExtendedFeatureSetMinutiae)
- the legacy 2008 standard minutiae block (itl:Minutiae).

Alternatively, implementers may define and substitute a complex element for <biom:RecordMinutiae>.

C.10.8 Type-10 Facial, other body part & SMT image record

The XML name for the Type-10 record (**Section 8.10**) is <itl:PackageFacialAndSMTImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “10”. Within a single Type-10 record, implementers shall choose between a single <biom:FaceImage> complex element, or a <biom:PhysicalFeatureImage> complex element.

C.10.9 Type-11 Voice record

This record type is reserved for future use.

C.10.10 Type-12 Dental record

This record type is reserved for future use.

C.10.11 Type-13 Friction-ridge latent image record

The XML name for the Type-13 record (**Section 8.13**) is <itl:PackageLatentImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “13”.

C.10.12 Type-14 Fingerprint image record

The XML name for the Type-14 record (Section **8.14**) is <itl:PackageFingerprintImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “14”.

C.10.13 Type-15 Palm print image record

The XML name for the Type-15 record (**Section** 8.15) is <itl:PackagePalmprintImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “15”.

C.10.14 Type-16 User-defined testing image record

The XML name for the Type-16 record (**Section** 8.16) is <itl:PackageUserDefinedTestingImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “16”.

C.10.15 Type-17 Iris image record

The XML name for the Type-17 record (**Section** 8.17) is <itl:PackageIrisImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “17”.

C.10.16 Type-18 DNA record

The XML name for the Type-18 record (**Section** 8.18) is <itl:PackageDNARecord>, and its <biom:RecordCategoryCode> element shall have a value of “18”.

C.10.17 Type-19 Plantar image record

The XML name (**Section** 8.19**)** is <itl:PackagePlantarImageRecord>, and its <biom:RecordCategoryCode> element shall have a value of “19”.

C.10.18 Type-20 Source representation record

The XML name for the Type-20 record (**Section** 8.20**)** is <itl:PackageSourceRepresentationRecord>, and its <biom:RecordCategoryCode> element shall have a value of “20”.

C.10.19 Type-21 Associated context record

The XML name for the Type-21 record (**Section** 8.21) is <itl:PackageAssociatedContextRecord>, and its <biom:RecordCategoryCode> element shall have a value of “21”.

C.10.20 Type-98 Information assurance record

The XML name for the Type-98 record (Section 8.22) is <itl:PackageInformationAssuranceRecord>, and its <biom:RecordCategoryCode> element shall have a value of “98”.

C.10.21 Type-99 CBEFF biometric data record

The XML name for the Type-99 record (**Section 8.23**) is <itl:PackageCBEFFBiometricDataRecord>, and its <biom:RecordCategoryCode> element shall have a value of "99". Implementers should note that the value of the <biom:CaptureDate> element differs in the Type-99 record from its occurrence in other records. CBEFF requires both date and time. The date and time shall appear as twenty characters in the format YYYY-MM-DDThh:mm:ssZ. The YYYY characters shall represent the year; the MM characters shall be the tens and units values of the month; and the DD characters shall be the tens and units values of the day of the month; the character T separates the date from the time; the hh characters represent the hour; the mm the minute; the ss represents the second; and Z denotes Coordinated Universal Time.

Complex element <biom:CaptureDate> shall have the simple element <nc:DateTime>, which shall contain transaction date and time data.

```
<biom:CaptureDate>
        <nc:DateTime>2008-02-29T05:25:00Z</nc:DateTime>
</biom:CaptureDate>
```

C.11 Information exchange package documentation (IEPD) artifacts

The latest version of all documents is to be referenced.The following artifacts are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm :

- Metadata
- Catalog
- Exchange Schema
- NIEM subset schema
- Instance document(s)
- Change log describing differences between ANSI/NIST-ITL 2-2008 to ANSI/NIST-ITL 2011
- XSLT transformation to/from *ANSI/NIST-ITL 2-2008*

Annex D: NCIC code table

Normative

In the 2007 and 2008 versions of the standard, the NCIC code table was present in the text of the standard as an annex. The NCIC table codes have been updated since the publication of those versions of this standard. In order to ensure consistency with the current version of these codes, this version of the standard includes the latest version of the NCIC code table as a normative reference. It is available at http://www.oregon.gov/OSP/CJIS/NCIC.shtml .

Note that any codes that were listed in the 2007 and 2008 versions of this standard that are not included in the list at the above website are still valid, in order to maintain backward compatibility. An example is CRIP FOOT. The current version of the NCIC code table has CRIP L FT and CRIP R FT.

Annex E: Facial Capture – SAPs 30 and above

Normative

E.1 Introduction

This annex is based upon work originating at a Mugshot and Facial Image Workshop held at NIST in 1995. The original recommendation document was incorporated as Annex H in the 2007 / 2008 version of the ANSI/NIST-ITL standard, supplemented by Annex I, which extended the recommendations further, as well as Annex J, which dealt with Face-Pose values. This annex combines the three annexes of the 2007 / 2008 standard and includes new information, which in no manner contradicts earlier guidance.

The annex is not designed to render current and legacy mugshot collections unacceptable. Rather, it is intended as a means of establishing or improving interoperability between mugshot systems. The provisions of this annex are keyed to the quality aspects associated with the unaltered captured mugshot image. For new mugshot images being captured, the specifications contained in this annex are equally applicable to real-time electronic capture of mugshots as well as the electronic conversion of photographic images. For conversion of legacy files of photographs, the provisions of this annex are applicable.

This annex consists of a set of Sections describing the capture of facial images at SAP levels 30 and above. See **Section 7.7.5.1 Subject acquisition profile for face / SAP.** These Sections can be categorized into six types of requirements: digital, photographic, subject and scene, number of photographs, data handling, and format (for SAP levels 40 and above).

E.2 Digital requirements

E.2.1 Pixel aspect ratio

Digital cameras and scanners used to capture facial images shall use square pixels with a pixel aspect ratio of 1:1.

E.2.2 Image aspect ratio

For SAPs 30 and 32, the aspect ratio shall be 4:5 (480x600pixels). For SAP 40 and above, the aspect ratio shall be 3:4. SAP 40 specifies a minimum of 768x1024 pixels, which corresponds to this aspect ratio, allowing a COTS digital camera to be used for capture. Images from some types of camera with a different aspect ratio shall need to be cropped.

E.2.3 No interlacing

Interlaced video frames shall not be used in the capture of a facial image.

E.2.4 No digital zoom

Digital zoom (interpolation) to achieve specified resolution associated with Subject Acquisition Profiles shall not be used in the capture of a facial image.

E.2.5 Minimum number of pixels

The minimum number of pixels in an electronic digital image shall be 480 pixels in the horizontal direction by 600 pixels in the vertical direction. It should be noted that the image quality of the captured mugshots and facial images may be improved as the number of pixels in both directions are increased. However, as images are captured with an increased number of pixels, the 4:5 (SAPs 30/32) and 3:4 (SAP 40 and above) (Width:Height) aspect ratio shall be maintained.

E.3 Photographic requirements

E.3.1 Depth of field

The subject's captured facial image shall always be in focus from the nose to the ears. Although this may result in the background behind the subject being out of focus, this is not a problem. It is recommended that auto-focus on the central part of face be used with digital camera photography. For optimum quality of the captured mugshot, the f- stop of the lens should be set at two f-stops below the maximum aperture opening when possible.

E.3.2 Subject lighting

Lighting shall be equally distributed on the face. There shall be no significant direction of the light from the point of view of the photographer.

For non-mobile SAPs (those other than 32, 42 and 52), the following conditions apply:

- Subject illumination shall be accomplished using a minimum of three (3) point-balanced illumination sources. Although a minimum of three photo lights is required for illuminating the subject's face, two of these lights should be sufficient for some operational environments. Use of a third light as a backlight generally requires about two feet of additional floor space behind the subject, which may not be available in all environments.

- Appropriate diffusion techniques shall be employed and lights positioned to minimize shadows, and to eliminate hot spots on the facial image. These hot spots usually appear on reflective areas such as cheeks and foreheads.

- Proper lighting shall contribute to the uniformity of illumination of the background described in the exposure requirement.

- The region of the face, from the crown to the base of the chin, and from ear-to-ear, shall be clearly visible and free of shadows. In particular, there shall be no dark shadows in the eye-sockets due to the brow, and the iris and pupil of the eyes shall be clearly visible.

E.3.3 Background and lighting

This section does not apply to mobile SAPs (32, 42, or 52).

The subject whose image is being captured shall be positioned in front of a background that is 18% gray with a plain smooth flat surface[71]. A Kodak or other neutral gray card or densitometer shall be used to verify this 18% gray reflectance requirement. The boundary between the head and the background should be clearly identifiable about the entire subject (very large volume hair excepted). There should be no shadows visible on the background behind the face image. Proper lighting shall contribute to the uniformity of illumination of the background.

Ensure that the background completely fills the image frame behind the subject. If possible, avoid the presence of visible shadows and other objects in the background, such as a clock.

E.3.4 Exposure calibration

This section does not apply to mobile SAPs (32, 42 or 52).

The exposure shall be keyed to the background. Several areas of the recorded 18% gray background shall be used to verify the proper exposure. The averages of the 8-bit Red, Green, and Blue (RGB) components within each area shall be calculated. Each of the RGB means shall fall between 105 and 125 with a standard deviation of ±10. Furthermore, for every area examined, the maximum difference between the means of any two of the RGB components shall not exceed 10.

E.3.5 Exposure

When capturing images using digital cameras, the exposure should be such that the image is as bright as possible without introducing any clipping of the highlights. With most digital cameras, this can easily be checked by examining the histogram[72] associated with the image. Most modern digital cameras have sophisticated metering systems that should ensure that a properly exposed image is always captured once the camera and lights have been correctly set up.

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[71] An example of a paint formula that will approximate an 18% gray (on matte surface) is one quart Olympic Premium Interior Latex Eggshell, Base 3 - 72403, 101-1Y31.5, 109-8.5, or one quart Benjamin Moore & Co. Premium Interior Latex Flat Finish Wall Satin, Medium Base 215 2B, Formula: OY-8½ RX-3/4 BK-21 GY-4 WH-10, Area/Tint Code: B.

[72] http://www.photographyreview.com/histogramguidecrx.aspx

E.3.6 No saturation

For each patch of skin on the person's face, the gradations in textures shall be clearly visible. In this sense, there shall be no saturation (over or under exposure) on the face.

E.3.7 No unnatural color or "red-eye"

Unnaturally colored lighting (e.g. yellow, red) is not allowed. Care shall be taken to correct the "white balance" of image capture devices. The lighting shall produce a face image with natural looking skin tones when viewed in typical examination environments. "Red-eye" is not acceptable.

E.3.8 No color or grayscale enhancement

A process that overexposes or underexposes a part or all of a color or grayscale image for purposes such as beauty enhancement or artistic pleasure is not allowed. The full spectrum shall be represented on the face image where appropriate. Teeth and whites of eyes shall be clearly light or white (when appropriate) and dark hair or features (when appropriate) shall be clearly dark.

E.3.9 Distortion and angle of view

Unnatural radial distortion of the camera lens, resulting in a diagonal angle of view of approximately 20 to 28 degrees, shall not be allowed. Fish eye effect, a type of distortion where central objects of the image erroneously appear closer than those at the edge, typically resulting in what appear to be unusually large noses in the image, is not allowed. While some distortion is usually present during portrait photography, that distortion should not be noticeable by human examination. For a typical photo capture system with a subject 1.5 to 2.5 meters from the camera, the focal length of the camera lens should be that of a medium telephoto lens. For 35 mm photography, this means that the focal length should be between 90 mm and 130 mm. For other negative formats/sensors, the recommended focal length is 2 to 3 times the diagonal of the negative/sensor.

E.3.10 Allowed color space

Digital images shall be represented as 24-bit RGB pixels. For every pixel, eight (8) bits shall be used to represent each of the Red, Green, and Blue components. The RGB color space is the basis for other color spaces including the Y, Cb, Cr and YUV. Additional color management techniques are available from the International Color Consortium. Information regarding these techniques can be downloaded from the following URL: http://www.color.org/.

A full color image shall be captured. To ensure that color images exchanged between differing systems can be correctly displayed or printed, images shall be converted to the device-independent color space, sRGB.

E.4 Subject and scene requirements

E.4.1 Pose

The full-face or frontal pose is the most commonly used pose in photo lineups and shall always be captured. This pose is in addition to profiles or intermediate angled poses captured to acquire perspective and other information.

E.4.2 Subject position

It is important that no shadows are cast onto the background from the subject's head. One way to achieve this is by positioning the subject 1-2 feet away from the background, and/or using an additional light source to illuminate the background.

E.4.3 Centering

The full-frontal face pose shall be positioned to satisfy all of the following conditions. For non-frontal pose (SAP levels 40, 50 and 51) , the subject shall satisfy these conditions when the head is rotated about an axis though the head and torso from the current pose back to center (zero angles) pose.

E.4.3.1 The "Head and Shoulders" photo composition

The composition consists of a subject's head, partial shoulders, and plain background. For a frontal-facing pose, the width of the subject's head shall occupy approximately 50% of the width of the captured image. This width shall be the horizontal distance between the mid-points of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head. See **Figure 21.**

- The approximate horizontal mid-points of the mouth and of the bridge of the nose shall lie on an imaginary vertical straight line positioned at the horizontal center of the image.

- An imaginary horizontal line through the center of the subject's eyes shall be located at approximately the 55% point of the vertical distance up from the bottom edge of the captured image.

- The width of the subject's head shall occupy approximately 50% of the width of the captured image. This width shall be the horizontal distance between the mid-points of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head.

E.4.3.2 The "Head Only" photo composition

The composition consists of a subject's head, and a plain background. For a frontal- facing pose, the width of the subject's head shall occupy approximately 70% of the width of the captured image. This width shall be the horizontal distance between the midpoints of two imaginary vertical lines. Each imaginary line shall be drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head. A template and an example are shown in **Figure 22**. This composition is applied to SAP 51.

For other than frontal image capture, the composition shall be rotated about an imaginary axis extending from the top of the head through the base of the neck**.**

E.4.4 Head coverings

Head coverings, including hats and scarves, shall not be worn. The full face and ears shall be displayed.

E.4.5 Hair

When capturing frontal, profile and angled images, the subject's hair shall be moved to reveal the full face and ears. If hair covers the ears, then when possible, two photographs shall be captured – one with hair in its normal state, and one with hair pulled back behind the ears. For SAP levels 40 and above, if hair covers the ears, then when possible, two photographs shall be captured. One should be with hair in its normal state, and a second should be with hair pulled back behind the ears.

E.4.6 Glasses and eye patches

For subjects who normally wear eyeglasses, every effort should be made to capture the mugshots with the glasses on. If significant glare in the glasses is evident in the photograph, then a second frontal mugshot image should be captured of the subject without glasses. Specification of eyeglasses in **Field 10.026: Subject facial description / SXS** is required. The wearing of eye patches is allowed only for medical reasons. In these cases, the specification of the patch, in the **Field 10.026: Subject facial description / SXS** is required.

E.4.7 Expression

The expression should be neutral (non-smiling) with both eyes open normally (i.e. not wide-open), and mouth closed. Every effort should be made to have supplied images conform with this specification. A smile with closed jaw is not recommended.

E.4.8 Mouth

Mouth shall be closed (unless medical condition precludes it).

E.4.9 Subject facial expression

The Subject facial description field shall be present in the transaction when one or more of the facial attributes given by the type codes of **Field 10.026: Subject facial description / SXS** is present in the image.

E.4.10 Subject hair color

The Subject hair color **Field 10.028: Subject hair color / SHC** shall be present in the transaction. The code “UNSPECIFIED” for this field is not allowed.

E.4.11 Subject eye color

The Subject eye color **Field 10.027: Subject eye color / SEC** shall be present in the transaction. The code “UNSPECIFIED” for this field is not allowed.

E.4.12 Shoulder position

Shoulder position shall be square to the camera and forward facing for frontal images. Shoulder position shall be perpendicular to the camera for profile images.

E.4.13 Make-up and cleanliness

The subject's face should not be presented with heavy make-up, dirt, blood, etc. In an operational environment where this may not be possible, best practice is to take a second (set of) photographs once the subject has been cleaned up.

E.4.14 Face count

Only one face per image is allowed.

E.4.15 Medical conditions

If bruising, injuries, bandages, or medical conditions exist, these shall be captured as is. In an operational environment, and where business processes and legislation permit, best practice should be to take a second picture once any bandages have been removed and any injuries to the face have healed.

E.5 Number of photographs

Levels 50 and 51 records mandate multiple images. However, if the subject has accessories that occlude facial features, e.g. such as eyebrow studs, ear plugs, or rings through the nose, at least one frontal image should be captured with them and one image without. Levels 50 and 51 shall include at least five photographs of the subject: (frontal, left full profile, right full profile, left half profile and right half profile).

Figure 20: Five poses for SAP 50 and 51

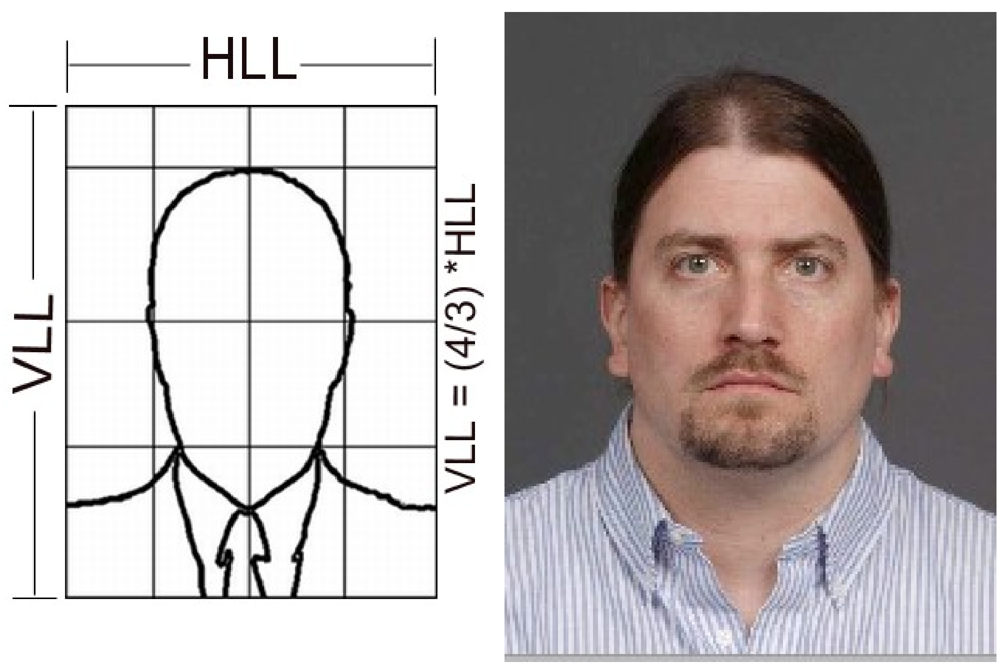

Figure 21: A facial template and example of

"Head and Shoulders" scene constraints

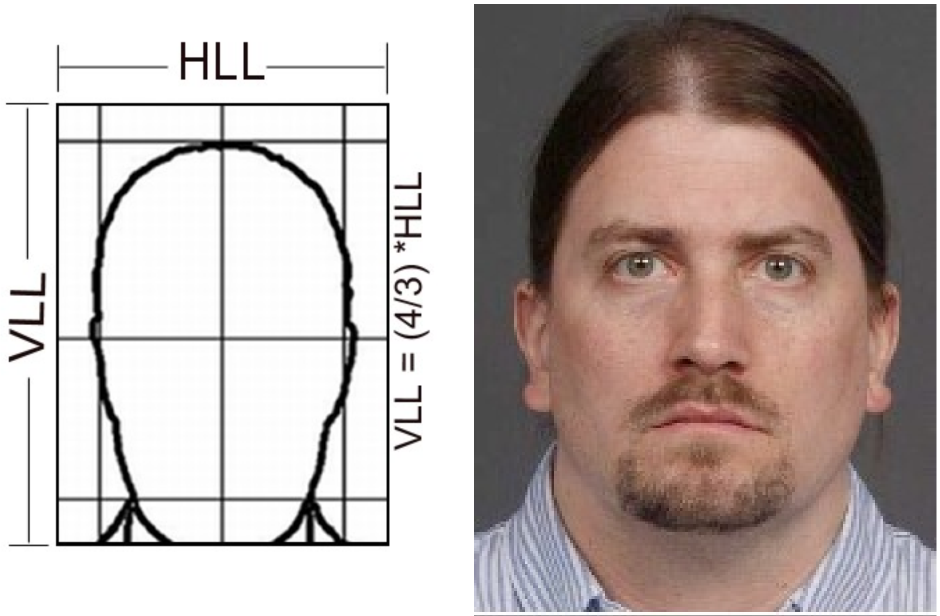

Figure 22: Facial image template and example of "Head Only" scene constraints

E.6 Data handling requirements

E.6.1 Compression algorithm

E.6.1.1 SAP Levels 30 and 32 only

The algorithm used to compress mugshot and facial images shall conform to the JPEG Sequential Baseline mode of operation as described in *ISO/IEC 10918*. The target size for a JPEG compressed color mugshot image file shall be 25,000 to 45,000 bytes.

E.6.1.2 SAP Levels 40 and above

Non-frontal facial images shall be compressed using JPEG 2000, as specified in *ISO/IEC 15444*. (JPEG is not allowed). There shall be one frontal facial image compressed using lossless JPEG 2000. If multiple frontal images are in the transaction, then one image must be compressed via lossless compression and the others can be compressed either using lossless JPEG 2000 or lossy JPEG 2000 that meets the maximum compression limits specified below. The best practice is to apply the lossless compression to the frontal image with ears visible.

E.6.2 Compression ratio

The maximum compression ratio for both JPEG and JPEG 2000 of a rectangular region containing any exposed skin of the face, from crown to chin and ear to ear, shall be at most 15:1. This requirement is derived from studies of face algorithm matching at high and low resolutions. The non-facial portion of the mugshot, as well as other Type-10 records, can be compressed up to a ratio of 120:1.

Custom JPEG source code can be created to implement compression with both ROI and fixed compression ratios. For JPEG 2000, these capabilities are built into the implementation.

For both JPEG and JPEG 2000, care must be taken to account for automatic compression by camera hardware. Multiple compression stages can damage the quality of photographic data. When possible, minimum compression (highest resolutions) should be applied at the camera level when external software performs the final (15:1 or less) compression stage.

Table 101: Example file sizes after compression

Level	Minimum WxH	Uncompressed Size (RGB888)	Size @ 2:1 Lossless Compression	Size @ 15:1 compression for the entire image	Size @ 15:1 compression for the face and 120:1 for the background
30/32	480x600	844 KB		58 KB	19.34 KB
40/42	768x1024	2.3 MB		156 KB	52.8 KB
50	3300x4400	42.5MB	14.2 MB		
51/52	2400x3200	22.5 MB	7.5 MB		

Table 101 provides the typical size of a single facial photograph using the compression recommendations contained in this section.This table is based upon the image being formatted as RGB888 (8 bits per color channel per pixel) for levels 30, 32, 40 and 42. Since the face width is 50% of the image width, then the area taken by the face is estimated to be 25% of the total image area. SAP levels 50, 51, and 52 include the constraint of lossless compression for the frontal pose facial image as discussed above.

E.7 Format requirements (SAP levels 40, 42, 50, 51 and 52)

E.7.1 The definition and range of pose angles

The Yaw and Roll angles shall be measured from the full face pose position and have a range of values from -180 degrees to +180 degrees. The Pitch angle shall have a range of values from -90 degrees to +90 degrees. The pose angle set is given by Tait-Bryan angles as shown in **Figure 23**.[73]

[73] From http://en.wikipedia.org/wiki/Euler_angles

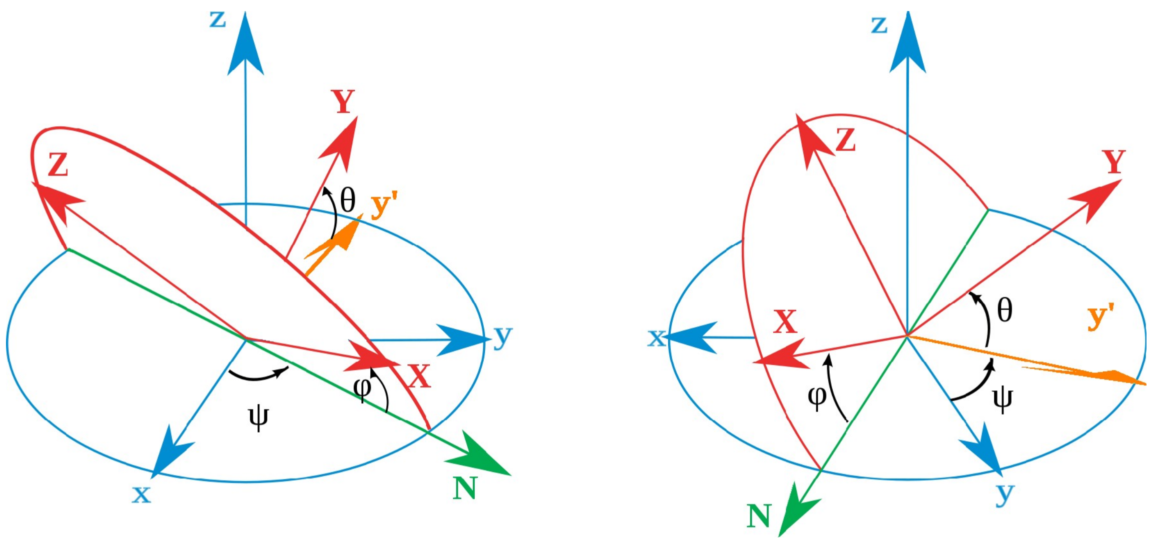

Figure 23: Tait-Bryan angles statically defined with the Z-X'-Y'' convention

The angles are defined relative to the frontal view of the subject, which has angles (0, 0, 0). Examples are shown in **Figure 24**.

Yaw angle: rotation about the vertical (y) axis. A positive Yaw angle is used to express the angular offset as the subject rotates from a full-face pose to their left (approaching a right profile). A negative Yaw angle is used to express the angular offset as the subject rotates from a full-face pose to their right (approaching a left profile).

Pitch angle: rotation about the horizontal side-to-side (x) horizontal axis.

Roll angle: rotation about the horizontal back to front (z) axis.

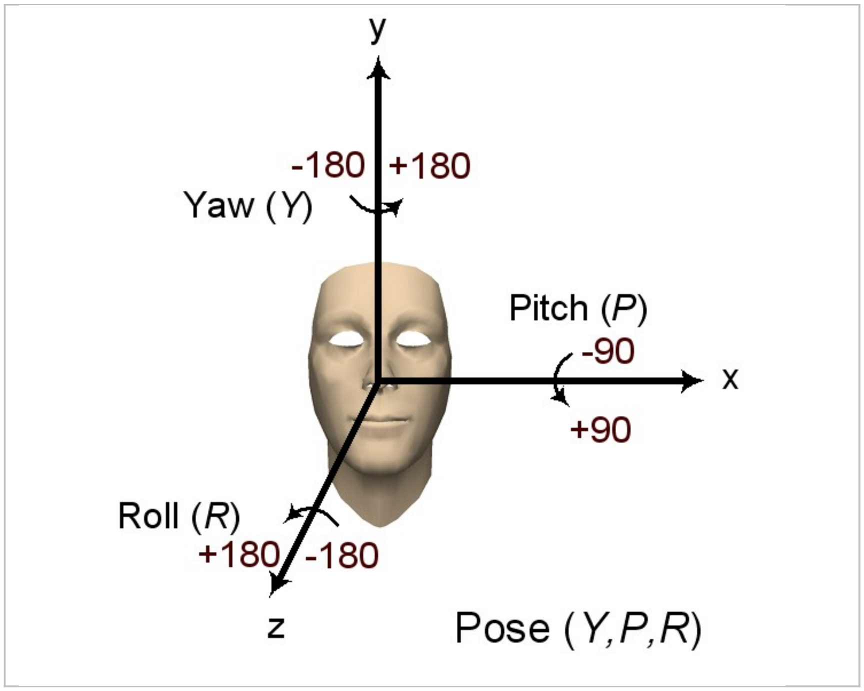

Figure 24: Pose angle set is with respect to the frontal view of the subject

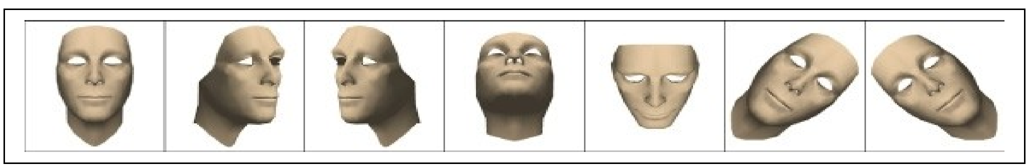

Figure 25: Examples of pose angles and their encodings.

The pose angles (Y, P, R) of (a) – (g) in **Figure 25** are given by (0, 0, 0), (+45, 0, 0), (-45, 0, 0), (0, -45, 0), (0, +45, 0), (0, 0, -45), and (0, 0, +45), respectively. (See also **Section E.7.3 The order of rotation through pose angles**)

The uncertainty in the pose angles is given by the range 0 to 90, inclusive. It shall denote approximately a maximum value of possible deviation in the measurement of the pose. This shall correspond to a two standard deviation confidence interval.

The encoding of angles is in ASCII format, with the minus sign "-" used to denote a negative value and the plus "+" sign optionally used to denote a positive value. Pose angle uncertainty angles always are positive.

E.7.2 Subject Pose (POS) and subject pose angles (SPA)

One of either the POS or SPA fields shall be used to denote pose angles.

The code values in **Field 10.020: Subject pose / POS** of “F”, “R”, and “L” can be used for images in which the Pitch and Roll angles are 0 and the Yaw angle is 0, 90, and -90 respectively. (The sign of the Yaw angle in the previous sentence corresponds to the field 10.020 where a right profile is when the subject is facing left).

Field 10.025: Subject pose angles / SPA can be used for the above poses and shall be used for all other angled poses. **Field 10.020: Subject pose / POS** shall then be of type code “D”, for determined 3D pose, instructing the user to use **Field 10.025: Subject pose angles / SPA** as the reference for pose angles. (For example, a ¾ profile capture would require a POS field entry of “D” with the angle specified for SPA.)

A frontal view consists of a face with a Yaw, Pitch, and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (0,0,0).

A full profile view consists of a face with a Yaw pose angle of ±90 degrees, and with Pitch and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (90,0,0), subject facing left (right profile), and (-90,0,0), subject facing right (left profile). For full profile photographs, the ear facing the camera should be visible, pushing the hair back to the extent possible. For full profile images, the entire body shall be rotated with the head.

A half profile view consists of a face with a Yaw pose angle of ±45 degrees, and with Pitch and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (45,0,0), subject facing left, and (-45,0,0), subject facing right. For half profile, the orientation of the head is rotated 45 degrees to half profile; the rotation of the body is recommended, but not required. Care should be taken to prevent the subject from keeping the head fixed while changing only the gaze. SAP 50/51 records may optionally include ¾ profile views, with a Yaw pose angle of ±67.5 degrees, and with Pitch and Roll angles of zero. Subject pose angle (**SPA**) values shall be recorded as (67.5,0,0), subject facing left, and (-67.5,0,0), subject facing right. In all cases, the uncertainty in the Yaw pose angle determination shall be less than 5 degrees of the frontal photograph, and 10 degrees in the non-frontal photographs. Uncertainty in the Pitch and Roll angles shall be less than 5 degrees.

E.7.3 The order of rotation through pose angles

As order of the successive rotation around the different axes does matter, the encoded rotation angle shall correspond to an order of execution starting from the frontal view. This order shall be given by Roll (about the front axis), then Pitch (about the horizontal axis) and finally Yaw (about the vertical axis). The (first executed) Roll transformation shall therefore always be in the image (x, y) plane. Examples are shown in **Figure 26**. From the point of view of executing a transformation from the observed view to a frontal view, the transformation order shall therefore be Yaw, Pitch, and then Roll. The encoded angle is from the frontal view to the observed view. The pose angles have an origin of coordinate system at the nose tip. Figures (a)-(c) show three successive rotation steps to achieve the pose angles (Y, P, R) of (-45, -30, +45). Figures (d)-(f) show three successive rotation steps to achieve the pose angles (-30, +20, -30).

(Y, P, R)=(0, 0, +45)	(Y, P, R)=(0,-30, +45)	(Y, P, R)=(-45, -30, +45)
a	b	c

(Y, P, R)=(0, 0, -30)	(Y, P, R)=(0, +20, -30)	(Y, P, R)=(-30, +20, -30)
d	e	f

Figure 26: Examples of the order of rotation

Annex F: Extended Feature Set Detailed Intructions

Normative

At the ANSI/NIST-ITL 1-2000 Standard Workshop I in April 2005, the Scientific Working Group on Friction Ridge Analysis, Study, and Technology (SWGFAST) was tasked to identify, define and provide guidance on additional fingerprint features beyond the traditional ending ridges and bifurcations currently defined in the ANSI/NIST-ITL-2000 standard. SWGFAST drafted a memo to NIST in response[74], enumerating the features used by expert human latent examiners that are not currently addressed in fingerprint feature standards. SWGFAST stated its concern: "AFIS [Automated Fingerprint Identification System] technology, since its onset, has utilized a very limited amount of fingerprint detail. Latent print experts must rely on far more information in effecting individualizations/exclusions than just ending ridges and bifurcations, i.e., the Type-9 minutiae record. SWGFAST is attempting to educate and provide to the vendor community the additional features and how they are utilized by these experts." In response to SWGFAST, a presentation was given at the ANSI/NIST-ITL 1-2000 Standard Workshop II in December 2005, entitled "Extended Fingerprint Feature Set", and it was proposed that a committee be convened to define an Extended Fingerprint Feature Set as an Annex to the next ANSI/NIST-ITL standard. The Committee to Define an Extended Fingerprint Feature Set (CDEFFS) was chartered for that purpose. The committee included representatives from various Federal Agencies, SWGFAST and the latent fingerprint community, and engineers from a variety of AFIS vendors.

This Annex to the standard and the fields associated with EFS included in Type-9 of this version of the standard are the result of agreements reached among the members of CDEFFS during workshops held in April, May, and July 2006, and extensive electronic interactions and document reviews from December 2005 through March 2011, as well as presentations and the agreement of participants in the workshops held in July 2010 and March 2011 at NIST to include EFS in the 2011 version of the standard.

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[74] Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST); Memo to Mike McCabe (NIST) Regarding ANSI/NIST ITL 1-2000; November, 2005; http://biometrics.nist.gov/cs_links/standard/ansi_2010/archive/SWGFAST_Memo.pdf

F.1 Introduction

This annex to the ANSI/NIST-ITL 1-2011 standard defines a series of updated fields for the Type-9 record that include a broad, complete, and detailed set of friction skin features. These fields are collectively described as the "Extended Friction Ridge Feature Set" (EFS). Extended friction ridge features will generally correspond to a latent fingerprint or palmprint image in a Type-13 record, a fingerprint image in a Type-14 record, a palmprint image in a Type-15 record, or a plantar image in a Type-19 record.

F.2 Scope

This annex defines the content, format, and units of measurement for the definition and/or exchange of friction ridge feature information that may be used in the identification of a subject based on fingerprint or palmprint image information. This information is intended for an individual examiner to define the content of a single impression or comparison of two impressions, as well as for interchange between criminal justice administrations or organizations that use fingerprints or palmprints for identification purposes.

F.3 Purpose

The purpose of this annex is to define a quantifiable, repeatable, and clear method of characterizing the information content or features of latent or exemplar images from fingerprints, palmprints, or other friction ridge skin.

Uses may include, but are not limited to,

- Definition of the information content of a *single* friction ridge impression as discerned by an examiner during analysis, for archiving, interchanges with other examiners, validation and quality assurance processing, and quantitative analysis.

- Definition of the information content and determination of *a comparison of two* friction ridge impressions as discerned by an examiner during comparison and evaluation, for archiving, interchanges with other examiners, validation and quality assurance processing, and quantitative analysis.

- Interoperable interchange format for automated fingerprint or palmprint systems, for human-initiated searches, fully automated searches, data interchange between automated systems, and feedback to examiners from automated processing.

Different uses may require different subsets of the features defined in this annex. **Field 9.303: EFS feature set profile / FSP** defines the specific sets of EFS fields. Profiles can be incorporated by reference into the definition of transactions: this decoupling of feature sets from transactions enables different transactions to share a common feature set, aiding in interoperability.

Automated algorithms can use the extended features defined for a latent search without explicitly computing them for the exemplar image, and thus it must be emphasized that automated extraction of the extended features on the exemplar is not necessarily the only nor the best way to use this information.

F.4 No features present fields

The following table shows the correspondence between related pairs of fields. For each row in the table, only one field shall be present in a record.

For example, if there are no cores included in **Field 9.320: EFS cores / COR**, then **Field 9.325: EFS no cores present / NCOR** would be set to "Y" if analysis determined that there were no cores discernible, but would have been omitted if analysis had not been conducted for cores.

Table 102: Features and Corresponding presence fields

Feature fields	Fields indicating lack of the feature
Field 9.320: EFS cores / COR	**Field 9.325: EFS no cores present / NCOR**
Field 9.321: EFS deltas / DEL	**Field 9.326: EFS no deltas present / NDEL**
Field 9.324: EFS distinctive features / DIS	**Field 9.327: EFS no distinctive features present / NDIS**
Field 9.331: EFS minutiae / MIN	**Field 9.334: EFS no minutiae present / NMIN**
Field 9.340: EFS dots / DOT	**Field 9.346: EFS no dots present / NDOT**
Field 9.341: EFS incipient ridges / INR	**Field 9.347: EFS no incipient ridges present / NINR**
Field 9.342: EFS creases and linear discontinuities / CLD	**Field 9.348: EFS no creases or linear discontinuities present / NCLD**
Field 9.343: EFS ridge edge features / REF	**Field 9.349: EFS no ridge edge features present / NREF**
Field 9.345: EFS pores / POR	**Field 9.344: EFS no pores present / NPOR**

If a field shown in the second column of **Table 102** is included, it will be populated with a "Y" indicating the analysis of the image has positively determined that there are no instances of that feature present in the image. If the analysis has not been performed for that particular feature, or if the analysis has determined there are a number of those features present in the image, the field in the second column of **Table 102** will be omitted from the transaction.

F.5 Definitions of feature confidence and local quality

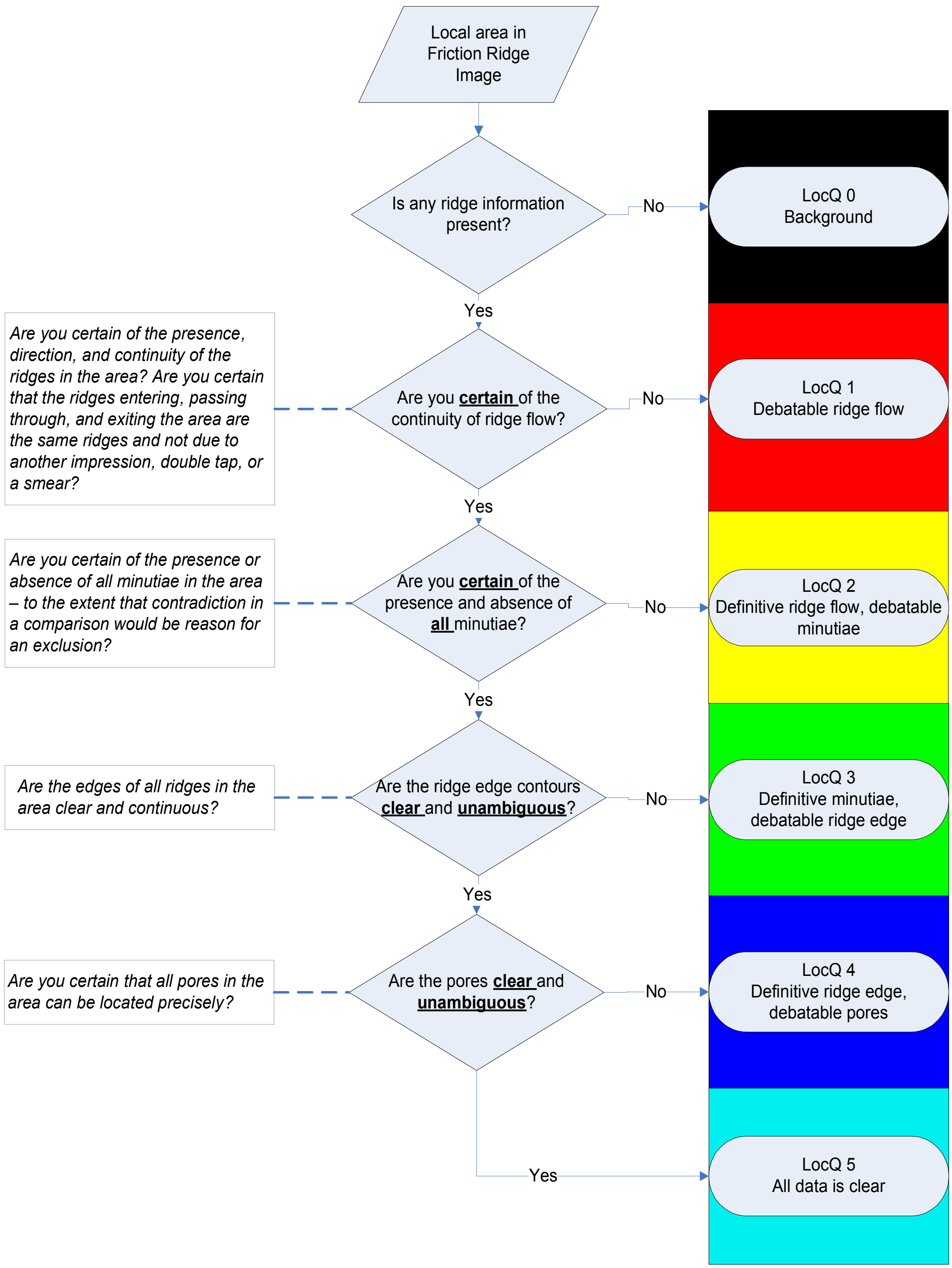
Local friction ridge quality (**Field 9.308: EFS ridge quality/confidence map / RQM**) is an assessment of confidence in small local areas within an image. The local quality map is used to define the confidence in all other features, and therefore is key information. In addition, when the quality map indicates a high-quality region in which features are not marked, that information can be used as "negative features" or definitive absence of features, which can be used for exclusion.

Accurate and consistent markup of local quality is essential, and the guidelines in **Table 103** and **Figure 27** should be followed as closely as possible. The names and color-coding indicated here are the result of extensive research and user feedback and are normative.

<table>
<tr><th></th><th></th><th></th><th>Ridge flow</th><th>Minutiae</th><th>Dots</th><th>Incipients</th><th>Ridge edge features</th><th>Pores</th><th></th></tr>
<tr><td>Black</td><td>0</td><td>Background</td><td colspan="6">✗</td><td>Black (0,0,0)</td></tr>
<tr><td>Red</td><td>1</td><td>Debatable ridge flow</td><td>?</td><td colspan="5">✗</td><td>Red (255,0,0)</td></tr>
<tr><td>Yellow</td><td>2</td><td>Definitive ridge flow, debatable minutiae</td><td>✔</td><td>?</td><td colspan="4">✗</td><td>Yellow (255,255,0)</td></tr>
<tr><td>Green</td><td>3</td><td>Definitive minutiae, debatable ridge edges</td><td colspan="2">✔</td><td colspan="3">?</td><td>✗</td><td>Green (0,255,0)</td></tr>
<tr><td>Blue</td><td>4</td><td>Definitive ridge edges, debatable pores</td><td colspan="5">✔</td><td>?</td><td>Blue (0,0,255)</td></tr>
<tr><td>Aqua</td><td>5</td><td>All features definitive</td><td colspan="6">✔</td><td>Aqua (0,240,240)</td></tr>
</table>

Table 103: Definitions for ridge quality map values

Figure 27: Decision process for local ridge quality



F.6 Extended friction ridge feature set fields – detailed instructions

The following sections provide additional definition or examples for some of the EFS fields described in the main text.

F.6.1 Location and orientation fields

These fields define where the impression is located in the image, how it is oriented, and the type of impression(s) present. Fields are described in this section only if there are additional instructions and guidance beyond that covered in the Sections comprising **8.9.7 Extended Feature Set.** The fields in this grouping are:

- **Field 9.300: EFS region of interest / ROI**
  See **8.9.7.0.2 EFS region of interest** in **Section 8.9.7** for more information about the ROI. With the exception of **Field 9.323: EFS center point of reference / CPR,** all other fields are in relation to the ROI defined in this field, and not the original image.
- **Field 9.301: EFS orientation / ORT**
- **Field 9.302: EFS finger - palm - plantar position / FPP**

F.6.1.2 Field 9.301: EFS orientation / ORT instructions

While arbitrary rotation of the image is not recommended due to image degradation concerns, rotation of the image in multiples of 90° can be performed without image degradation and is acceptable. See **Section 8.9.7.2** for a description of the information items contained in this field.

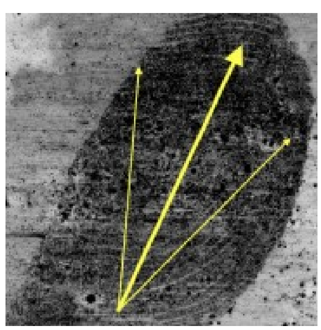


Figure 28: Example of orientation: -25 ± 20 degrees

F.6.1.3 Field 9.302: EFS finger - palm - plantar position / FPP ***instructions***

If the image/region of interest contains multiple areas, this field allows the option to label and mark each of those areas within the region of interest. Each of the areas present shall be indicated using the appropriate **friction ridge generalized position / FGP**, with a polygon delineating each of the areas. Polygons may overlap if appropriate. See **Figure 29**, **Figure 30** and **Figure 31** for examples.

If the image is an exemplar entire joint image or full finger view (from a set of complete friction ridge exemplars), or a latent of equivalent area, it shall be marked with the information item **friction ridge generalized position / FGP** (0-10), and shall have the individual segments marked with the information item **segment polygon / SGP** (See **Figure 29** for segment areas)

If the image is of a palm (or foot), each of the palm areas present shall be marked with the relevant **friction ridge generalized position / FGP** and delineated with the information item **segment polygon / SGP**.

The information item **off-center print / OCF** information item is optional, but is only used for fingerprints. An example is shown in **Figure 31** of an off-center fingerprint.

Figure 29: Use of polygons to mark multiple finger segments in a latent equivalent to a full finger view

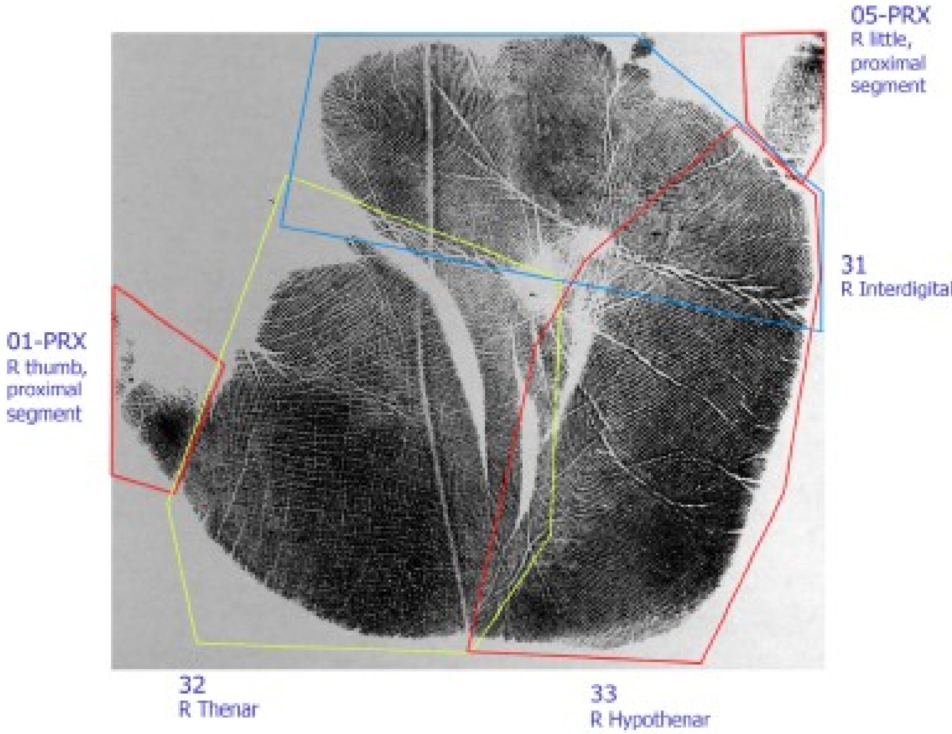


Figure 30: Use of polygons to mark multiple areas within a palm impression

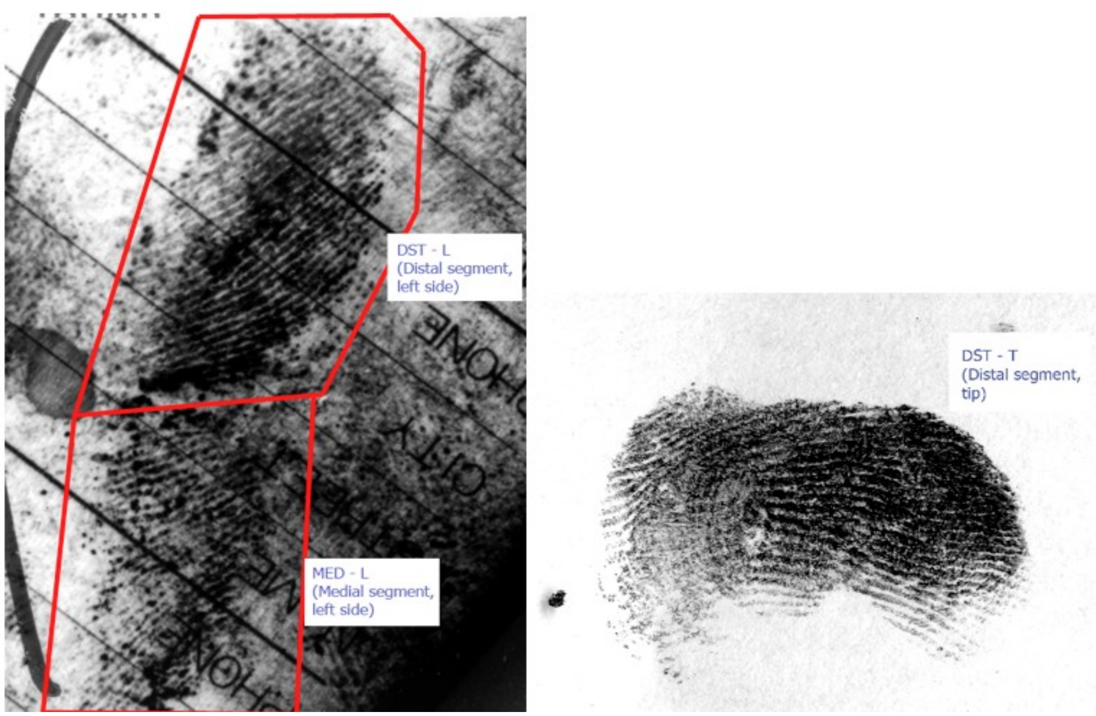


Figure 31: Examples of off-center fingerprint positions

F.6.2 Overall image characteristics

F.6.2.1 Field 9.307: EFS pattern classification / PAT instructions

This field, described in **Section 8.9.7.5** , contains fingerprint classification information for the image. This field shall only be used for fingerprints, and shall be omitted (left empty) for other friction ridge impressions.

The first information item, **general class / GCF,** is the general set of pattern classifications with a value selected from **Table 32 Pattern classification codes,** general class column.

The second information item, **subclass / SUB,** is the subclass of arches and whorls selected from **Table 32 Pattern classification codes,** subclass column. This information item shall only be included if the sub-classification can be determined precisely.

The third information item, **whorl - delta relationship / WDR** (also known as Whorl Tracing) may optionally be used by a human examiner or automated system to provide the relationship between the deltas in a whorl. This information item shall only be included for whorls if the subclass is known, and only if the whorl delta relationship can be determined precisely. This information item shall be set to I (Inner), O (Outer), or M (Meeting), following the guidelines from *The Science of Fingerprints*, p. 60 (See **Section 3 Normative references**): *When the deltas have been located, the ridge emanating from the extreme left delta is traced until the point nearest or opposite the extreme right delta is reached. The number of ridges intervening between the tracing ridge and the right delta are then counted. If the ridge traced passes inside of (above) the right delta, and three or more ridges intervene between the tracing ridge and the delta, the tracing is designated as an "inner" […] If the ridge traced passes outside of (below) the right delta, and three or more ridges intervene between the tracing ridge and the delta, the tracing is designated as an "outer" […] All other tracings are designated as "meeting."*

This field may include up to seven subfields, indicating all possible pattern classifications. Classification must be conservative: if the pattern is known precisely, only a single pattern shall be indicated; however, if there is any doubt as to the precise classification, all possible patterns shall be included. If the pattern cannot be classified, but a pattern type can be definitively excluded, then that shall be indicated by including all possible patterns. For example, a latent that contains a delta but no other pattern area information could possibly be a left loop, right loop, whorl (of any type), or tented arch, so it would indicate 4 subfields with the following information items specified:

general class / GCF = LS

general class / GCF = RS

general class / GCF = WU

general class / GCF = AU and **subclass / SUB** = TA

Complete Scar (SR) and Dissociated Ridges/Dysplasia (DR) should only be noted if the fingerprint cannot be classified. If the print can be classified and scar(s), dissociated ridges, and/or dysplasia are present, this field should note the classification(s) and the scar(s), dissociated ridges, and/or dysplasia should be noted in **Field 9.324: EFS distinctive features / DIS**. The use of **Field 9.322: EFS core delta ridge counts / CDR** can be used to further subcategorize pattern classification.

F.6.3 Reference points

F.6.3.1 Field 9.321: EFS deltas / DEL instructions

This field is described in **Section 8.9.7.17.**

For fingerprints, one or more deltas are defined for all pattern classifications other than plain arches, as shown in **Table 40 EFS delta codes**. Note that tented arches should have deltas marked if such a structure is present. Accidentals may have any number of deltas.

Most palmprints contain four interdigital deltas and one carpal delta. Other delta-like patterns may be defined using this field if such structures are present in friction ridge images.

This field consists of the following information items:

The first two information items are mandatory. (**'x' coordinate / DXC** and **'y' coordinate / DYC**). They define the location of the delta, in units of 10 micrometers (0.01mm).

The next three optional information items (**direction up / DUP, direction left / DLF,** and **direction right / DRT)** define the three directions of the delta, in degrees counterclockwise from the right. The three angles shall be reported in order by increasing angle, which for fingerprint deltas with known orientation will result in the order up, left, then right. These three information items may be omitted (left empty).

The sixth information item, **type / DTP,** is optional. It defines the type of delta, as defined in **Table 40 EFS delta codes**.

The seventh information item, **radius of position uncertainty / RPU,** is optional. It defines the radius of a circle centered at the location (X,Y) of the delta; the circle is sized to include the area of other possible locations of the delta, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the image.

The eighth through tenth information items (**direction uncertainty up / DUU**, **direction uncertainty left / DUL,** and **direction uncertainty right / DUR)** contain the uncertainty of the three delta angles, in non-negative integer degrees. Valid values range from “0” to “180”: a value of “0” (default) indicates a certain direction, while a value of “180” indicates an unknown orientation. If one or more deltas are present and the features set is from a fingerprint, **Field 9.307: EFS pattern classification / PAT** should be defined. Note that this does not mean that the classification has to be known definitively, but must at least be known to the extent of excluding plain arches.

Figure 32: Palm with carpal delta and interdigital deltas 7-10 marked

F.6.3.2 Field 9.323: EFS center point of reference / CPR instructions

This field, described in **Section 8.9.7.19,** contains the location of a center point of reference of a fingerprint, which can be used to define how centered a fingerprint is, as a feature, for registration or orientation, and for quality measurements. While the core may serve some of the same purposes, a center point of reference is defined for arches and provides a single center location for complex whorls, unlike cores.

The location of a center point of reference can be determined using different algorithms, as stored in the Method information item, in which case different center points of reference may be stored in different subfields.

The center point of reference is defined for fingerprints or toeprints, not for other types of friction ridge images. This field consists of the following information items:

The first information item is the **method / CPM** of determining the X,Y location, selected from **Table 104**. (This is an expanded version of **Table 41**).

The second and third information items (**'x' coordinate / PXC** and **'y' coordinate / PYC**) are the location of the center point of reference, as defined in CPM, stated in units of 10 micrometers (0.01mm)

The fourth information item, **radius of position uncertainty/ RPU, is optional.** It is 0 (default) if the location is known precisely; if the precise location cannot be determined (such as due to poor clarity), the position is marked at the best estimate of position, with a radius including the area of other possible locations, in integer units of 10 micrometers (0.01mm). The radius of uncertainty can overlap the edge of the image.

Table 104: Explanation of methods of determining center point of reference locations

Name	Code	Description
Lateral center only	L	The center location is defined laterally (across the finger) but is not meaningful in the other dimension (longitudinally, or along the finger), such as for defining the center line of arches, tips, and lower joints. Lateral center is only meaningful if the orientation (**Field 9.301: EFS orientation / ORT**) is known; the point marked is the center with respect to the orientation angle.
Uppermost point of the ridge with greatest curvature	0	For a fingerprint with a known or estimated orientation, the center point is determined by finding the highest point of each ridge that is convex and pointing upward, and measuring the curvature/peak angle by following the ridge 1.63mm (0.064in) in both directions from that point, as shown in **Figure 34**. The point with the minimum angle (greatest curvature) is the center point of reference.
Overall fingerprint focal point	1	The overall fingerprint focal point is the point where the lines perpendicular to ridge flow converge. as shown in **Figure 35**. The point of convergence is determined in terms of least squares (see, e.g., Novikov and Kot (1998)[75]

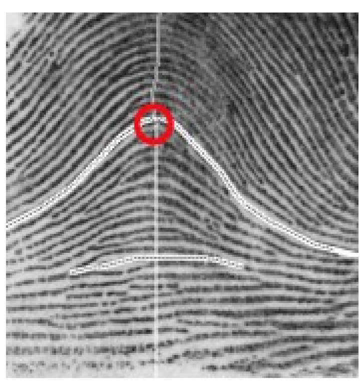


Figure 33: Lateral center example

[75] Novikov S.O and Kot V.S.; "Singular Feature Detection and Classification of Fingerprints using Hough Transform"; *Proc. Of SPIE (Int. Workshop on Digital Image Processing and Computer Graphics (6th): Applications in Humanities and Natural Sciences)*; vol 3346, pp 259-269, 1998

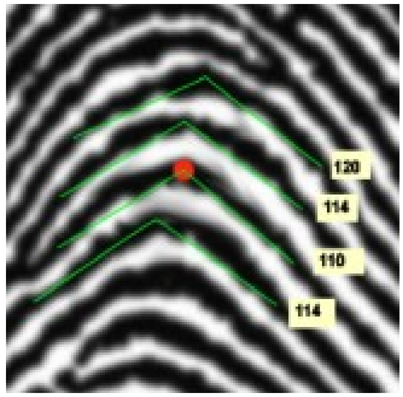


Figure 34: Uppermost point of the ridge with greatest curvature. Measurements are angles (degrees)

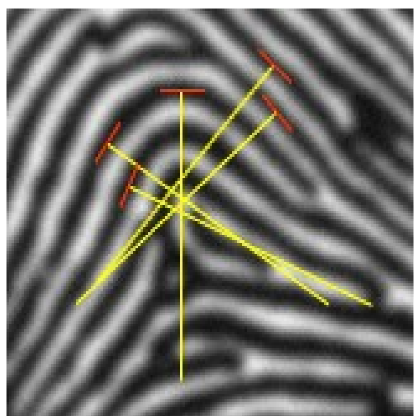


Figure 35: Overall fingerprint focal point

F.6.4 Minutiae

F.6.4.1 Field 9.331: EFS minutiae / MIN instructions

This field is used to define the characteristics of all minutiae in the region of interest.

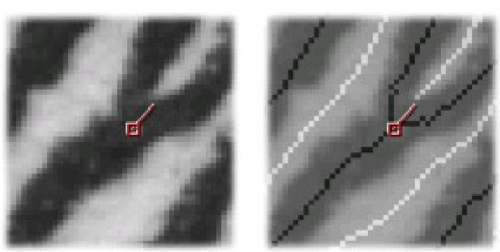


Figure 36: Minutia placement for a bifurcation

The information item **type / MTY** of minutiae shall be marked if it is clearly identifiable as a ridge ending or bifurcation (as selected from **Table 43 EFS codes for minutia types)**; otherwise, it shall be marked as unknown type (code 'X'). If the type is unknown, the information item **radius of position uncertainty/ MRU** shall be indicated. As seen in **Figure 36**, the center of the bifurcation should be at the "Y" of the ridge. The theta angle should run down the valley.

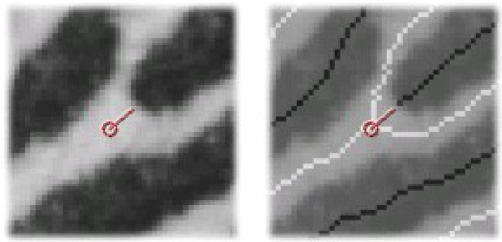


Figure 37: Minutia placement for a ridge ending

As seen in **Figure 37**, the center of the ridge ending should be at the "Y" of the valley. The theta angle should run up the ridge. Note that the ridge ending location corresponds with that used for the FBI's EFTS and INCITS 378, and differs from some vendor-specific approaches. If the precise location for a ridge ending cannot be ascertained, a radius of uncertainty shall be marked to include the area of possible locations.

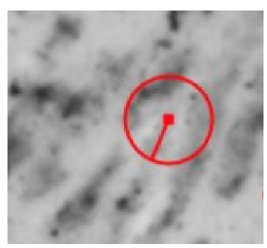


Figure 38: Minutia placement when type is unknown

In **Figure 38,** **t**he minutia is placed as for a ridge ending, **type / MTY** is set to unknown, and the **radius of position uncertainty / MRU** is defined to include possible points of intersection with neighboring ridges, as shown. The **type / MTY** of minutia shall be set if the examiner/encoding process is confident as to type: the "either" type (Code 'X' from **Table 43 EFS codes for minutia types**) shall be used for all minutiae that are not clearly identifiable as a ridge ending or a bifurcation. Because of the frequency with which minutiae appear to be ridge endings in one impression and bifurcation in another, even in clear images, it is recommended that the minutiae **type / MTY** be used as supporting evidence rather than as a basis for exclusion. All complex minutiae types (crossovers/trifurcations etc) should be marked as combinations of bifurcation/endings. Unusually distinctive types/combinations of minutiae should be marked as unusual minutiae/groups of minutiae in **Field 9.324: EFS distinctive features / DIS**.

The location of the minutia (the information items **'x' coordinate** and **'y' coordinate)** **,** are in units of 10 micrometers (0.01mm). Ridge endings are located at the fork of the midpoint of the valley (see **Figure 37**), and bifurcations are at the fork of the midpoint of the ridge (**Figure 36**). Unknown types are marked as for ridge endings (Code 'E' in information item **type / MTY)**, and with the information item **radius of uncertainty / MDU** also defined (**Figure 38**).

The direction of the minutia, the information item **theta / MTD,** is expressed in degrees. The angle of the minutia is determined by constructing three virtual rays originating at the minutia and extending 1.93mm (0.064" – about three ridge widths) along each ridge (for a bifurcation) or valley (for a ridge ending). The smallest of the three angles formed by the rays is bisected to indicate the minutiae direction.

The information item **radius of position uncertainty / MRU** is optional. It defines the radius of a circle centered at the location (X,Y) of the minutia; the circle is sized to include the area of other possible locations of the minutia, if the precise location cannot be determined (such as due to poor clarity). If the location is known precisely, the radius of position uncertainty may be omitted or set to 0. The radius of uncertainty is measured in integer units of 10 micrometers (0.01mm), and may overlap the edge of the Region of Interest.

The information item **direction uncertainty / MDU** is optional. It contains an integer from "0" (default) to "180" indicating the precision in the direction (theta) of the minutia, measured in degrees. The resulting direction is Theta±Uncertainty°. Examples of cases in which confidence in direction may be low include cases when the ridge stops or bends close to the minutia so that a good angle measurement cannot be taken, or cases with three equally spaced legs.

Note the relationship between **Field 9.308: EFS ridge quality/confidence map / RQM** and minutiae. In areas of **RQM** that are green, blue or aqua, the presence and absence of minutiae is definitive and can be used in future comparison. Otherwise, the regions should be marked yellow.

F.6.5 Additional features

F.6.5.1 Field 9.343: EFS ridge edge features / REF instructions

This field is described in **Section 8.9.7.32.**

Ridge edge features include Protrusions (abrupt increases in ridge width), Indentations (abrupt decreases in ridge width), and Discontinuities (points where a ridge stops briefly):

- A protrusion (or spur) is an abrupt increase in ridge width that is not long enough to be called a bifurcation. An event on a ridge longer than local ridge width shall be marked as a standard bifurcation with a ridge ending; a shorter event shall be marked as a protrusion. Protrusions are marked at the center of the protruding area.

- An indentation is an abrupt decrease in ridge width. Indentations are marked at the center of the gap in the ridge.

- A discontinuity is a point where the ridge stops briefly and restarts again without shifting. A wider gap in the ridge flow, or where the ridges do not line up across the divide, should be marked as two ridge endings, not a discontinuity. A series of discontinuities in a line (such as a cut or crack) should be marked as a linear discontinuity, using the **Field 9.342: EFS creases and linear discontinuities / CLD**. A discontinuity is marked at the center of the gap in the ridge.

This field consists of three information items. The first two (**'x' coordinate/ CLX** and **'y' coordinate ' CLY**) are the coordinates of one endpoint in units of 10 micrometers (0.01 mm). The third information item is the **type / CLT** of feature. It is:

P (Protrusion), I (Indentation), or D (Discontinuity).

F.6.6 Corresponding features

These fields are used to define the areas or points that correspond or do not correspond between two or more of the images contained in the current transaction: when images are compared as candidates for individualization (potential mates), the corresponding areas and points can be retained in these fields; similarly, the reasons for complex exclusions can be indicated. Points of Correspondence may be marked using any type of feature, and are explicitly not limited to minutiae.

Comparison features are especially appropriate in transactions in which one latent image is bundled with one or more candidate/potential match images in order to show which areas and points in the latent image correspond to areas and points in the candidate images. Such transactions may be useful for exchanges between examiners, or for communicating results back from AFIS searches. See **Figure 12: EFS areas and points of correspondence in rolled exemplar, latent, and plain exemplar images** for an example. The latent illustrated has two different areas of correspondence, one for each of the exemplars.

F.6.7.1 Field 9.361: EFS corresponding points or features / CPF instructions

This field, described in **Section 8.9.7.48** , is used to label points or features for comparison of the current feature set with other Type-9 feature sets in this transaction, as illustrated in **Figure 10: EFS locations of major flexion creases**.This field is to be used only when two or more images contained in a single transaction are compared, either as candidates for individualization (potential mates), or for annotating reasons for exclusion. For each of the images being compared, specific points or features are marked in each of the type-9 records, with correspondence indicated by the use of the same label. Labels within a single Type-9 record shall be unique.

For example, if a transaction contains one latent and multiple candidate exemplars, a feature labeled "A" in the latent's Type-9 feature set corresponds with the feature labeled "A" (if present) in all of the exemplar Type-9 feature sets.

Table 105: Informal explanation of types of corresponding points and features

Category	Type	Code	Description
Definite correspondence	Feature	F	The labeled feature *definitely corresponds* to the feature defined by the **corresponding field number / CFN** and **corresponding field occurrence / FOC** information items. (**corresponding x coordinate / CXC** and **corresponding Y coordinate / CYC** are unused) *Informally: It definitely exists & it corresponds to this specific minutia (or dot, pore, core, etc*)
	Point	P	The labeled feature *definitely corresponds* to the location with the coordinates defined in the **corresponding x coordinate / CXC** and **corresponding Y coordinate / CYC** information items. (**corresponding field number / CFN** and **corresponding field occurrence / FOC** information items are unused) *Informally: It definitely exists & it corresponds to this specific point (allows quick definition of points, rather than having to define each feature*)
Possible or debatable correspondence	Debatable Feature	DF	The labeled feature may debatably correspond to the feature defined by the **corresponding field number / CFN** and **corresponding field occurrence / FOC** information items. (**corresponding x coordinate / CXC** and **corresponding Y coordinate / CYC** information items are unused). *Informally: It appears to correspond to this specific minutia (or dot, pore, core, etc), but it isn't clear enough to be certain.*
	Debatable Point	DP	The labeled feature may debatably correspond to the location with the coordinates defined in the **corresponding x coordinate / CXC** and **corresponding Y coordinate / CYC** information items. (**corresponding field number / CFN** and **corresponding field occurrence / FOC** information items are unused) *Informally: It appears to correspond to this specific point, but it isn't clear enough to be certain.*

Category	Type	Code	Description
Definite lack of correspondence	Does not exist	X	The labeled feature definitely does not exist in the impression, and the consistency of presentation of the potentially corresponding region is sufficient to make a definite determination. (**corresponding x coordinate / CXC, corresponding Y coordinate / CYC**, **corresponding field number / CFN** and **corresponding field occurrence / FOC** information items are unused) *Informally: The feature isn't there, and the regions correspond enough that I would be able to see it if it were there – this is presumably a justification for an exclusion.*
Inconclusive	Out of region	R	The labeled feature is not visible in the impression because it lies outside of the area of correspondence for this image: the feature may or may not be present, but the impression does not include the relevant area (**corresponding x coordinate / CXC**, **corresponding Y coordinate / CYC**, **corresponding field number / CFN** and **corresponding field occurrence / FOC** information items are unused) *Informally: It isn't in the area of overlap, so I can't say anything.*
	Unclear area	U	The labeled feature is not visible in the impression because the potentially corresponding region is not sufficiently clear: the feature may or may not be present, but local quality issues prevent a definite determination. (**corresponding x coordinate / CXC, corresponding Y coordinate / CYC**, **corresponding field number / CFN** and **corresponding field occurrence / FOC** information items are unused) *Informally: I can't tell if the feature is there because the area where it would be is smudged or otherwise unclear.*

Corresponding Points or Features may refer to arbitrary points, or may refer to predefined features (as noted in **Table 105** and **Table 54 EFS codes for field numbers used for corresponding features**). Note that the features include point features (such as minutiae, dots, or pores), but also may refer to areas (such as distinctive characteristics), lines (incipients or creases), or paths (ridge path segments).

Arbitrary points may be used to indicate characteristics that were not noted during analysis, or to indicate points in an exemplar that was not previously marked up. For example, see **Table 106.** Assume that a latent and exemplar are both present in a transaction, and that the latent and exemplar columns in these tables are examples from **Field 9.361: EFS corresponding points or features / CPF** from different type-9 records in a single transaction. The label "M1" indicates that the latent minutia (stored in **Field 9.331: EFS minutiae / MIN**) #5 corresponds to corresponds to location (1024,765) within the exemplar's **8.9.7.0.2 EFS region of interest**. The **label / COL** "X1" indicates that the dot (**Field 9.340: EFS dots / DOT**) #1 does not exist within the exemplar image.

Field 9.361 consists of the following information items:

The first information item, **label / COL,** 1-3 character alphanumeric label used to indicate correspondence between feature points in different type-9 records within the same transaction. Labels within a single Type-9 record shall be unique. Note that the use of a given label in one type-9 record means that that point or feature corresponds with any or all other features with the same label in other type-9 records in the transaction.

Table 106: Examples of corresponding points and features

Field 9.361 information Item	Latent	Exemplar	Latent	Exemplar
label / COL	M1	M1	X1	X1
type of correspondence / TOC (from Table 106)	F	P	F	X
corresponding field number / CFN	331		340	
corresponding field occurrence / FOC	5		1	
corresponding x coordinate / CXC		1024		
corresponding y coordinate / CYC		765		

The second information item, **type of correspondence / TOC,** is a 1-2 character information item and is set to the appropriate value from **Table 105**.

The third information item, **corresponding field number / CFN,** is used only if **TOC** = F or DF) The Field Number information item indicates the type of field being compared, from Table F29. Note that these are simply the Type-9 field numbers of the fields that can be used for comparisons.

The fourth information item, **corresponding field occurrence / FOC,** is used only if **TOC** = F or DF) This information item indicates which subfield (occurrence) of the specified field to which the label is applied. This is a 1-based index, not a 0-based index: occurrences are numbered (1…count), not (0…count-1).

The fifth and sixth information items (**corresponding x coordinate / CXC** and **corresponding y coordinate / CYC**) are used only if **TOC** = P or DP) These two optional information items define the location of the **CPF**, in units of 10 micrometers (0.01mm).

The seventh information (**comment / COM)** is optional. It allows a free text comment or description related to the **CPF**.

F.6.8 Ridge path: skeletonized image and ridge path segments

Ridge path describes the course of a friction ridge. This specification provides for image or vector representations of ridge path information: as a skeletonized image, or as a set of ridge path segments (open path vectors). Either representation is a simplified representation of the ridges in the image that provides a rich method of conveying information, including feature placement, interrelationships, ridge direction, and wavelength. Note that the ridge path representation is a means of annotating the image (rather than replacing the image): it is a clear way of defining and communicating the specific path of each ridge, both for a human examiner and an automated extractor.

Skeletonized image

The ridge path for the entire region of interest can be represented as a skeletonized image, also known as a ridge tracing, which reduces the friction ridge impression to an image with thinned representations of each ridge. The skeletonized image is a 2-tone image with a white background and a black single-pixel-wide thinned representation of each ridge and stored in **Field 9.372: EFS skeletonized image / SIM**.

Ridge Path Segments

The ridge path can be decomposed into a number of ridge path segments. Each ridge path segment (if completely visible) is the portion of a ridge that connects two minutiae, so each ridge path segment starts and stops either where the ridge intersects another ridge path segment (a bifurcation) or ends (a ridge ending). In the infrequent case in which a ridge segment forms a complete loop back on itself without intersecting another ridge segment (such as near the core of some plain whorls or central pocket loops), the ridge path starts and stops at a single arbitrary point on the ridge. Each ridge path segment is saved as an open path (ordered set of vertices) in **Field 9.373: EFS ridge path segments / RPS**; see **Section 7.7.12.1, Type-9 extended feature set (EFS) paths** for information on path formats.

Incipient ridges, dots, ridge discontinuities, and protrusions are not included in the ridge path representation.

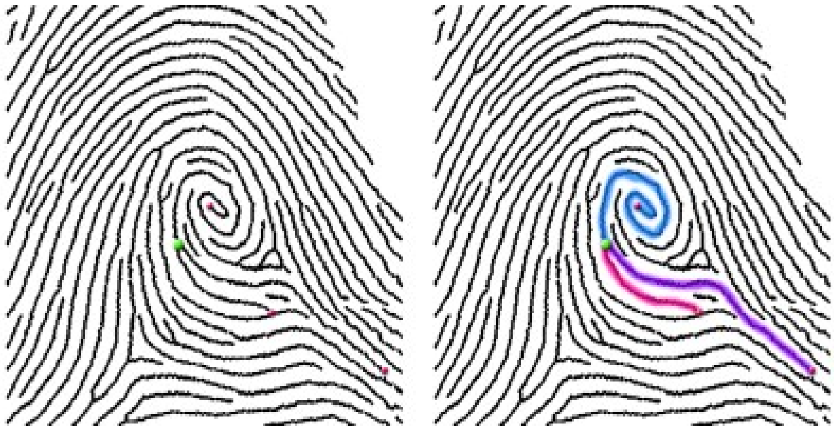


Figure 39: Example of interrelationships between minutiae, with connecting ridge path segments highlighted

Note that often ridge path segments are not visible over their entire length due to image clarity problems or due to being truncated by the edge of the impression, and therefore one or both ends of a ridge segment may not end at points defined as minutiae. Effective use of ridge path representations requires distinguishing between any areas in which the skeleton is debatable rather than definitive. **Field 9.308: EFS ridge quality/confidence map / RQM** is used for this purpose: **Table 107** shows the relationship between the local quality values and the ridge path. **Figure 40** shows an example of a skeletonized image with a quality map: black and red areas (quality 0-1) have no skeleton; the yellow areas are poor (quality 2) and the skeleton information is not definitive; in other areas the skeleton is definitive.

Table 107: Local ridge quality and tracing

Ridge path	Local Quality Code	Name	Display color
Ridge path is definitive	5	Definitive pores	
	4	Definitive ridge edges, debatable pores	
	3	Definitive minutiae, debatable ridge edges	
Ridge path is debatable	2	Definitive ridge flow, debatable minutiae	
No ridge path	1	DebaTable Fridge flow	
	0	Background	

Figure 40: Examples of fingerprint, skeletonized representation, and overlay of original / skeleton / quality map

A ridge skeleton can represent sophisticated interrelationships between features. For example, **Figure 39** shows that the bifurcation in green shares the same ridge with the three minutiae in red. The human latent fingerprint comparison process relies heavily on such feature interrelationships.

Note that the PATH format permits the treatment of each ridge segment as a distinct feature, indexed by its (1-based) subfield number. Each ridge segment can be associated with the minutiae at its ends and features such as pores and ridge edge features along its length. Dots and incipients can be associated with the ridge segments on either side. Each ridge ending is associated with one ridge segment; each bifurcation is associated with three ridge segments.

In the case that the type of minutia cannot be determined or its precise location cannot be ascertained, a minutia can be tentatively associated with any ridge segments that cross the minutia's radius of uncertainty, as shown in **Figure 41**.

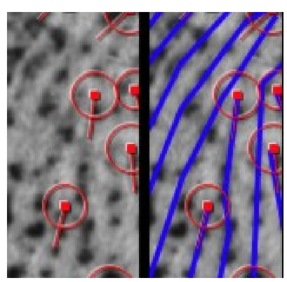


Figure 41: Examples of minutiae of uncertain type and radii of uncertainty, without and with ridge segments

F.6.8.1 Field 9.372: EFS skeletonized image / SIM instructions

The skeletonized image, also known as a ridge tracing, is stored as a 1-bit per pixel grayscale PNG[76] compressed image, bit-packed 6 bits per character using base-64 representation (See **Annex A: Character encoding information**). (Note that the result is a

[76] See ISO/IEC 15948:2004 in **Section 3 Normative references.**

bit-packed image with 6 pixels per base-64 character.) The entire PNG-formatted image file is included as a single subfield. Interlacing, alpha transparency, and color palettes shall not be used. The resolution of the skeletonized image must be the same as the original image.

Each black pixel can have 1, 2, or 3 neighboring black pixels; other values (0, 4-8) are errors. The skeletonized image's dimensions shall be identical to that specified in **Field 9.300: EFS region of interest / ROI**.

The values in **Field 9.308: EFS ridge quality/confidence map / RQM** are used to distinguish between the areas in which the skeleton is debatable and those in which it is definitive: Table F31 shows the relationship between the local quality values and the tracing.

F.6.8.2 Field 9.373: EFS ridge path segments / RPS instructions

Each skeletonized ridge segment is stored as a separate subfield, as an open path of consecutive vertices (see **Section 7.7.12.1 Type-9 extended feature set (EFS) paths**). Each endpoint of a ridge segment is either shared by 3 ridge segments (at a bifurcation) or is unique to a single ridge segment (at a ridge ending).

Annex G: Mapping to the NIEM IEPD

Informative

This Annex maps the elements defined in the ANSI/NIST-ITL 1-2011 specification to the specific XML elements used to implement them in the NIEM-conformant XML encoding (described in **Annex C**). Note that the allowed elements and their cardinalities may be more restrictive in this Annex than in the accompanying schema, due to the reuse of complex types across multiple record types, in accordance with NIEM conformance requirements.

Representation terms

The valid value set of a data element or value domain is described by the representation term. NIEM uses a standard set of representation terms in the representation portion of a NIEM- conformant component name. The following table lists the primary representation terms and a definition for the concept associated with the use of that term. The table also lists secondary representation terms that may represent more specific uses of the concept associated with the primary representation term.The NIEM naming rules are such that the representation term is the final part of the XML element name. For more information, see *National Information Exchange Model Naming and Design Rules.*

Primary Representation Term	**Secondary Representation Term**	**Definition**
Amount		A number of monetary units specified in a currency where the unit of currency is explicit or implied.
BinaryObject		A set of finite-length sequences of binary octets.
	Graphic	A diagram, graph, mathematical curves, or similar representation
	Picture	A visual representation of a person, object, or scene
	Sound	A representation for audio
	Video	A motion picture representation; may include audio encoded within
Code		A character string (i.e., letters, figures, and symbols) that for brevity, language independence, or precision represents a definitive value of an attribute.
DateTime		A particular point in the progression of time together with relevant supplementary information.

Primary Representation Term	Secondary Representation Term	Definition
	Date	A particular day, month, and year in the Gregorian calendar.
	Time	A particular point in the progression of time within an unspecified 24-hour day.
ID		A character string to identify and distinguish uniquely one instance of an object in an identification scheme from all other objects in the same scheme together with relevant supplementary information.
	URI	A string of characters used to identify (or name) a resource. The main purpose of this identifier is to enable interaction with representations of the resource over a network, typically the World Wide Web, using specific protocols. A URI is either a Uniform Resource Locator (URL) or a Uniform Resource Name (URN).
Indicator		A list of two mutually exclusive Boolean values that express the only possible states of a property.
Measure		A numeric value determined by measuring an object along with the specified unit of measure.
Numeric		Numeric information that is assigned or is determined by calculation, counting, or sequencing. It does not require a unit of quantity or unit of measure.
	Value	A result of a calculation.
	Rate	A representation of a ratio where the two units are not included.
	Percent	A representation of a ratio in which the two units are the same.
Quantity		A counted number of non-monetary units possibly including fractions.
Text		A character string (i.e., a finite sequence of characters) generally in the form of words of a language.
	Name	A word or phrase that constitutes the distinctive designation of a person, place, thing, or concept.

Type-1

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageInformationRecord	1..1
1.001		biom:RecordCategoryCode	1..1
-	-	biom:Transaction	1..1
1.005	DAT	biom:TransactionDate	1..1
-	-	biom:TransactionDestinationOrganization	1..1
1.007	DAI	nc:OrganizationIdentification	1..1

Field ID	Mnemonic	XML element name	Cardinality
1.017	DAN	nc:OrganizationName	0..1
-	-	biom:TransactionOriginatingOrganization	1..1
1.008	ORI	nc:OrganizationIdentification	1..1
1.017	OAN	nc:OrganizationName	0..1
1.014	GMT	biom:TransactionUTCDate	0..1
1.009	TCN	biom:TransactionControlIdentification	1..1
1.010	TCR	biom:TransactionControlReferenceIdentification	0..1
1.013	DOM	biom:TransactionDomain	0..1
"	DVN	biom:DomainVersionNumberIdentification	0..1
"	DNM	biom:TransactionDomainName	1..1
1.016	APS	biom:TransactionApplicationProfile	0..99
"	APO	biom:ApplicationProfileOrganizationName	1..1
"	APN	biom:ApplicationProfileName	1..1
"	APV	biom:ApplicationProfileVersionIdentification	1..1
-		biom:TransactionImageResolutionDetails	1..1
1.011	NSR	biom:NativeScanningResolutionValue	1..1
1.012	NTR	biom:NominalTransmittingResolutionValue	1..1
1.002	VER	biom:TransactionMajorVersionValue[77]	1..1
1.002	VER	biom:TransactionMinorVersionValue[78]	1..1
1.006	PRY	biom:TransactionPriorityValue	0..1
1.004	TOT	biom:TransactionCategory[79]	1..1
1.003	CNT	biom:TransactionContentSummary	1..1
"	FRC	biom:ContentFirstRecordCategoryCode	1..1
"	CRC	biom:ContentRecordQuantity	1..1
"	-	biom:ContentRecordSummary[80]	1..*
"	IDC	biom:ImageReferenceIdentification	1..1
"	REC	biom:RecordCategoryCode	1..1
1.015	DCS	biom:TransactionCharacterSetDirectory	0..1
"	CSN	biom:CharacterSetCommonNameCode	1..1
"	CSI	biom:CharacterSetIndexCode	1..1
"	CSV	biom:CharacterSetVersionIdentification	0..1

[77] This element contains the first 2 characters of **Field 1.002 Version number / VER**.
[78] This element contains the last 2 characters of **Field 1.002 Version number / VER**.
[79] This element is abstract and must be substituted either with biom:TransactionCategoryCode or a user-defined element that is in the substitution group of biom:TransactionCategory
[80] This element repeats for each subfield of **Field 1.003 Transaction content / CNT** after the first one.

Type-2

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageDescriptiveTextRecord	0..*
2.001	-	biom:RecordCategoryCode	1..1
2.002	IDC	biom:ImageReferenceIdentification	1..1
2.003+	-	itl:UserDefinedDescriptiveDetail	0..1
“	“	itl:DomainDefinedDescriptiveDetail[81]	1..1
“	“	itl:OtherDescriptiveDetail[81]	0..*

Type-4

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageHighResolutionGrayscaleImageRecord	0..*
4.001	-	biom:RecordCategoryCode	1..1
4.002	IDC	biom:ImageReferenceIdentification	1..1
-	-	biom:FingerprintImage	1..1
4.009	DATA	nc:BinaryBase64Object	1..1
-	-	biom:ImageCaptureDetail	1..1
4.005	ISR	biom:CaptureResolutionCode	1..1
4.008	GCA	biom:ImageCompressionAlgorithmCode	1..1
4.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
4.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
-	-	biom:FingerprintImagePosition	1..1
4.004	FGP	biom:FingerPositionCode	1..6
4.003	IMP	biom:FingerprintImageImpressionCaptureCategoryCode	1..1

Type-7

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageUserDefinedImageRecord	0..*
7.001	-	biom:RecordCategoryCode	1..1
7.002	IDC	biom:ImageReferenceIdentification	1..1
7.003+	-	biom:BiometricImage[82]	0..1

[81] This element is abstract and must be substituted with a user-defined element.

[82] This element is abstract. Implementations may use any element substitutable for biom:BiometricImage or a user-defined element that is in the substitution group of itl:UserDefinedImage.

Type-8

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageSignatureImageRecord	0..*
8.001	-	biom:RecordCategoryCode	1..1
8.002	IDC	biom:ImageReferenceIdentification	1..1
-	-	biom:SignatureImage	1..1
8.008	DATA	nc:BinaryBase64Object	0..1 [83]
-	-	biom:ImageCaptureDetail	1..1
8.005	ISR	biom:CaptureResolutionCode	1..1
8.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
8.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
8.008	DATA	biom:SignatureImageVectorRepresentation	0..1 [84]
"	"	biom:SignatureImageVector[85]	2..*
"	"	biom:VectorPenPressureValue[86]	1..1
"	"	biom:VectorPositionVerticalCoordinateValue[87]	1..1
"	"	biom:VectorPositionHorizontalCoordinateValue[88]	1..1
8.004	SRT	biom:SignatureRepresentationCode	1..1
8.003	SIG	biom:SignatureCategoryCode	1..1

Type-9

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageMinutiaeRecord	0..*
9.001	-	biom:RecordCategoryCode	1..1
9.002	IDC	biom:ImageReferenceIdentification	1..1
9.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
9.003	IMP	biom:MinutiaeImpressionCaptureCategoryCode	1..1

[83] If the **SRT** field is "0" or "1", this element is mandatory; otherwise it shall not appear.
[84] If the **SRT** field contains the value of “2”, this element is mandatory; otherwise it shall not appear.
[85] Each occurrence of this element represents a single vector in the list, as specified in the description of **Field 8.008: Signature image data / DATA**.
[86] The pen pressure value of line segments within the signature, as specified in the description of **Field 8.008: Signature image data / DATA**.
[87] A vertical (Y) coordinate value, as specified in the description of **Field 8.008: Signature image data / DATA**.
[88] A horizontal (X) coordinate value, as specified in the description of **Field 8.008: Signature image data / DATA**.

Field ID	Mnemonic	XML element name	Cardinality
9.004	FMT	biom:MinutiaeFormatNISTStandardIndicator[89]	1..1
9.901	ULA	biom:MinutiaeUniversalLatentWorkstationAnnotationText	0..*
-	-	biom:BiometricCaptureDetail	0..1
9.903	DUI	biom:CaptureDeviceIdentification	0..1
9.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
9.013-9.125, 9.151-9.175, 9.180-9.225	-	biom:RecordMinutiae[90]	0..*
-	-	itl:Minutiae [91]	0..*
-	-	itl:MinutiaeNISTStandard	1..1
9.012	MRC	itl:MinutiaDetail	1..*
"	-	biom:PositionHorizontalCoordinateValue	1..1
"	-	biom:PositionVerticalCoordinateValue	1..1
"	-	biom:MinutiaIdentification	1..1
"	-	biom:PositionThetaAngleMeasure	1..1
"	-	biom:MinutiaQualityValue	0..1
"	-	biom:MinutiaCategoryCode	0..1
"	-	biom:MinutiaRidgeCount	0..*
"	-	biom:RidgeCountReferenceIdentification	1..1
"	-	biom:RidgeCountValue	1..1
9.010	MIN	biom:MinutiaeQuantity	1..1
9.005	OFR	biom:MinutiaeReadingSystem	0..1
"	-	biom:ReadingSystemCodingMethodCode	1..1
"	-	biom:ReadingSystemName	1..1
"	-	biom:ReadingSystemSubsystemIdentification	0..1
9.011	RDG	biom:MinutiaeRidgeCountIndicator	1..1
9.008	CRP	biom:MinutiaeFingerCorePosition	0..*
"	MXC	biom:PositionHorizontalCoordinateValue	1..1
"	MYC	biom:PositionVerticalCoordinateValue	1..1
9.009	DLT	biom:MinutiaeFingerDeltaPosition	0..*
"	MXC	biom:PositionHorizontalCoordinateValue	1..1
"	MYC	biom:PositionVerticalCoordinateValue	1..1

[89] The value "U" from the description of **Field 9.004: Minutiae format / FMT** maps to the value "false" in the XML, and the value "S" from the description of **field 9.004** maps to the value "true" in the XML.

[90] This element is abstract and must be substituted with a user-defined element.

[91] itl:Minutiae (and its contents) are legacy; Shall be used only for legacy data.

Field ID	Mnemonic	XML element name	Cardinality
9.007	FPC	itl:MinutiaeFingerPatternDetail	0..*
"	-	itl:FingerPatternCodeSourceCode	1..1
"	-	biom:FingerPatternCode	1..*
"	-	biom:FingerPatternText	1..*
9.006	FGP	biom:MinutiaeFingerPositionCode[92]	0..*
9.006	-	biom:MinutiaePalmPositionCode[93]	0..*
-	-	biom:OtherMinutiae	0..*
9.176	OOD	biom:MinutiaeAlgorithmOwnerText	1..1
9.177	PAG	biom:MinutiaeAlgorithm	1..1
"	PAN	biom:MinutiaeAlgorithmName	1..1
"	PAV	biom:MinutiaeAlgorithmVersionText	0..1
9.178	SOD	biom:MinutiaeCaptureDevice	0..1
-	OFN	biom:CaptureDeviceName	1..1
-	OFV	biom:CaptureDeviceVersionText	0..1
		biom:MinutiaeFormatContactOrganization	1..1
9.179	DTX	nc:OrganizationPrimaryContactInformation	1..1
		nc:ContactInformationDescriptionText	1..1
-	-	biom:INCITSMinutiae	0..*
9.126	CBI		
"	CFO	biom:CBEFFFormatOwnerIdentification	1..1
"	CFT	biom:CBEFFFormatCategoryIdentification	1..1
"	CPI	biom:CBEFFProductIdentification	1..1
9.127	CEI	biom:ImageCaptureDetail	1..1
"	CID	biom:CaptureDeviceIdentification	1..1
"	AFS	biom:CaptureDeviceCertificationCode	1..1
-		biom:FingerImpressionImage	1..1
9.128	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
9.131	THPS	biom:ImageHorizontalPixelDensityValue	1..1
9.130	SLC	biom:ImageScaleUnitsCode	1..1
9.129	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
9.132	TVPS	biom:ImageVerticalPixelDensityValue	1..1
9.134	FGP	biom:FingerPositionCode	1..1
9.133	FVW	biom:FingerViewNumeric	1..1
9.135	FQD	biom:MinutiaeQuality	1..9
"	QAP	biom:QualityAlgorithmProductIdentification	0..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	0..1
9.136	NOM	biom:MinutiaeQuantity	1..1
9.137	FMD	biom:INCITSMinutia	1..*

[92] Use this element when the image represents a fingerprint.
[93] Use this element when the image represents a palmprint.

Field ID	Mnemonic	XML element name	Cardinality
"	MAN	biom:MinutiaIdentification	1..1
"	-	biom:INCITSMinutiaLocation	1..1
"	MXC	biom:PositionHorizontalCoordinateValue	1..1
"	MYC	biom:PositionVerticalCoordinateValue	1..1
"	MAV	biom:ImageLocationThetaAngleMeasure	1..1
"	M1M	biom:INCITSMinutiaCategoryCode	1..1
"	QOM	biom:MinutiaQualityValue	1..1
9.138	RCI	biom:MinutiaeRidgeCountDetail	0..1
"	REM	biom:INCITSRidgeCountAlgorithmCode	1..1
"	-	biom:MinutiaeRidgeCountItem	1..*
"	CMI	biom:MinutiaIdentification	1..1
"	NMN	biom:MinutiaReferenceIdentification	1..1
"	NRC	biom:RidgeCountValue	1..1
9.139	CIN	biom:FingerprintPatternCoreLocation	0..9
"	XCC	biom:PositionHorizontalCoordinateValue	1..1
"	YCC	biom:PositionVerticalCoordinateValue	1..1
"	ANGC	biom:ImageLocationThetaAngleMeasure	1..1
9.140	DIN	biom:FingerprintPatternDeltaLocation	0..9
"	XCD	biom:PositionHorizontalCoordinateValue	1..1
"	YCD	biom:PositionVerticalCoordinateValue	1..1
"	ANG1	biom:ImageLocationThetaAngleMeasure	1..1
9.141	ANG2	biom:ImageLocationThetaAngleMeasure	1..1
"	ANG3	biom:ImageLocationThetaAngleMeasure	1..1
-	-	biom:ExtendedFeatureSetMinutiae	0..*
9.303	FSP	biom:ExtendedFeatureSetProfileIdentification	0..9
9.300	ROI	biom:FrictionRidgeImageRegionOfInterest	1..1
"	EWI	biom:ImageSegmentWidthMeasure	1..1
"	EHI	biom:ImageSegmentHeightMeasure	1..1
"	EHO	biom:ImageSegmentHorizontalOffsetMeasure	0..1
"	EVO	biom:ImageSegmentVerticalOffsetMeasure	0..1
"	ROP	biom:ImageSegmentPolygon	0..1
"		biom:ImageSegmentVertex	3..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1
9.301	ORT	biom:FingerprintImageFingerprintOrientation	0..1
"	EOD	biom:OrientationAngleValue	1..1
"	EUC	biom:OrientationAngleUncertaintyValue	0..1
9.302	FPP	biom:MinutiaeFingerLocation [92]	0..20
"	FPP	biom:MinutiaePalmLocation [93]	0..20
"	FPP	biom:MinutiaePlantarLocation [94]	0..20

[94] Use this element when the image represents a plantar print.

Field ID	Mnemonic	XML element name	Cardinality
"	FGP	biom:FingerPositionCode [92]	1..1
"	FGP	biom:PalmPositionCode [93]	1..1
"	FGP	biom:PlantarPositionCode [94]	1..1
"	FSM	biom:SegmentLocationCode	0..1
"	OCF	biom:FingerprintOffCenterCode	0..1
"	SGP	biom:ImageSegmentPolygon	0..1
"	-	biom:ImageSegmentVertex	3..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1
9.307	PAT	biom:FingerprintPatternClassification	0..7
"	GCF	biom:FingerprintPatternGeneralClassCode	1..1
"	SUB	biom:FingerprintPatternSubClassCode	0..1
"	WDR	biom:FingerprintPatternWhorlDeltaRelationshipCode	0..1
9.309	RQF	biom:MinutiaeRidgeQualityMap	0..1
"	GSZ	biom:MinutiaeRidgeQualityMapCellSizeValue	1..1
"	RDF	biom:MinutiaeRidgeQualityMapFormatCode	1..1
9.308	RQM	biom:MinutiaeRidgeQualityMapRowText	1..*
9.311	RFF	biom:MinutiaeRidgeFlowMap	0..1
"	SFQ	biom:MinutiaeRidgeFlowMapSamplingFrequencyValue	1..1
"	RDF	biom:MinutiaeRidgeFlowMapFormatCode	1..1
9.310	RFM	biom:MinutiaeRidgeFlowMapRowText	1..*
9.313	RWF	biom:MinutiaeRidgeWavelengthMap	0..1
"	FWS	biom:MinutiaeRidgeWavelengthMapSamplingFrequencyValue	1..1
"	FDF	biom:MinutiaeRidgeWavelengthMapFormatCode	1..1
9.312	RWM	biom:MinutiaeRidgeWavelengthMapRowText	1..*
9.314	TRV	biom:FrictionRidgeImageTonalReversalCode	0..1
9.315	PLR	biom:FrictionRidgeImageLateralReversalCode	0..1
9.316	FQM	biom:ImageQuality	0..9
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
9.317	PGS	biom:MinutiaeGrowthOrShrinkage	0..1
"	TGS	biom:MinutiaeGrowthOrShrinkageCode	1..1
"	CGS	biom:MinutiaeCommentText	0..1
9.325	NCOR	biom:MinutiaeNoCoresPresentIndicator	0..1
9.320	COR	biom:MinutiaeCore	0..*
"	CXC	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	CYC	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	CDI	biom:MinutiaeCoreDirectionMeasure	0..1
"	RPU	biom:ImageLocationUncertaintyRadiusMeasure	0..1
"	DUY	biom:MinutiaeCoreDirectionUncertaintyValue	0..1

Field ID	Mnemonic	XML element name	Cardinality
9.326	NDEL	biom:MinutiaeNoDeltasPresentIndicator	0..1
9.321	DEL	biom:MinutiaeDelta	0..*
"	DXC	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	DYC	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	DUP	biom:MinutiaeDeltaDirectionUpMeasure	0..1
"	DLF	biom:MinutiaeDeltaDirectionLeftMeasure	0..1
"	DRT	biom:MinutiaeDeltaDirectionRightMeasure	0..1
"	DTP	biom:MinutiaeDeltaCategoryCode	0..1
"	RPU	biom:ImageLocationUncertaintyRadiusMeasure	0..1
"	DUU	biom:MinutiaeDeltaDirectionUpUncertaintyValue	0..1
"	DUL	biom:MinutiaeDeltaDirectionLeftUncertaintyValue	0..1
"	DUR	biom:MinutiaeDeltaDirectionRightUncertaintyValue	0..1
9.322	CDR	biom:MinutiaeRidgeCountCoreToDelta	0..225
"	CIX	biom:MinutiaeCoreIdentification	1..1
"	DIX	biom:MinutiaeDeltaIdentification	1..1
"	MNRC	biom:RidgeCountMinimumValue	1..1
"	MXRC	biom:RidgeCountMaximumValue	0..1
9.323	CPR	biom:FrictionRidgeImageCenter	0..3
"	CPM	biom:FrictionRidgeImageCenterLocationMethodCode	1..1
"	PXC	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	PYC	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	CRU	biom:ImageLocationUncertaintyRadiusMeasure	0..1
9.327	NDIS	biom:MinutiaeNoDistinctiveFeaturesPresentIndicator	0..1
9.324	DIS	biom:MinutiaeDistinctiveFeature	0..99
"	DIT	biom:MinutiaeDistinctiveFeatureCategoryCode	1..1
"	DFP	biom:ImageSegmentPolygon	0..1
"	-	biom:ImageSegmentVertex	3..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1
"	DFC	biom:MinutiaeCommentText	0..1
9.334	NMIN	biom:MinutiaeNoMinutiaePresentIndicator	0..1
9.331	MIN	biom:EFSMinutia	0..999
"	MXC	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	MYC	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	MTD	biom:ImageLocationThetaAngleMeasure	1..1
"	MTY	biom:EFSMinutiaCategoryCode	1..1
"	MRU	biom:ImageLocationUncertaintyRadiusMeasure	0..1
"	MDU	biom:MinutiaDirectionUncertaintyValue	0..1
9.332	MRA	biom:EFSRidgeCountAlgorithmCode	0..1
9.333	MRC	biom:EFSRidgeCountItem	0..7992
"	MIA	biom:MinutiaIdentification	1..1

Field ID	Mnemonic	XML element name	Cardinality
"	MIB	biom:MinutiaReferenceIdentification	1..1
"	MIR	biom:RidgeCountValue	1..1
"	MRN	biom:MinutiaeRidgeCountOctantNumeric	0..1
"	MRS	biom:MinutiaeRidgeCountResidualCode	0..1
9.335	RCC	biom:MinutiaeRidgeCountConfidence	0..7992
"	-	biom:MinutiaLocationPoint	1..1
"	ACX	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	ACY	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	-	biom:MinutiaLocationReferencePoint	1..1
"	BCX	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	BCY	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	MORC	biom:MinutiaeRidgeCountMethodCode	1..1
"	MCV	biom:MinutiaeRidgeCountConfidenceValue	1..1
9.346	NDOT	biom:MinutiaeNoDotsPresentIndicator	0..1
9.340	DOT	biom:MinutiaeDot	0..999
"	DOX	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	DOY	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	DOL	biom:MinutiaeDotLengthMeasure	0..1
9.347	NINR	biom:MinutiaeNoIncipientRidgesPresentIndicator	0..1
9.341	INR	biom:MinutiaeIncipientRidge	0..999
"	-	biom:MinutiaLocationPoint	1..1
"	X1C	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	Y1C	biom:ImageLocationVerticalCoordinateMeasure	1..1
		biom:MinutiaLocationReferencePoint	1..1
"	X2C	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	Y2C	biom:ImageLocationVerticalCoordinateMeasure	1..1
9.348	NCLD	biom:MinutiaeNoCreasesPresentIndicator	0..1
9.342	CLD	biom:MinutiaeFlexionCrease	0..999
"	-	biom:MinutiaLocationPoint	1..1
"	X1D	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	Y1D	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	-	biom:MinutiaLocationReferencePoint	1..1
"	X2D	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	Y2D	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	TPD	biom:MinutiaeFlexionCreaseCategoryCode	1..1
9.349	NREF	biom:MinutiaeNoRidgeEdgeFeaturesPresentIndicator	0..1
9.343	REF	biom:MinutiaeRidgeEdgeOrDiscontinuity	0..999
"	CLX	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	CLY	biom:ImageLocationVerticalCoordinateMeasure	1..1
"	CLT	biom:MinutiaeRidgeEdgeOrDiscontinuityCategoryCode	1..1
9.344	NPOR	biom:MinutiaeNoPoresPresentIndicator	0..1

Field ID	Mnemonic	XML element name	Cardinality
9.345	POR	biom:MinutiaePore	0..9999
"	POX	biom:ImageLocationHorizontalCoordinateMeasure	1..1
"	POY	biom:ImageLocationVerticalCoordinateMeasure	1..1
9.350	MFD	biom:MinutiaeFeatureDetection	0..99
"	FIE	biom:MinutiaeFeatureDetectionFieldListText	1..1
"	FME	biom:MinutiaeFeatureDetectionMethodCode	1..1
"	FAV	biom:MinutiaeAlgorithmVendorIdentification	0..1
"	FAL	biom:MinutiaeAlgorithmIdentification	0..1
"	-	biom:MinutiaeExaminer	0..1
"	-	nc:PersonName	0..1
"	EGN	nc:PersonGivenName	0..1
"	ESN	nc:PersonSurName	0..1
"	-	biom:MinutiaeExaminerAffiliation	0..1
"	EAF	nc:OrganizationName	0..1
"	EMT	biom:MinutiaeFeatureDetectionDateTime	0..1
"	NTS	biom:MinutiaeCommentText	0..1
9.351	COM	biom:MinutiaeCommentText	0..1
9.352	LPM	biom:LatentProcessingCategoryCode	0..9
9.353	EAA	biom:MinutiaeValueAssessment	0..1
"	AAV	biom:MinutiaeValueAssessmentResultCode	1..1
"	-	biom:MinutiaeExaminer	1..1
"	-	nc:PersonName	1..1
"	AFN	nc:PersonGivenName	1..1
"	ALN	nc:PersonSurName	1..1
"	-	biom:MinutiaeExaminerAffiliation	1..1
"	AAF	nc:OrganizationName	1..1
"	AMT	biom:MinutiaeValueAssessmentDateTime	1..1
"	CXF	biom:MinutiaeAnalysisComplexityCode	0..1
"	ACM	biom:MinutiaeCommentText	0..1
9.354	EOF	biom:MinutiaeFraudEvidence	0..4
"	FRA	biom:MinutiaeFraudEvidenceCategoryCode	1..1
"	CFD	biom:MinutiaeCommentText	0..1
9.355	LSB	biom:MinutiaeLatentSubstrate	0..3
"	CLS	biom:MinutiaeLatentSubstrateCategoryCode	1..1
"	OSD	biom:MinutiaeLatentSubstrateDescriptionText	0..1
9.356	LMT	biom:MinutiaeLatentMatrix	0..3
"	TOM	biom:MinutiaeLatentMatrixCategoryCode	1..1
"	CLA	biom:MinutiaeCommentText	0..1
9.357	LQI	biom:MinutiaeLocalQualityIssues	0..*
"	LQT	biom:MinutiaeLocalQualityIssuesCategoryCode	1..1

Field ID	Mnemonic	XML element name	Cardinality
"	LQP	biom:ImageSegmentPolygon	1..1
"	-	biom:ImageSegmentVertex	3..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1
"	LQC	biom:MinutiaeCommentText	0..1
9.360	AOC	biom:FrictionRidgeImageAreaOfCorrespondence	0..*
"	CIR	biom:ImageReferenceIdentification	1..1
"	AOP	biom:ImageSegmentPolygon	1..1
"	-	biom:ImageSegmentVertex	3..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1
"	CAC	biom:MinutiaeCommentText	0..1
9.361	CPF	biom:MinutiaeFeatureCorrespondence	0..*
"	COL	biom:MinutiaeFeatureIdentification	1..1
"	TOC	biom:MinutiaeFeatureCorrespondenceCategoryCode	1..1
"	CFN	biom:MinutiaeFeatureCategoryCode	0..1
"	FOC	biom:MinutiaeFeatureReferenceIdentification	0..1
"	CXC	biom:ImageLocationHorizontalCoordinateMeasure	0..1
"	CYC	biom:ImageLocationVerticalCoordinateMeasure	0..1
"	COC	biom:MinutiaeCommentText	0..1
9.362	ECD	biom:MinutiaeExaminerComparisonDetermination	0..*
"	EDC	biom:ImageReferenceIdentification	1..1
"	EDE	biom:MinutiaeExaminerComparisonDeterminationResultCode	1..1
"	WIP	biom:MinutiaeExaminerProgressCode	1..1
"	-	biom:MinutiaeExaminer	1..1
"	-	nc:PersonName	1..1
"	EFN	nc:PersonGivenName	1..1
"	ELN	nc:PersonSurName	1..1
"	-	biom:MinutiaeExaminerAffiliation	1..1
"	EAF	nc:OrganizationName	0..1
"	DTG	biom:MinutiaeExaminerComparisonDeterminationDateTime	1..1
"	CCF	biom:MinutiaeComparisonComplexityCode	0..1
"	CZZ	biom:MinutiaeCommentText	0..1
9.363	RRC	biom:FrictionRidgeImageRelativeRotation	0..*
"	RIR	biom:ImageReferenceIdentification	1..1
"	ROR	biom:ImageRelativeOverallRotationValue	1..1
9.372	SIM	biom:FrictionRidgeSkeletonizedImageBinaryObject	0..1
9.373	RPS	biom:MinutiaeImageRidgePathRepresentation	0..1
"		biom:MinutiaeRidgePathSegment	1..*

Field ID	Mnemonic	XML element name	Cardinality
"	-	biom:ImageSegmentVertex	2..99
"		biom:ImageLocationHorizontalCoordinateMeasure	1..1
"		biom:ImageLocationVerticalCoordinateMeasure	1..1

Type-10

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageFacialAndSMTImageRecord	0..*
10.001	-	biom:RecordCategoryCode	1..1
10.002	IDC	biom:ImageReferenceIdentification	1..1
10.200-10.900	UDF	itl:UserDefinedFields[95]	0..*
10.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
10.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
10.996	HAS	biom:ImageHashValue	0..1
10.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:FaceImage[96]	0..1[97]
-	-	biom:PhysicalFeatureImage[98]	0..1
10.999	DATA	nc:BinaryBase64Object	1..1
-	-	biom:ImageCaptureDetail	1..1
10.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1

[95] This element is abstract and must be substituted with a user-defined element.
[96] If the **IMT** field contains the value "FACE", this element is mandatory; otherwise it shall not appear.
[97] One and only one of biom:FaceImage or biom:PhysicalFeatureImage must appear.
[98] If the **IMT** field does *not* contain the value "FACE", this element is mandatory; otherwise it shall not appear.

Field ID	Mnemonic	XML element name	Cardinality
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode[99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName[100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
10.005	PHD	biom:CaptureDate	1..1
10.903	DUI	biom:CaptureDeviceIdentification	0..1
10.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
10.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
10.004	SRC	nc:OrganizationIdentification	1..1
10.993	SAN	nc:OrganizationName	0..1
10.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
10.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
10.012	CSP	biom:ImageColorSpaceCode	1..1
10.038	COM	biom:ImageCommentText	0..1
10.011	CGA	biom:ImageCompressionAlgorithmText	1..1
10.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
10.009	THPS	biom:ImageHorizontalPixelDensityValue	1..1
10.024	SQS	biom:ImageQuality	0..9
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
10.008	SLC	biom:ImageScaleUnitsCode	1..1
10.003	IMT	biom:ImageCategoryCode	1..1
10.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1

[99] Used for specific values in **Table 6.**
[100] Used for user-defined "other" values (entries up to 6 characters).

Field ID	Mnemonic	XML element name	Cardinality
10.010	TVPS	biom:ImageVerticalPixelDensityValue	1..1
10.018	DIST	biom:ImageDistortion	0..1
"	IDK	biom:ImageDistortionCategoryCode	1..1
"	IDM	biom:ImageDistortionMeasurementCode	1..1
"	DSC	biom:ImageDistortionSeverityCode	1..1
10.025	SPA	biom:FaceImage3DPoseAngle	0..1
"	PIT	biom:PosePitchAngleMeasure	1..1
"	PITU	biom:PosePitchUncertaintyValue	0..1
"	ROL	biom:PoseRollAngleMeasure	1..1
"	ROLU	biom:PoseRollUncertaintyValue	0..1
"	YAW	biom:PoseYawAngleMeasure	1..1
"	YAWU	biom:PoseYawUncertaintyValue	0..1
10.013	SAP	biom:FaceImageAcquisitionProfileCode	0..1
10.022[101]	PXS	biom:FaceImageAttribute	0..9
"	PXS	biom:FaceImageAttributeCode	1..1
"	PXS	biom:FaceImageAttributeText	0..1
10.026	SXS	biom:FaceImageDescriptionCode[102]	0..50
10.026	SXS	biom:FaceImageDescriptionText[103]	0..50
10.027	SEC	biom:FaceImageEyeColorAttributeCode	0..1
10.029	FFP	biom:FaceImageFeaturePoint	0..88
"	HCX	biom:FeaturePointHorizontalCoordinateValue	1..1
"	FPC	biom:FeaturePointIdentification	1..1
"	FPT	biom:FeaturePointCategoryCode	1..1
"	HCY	biom:FeaturePointVerticalCoordinateValue	1..1
10.028	SHC	biom:FaceImageHairColorAttributeCode	0..2
10.021	POA	biom:FaceImagePoseOffsetAngleMeasure	0..1
10.020	POS	biom:FaceImageSubjectPoseCode	0..1
10.023	PAS	biom:FaceImageAcquisitionSource	0..1
"	PAC	biom:CaptureSourceCode	1..1
"	VSD	biom:CaptureSourceDescriptionText	0..1
10.014	FIP	biom:FaceImageBoundingSquare	0..1
"	BBC	biom:FaceImageBoundingCategoryCode	0..1
"	BVC	biom:SegmentBottomVerticalCoordinateValue	1..1
"	LHC	biom:SegmentLeftHorizontalCoordinateValue	1..1
"	RHC	biom:SegmentRightHorizontalCoordinateValue	1..1
"	TVC	biom:SegmentTopVerticalCoordinateValue	1..1
10.015	FPFI	biom:FaceImageBoundary	0..1

[101] For legacy use only.
[102] Use this element when the value is explicitly specified in **Table 62 Subject facial description codes** , or is a physical characteristic from **Annex D: NCIC code table.**
[103] Use this element when the value is unformatted text (identified as "Other characteristics" in **Table 62 Subject facial description codes)**.

Field ID	Mnemonic	XML element name	Cardinality
"	BYC	biom:FaceImageBoundaryShapeCode	1..1
"	NOP	biom:PositionPolygonVertexQuantity	1..1
"	-	biom:PositionPolygonVertex	2..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
10.019	LAF	biom:FaceImageLightingArtifactsCode	0..3
10.031	TMC	biom:FaceImageFeaturePointTierCode[104]	0..1
"	TMC	biom:FaceImageFeaturePointTierNumeric[105]	0..1
10.032	AFF	biom:FaceImage3DFeaturePoint	0..88
"	HCX	biom:FeaturePointHorizontalCoordinateValue	1..1
"	FPC	biom:FeaturePointIdentification	1..1
"	FPT	biom:FeaturePointCategoryCode	1..1
"	HCY	biom:FeaturePointVerticalCoordinateValue	1..1
"	HCZ	biom:FeaturePointZCoordinateValue	1..1
10.033	FEC	biom:FaceImageContour	0..12
"	FCC	biom:FaceImageContourCategoryCode	1..1
"	NOP	biom:PositionPolygonVertexQuantity	1..1
"	-	biom:PositionPolygonVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
10.045	OCC	biom:FaceImageOcclusion	0..16
"	OCY	biom:FaceImageOcclusionOpacityCode	1..1
"	OCT	biom:FaceImageOcclusionCategoryCode	1..1
"	NOP	biom:PositionPolygonVertexQuantity	1..1
"	-	biom:PositionPolygonVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
-	-	biom:PhysicalFeatureDescriptionDetail	0..9
10.043	COL	biom:PhysicalFeatureColorDetail	0..1
"	TC1	biom:PhysicalFeaturePrimaryColorCode	1..1
"	TC2, TC3, TC4, TC5, TC6	biom:PhysicalFeatureSecondaryColorCode[106]	0..5
10.042	SMD	-	
"	SMI	biom:PhysicalFeatureCategoryCode	1..1
"	TAC	biom:PhysicalFeatureClassCode	0..1
"	TDS	biom:PhysicalFeatureDescriptionText	0..1
"	TSC	biom:PhysicalFeatureSubClassCode	0..1

[104] Use this element when the value is explicitly listed in **Table 66 Tiered markup collections (frontal) .**

[105] Use this element for user-defined values.

[106] Repeat this element as necessary to represent **TC2**, **TC3**, **TC4**, **TC5** and **TC6**.

Field ID	Mnemonic	XML element name	Cardinality
10.040	SMT	biom:PhysicalFeatureNCICCode	0..3
10.041	SMS	biom:PhysicalFeatureSize	0..1
"	HGT	biom:PhysicalFeatureHeightMeasure	1..1
"	WID	biom:PhysicalFeatureWidthMeasure	1..1
10.039	T10	biom:PhysicalFeatureReferenceIdentification	0..1
10.044	ITX	biom:ImageTransformationCode	0..18

Type-11

Reserved for future use.

Type-12

Reserved for future use.

Type-13

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageLatentImageRecord	0..*
13.001	-	biom:RecordCategoryCode	1..1
13.002	IDC	biom:ImageReferenceIdentification	1..1
13.200-13.900	UDF	itl:UserDefinedFields[107]	0..*
13.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
13.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
13.996	HAS	biom:ImageHashValue	0..1
13.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:FingerImpressionImage[108]	0..1 [109]
-	-	biom:PalmprintImage [110]	0..1

[107] This element is abstract and must be substituted with a user-defined element.
[108] This element is used if the **IMP** field contains one of the values 4 through 7, 28 or 29.
[109] One and only one of biom:FingerImpressionImage, biom:PalmprintImage, biom:PlantarImage or biom:FrictionRidgeImage must appear.
[110] This element is used if the **IMP** field contains one of the values 12 through 15, 28 or

Field ID	Mnemonic	XML element name	Cardinality
-	-	biom:PlantarImage [111]	0..1
-	-	biom:FrictionRidgeImage [112]	0..1
13.999	DATA	nc:BinaryBase64Object	1..1
13.012	BPX	biom:ImageBitsPerPixelQuantity	1..1
-		biom:ImageCaptureDetail	1..1
13.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
13.005	LCD	biom:CaptureDate	1..1
13.903	DUI	biom:CaptureDeviceIdentification	0..1
13.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
13.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
13.004	SRC	nc:OrganizationIdentification	1..1

29.

[111] This element is used if the **IMP** field contains one of the values 32 through 35, 28 or 29.

[112] This element is used if the **IMP** field contains one of the values 4 through 7, 12 through 15, 28, 29, or 32 through 39.

Field ID	Mnemonic	XML element name	Cardinality
13.993	SAN	nc:OrganizationName	0..1
13.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
13.020	COM	biom:ImageCommentText	0..1
13.011	CGA	biom:ImageCompressionAlgorithmText	1..1
13.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
13.009	THPS	biom:ImageHorizontalPixelDensityValue	1..1
13.008	SLC	biom:ImageScaleUnitsCode	1..1
13.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
13.010	TVPS	biom:ImageVerticalPixelDensityValue	1..1
13.003	IMP	biom:FingerprintImageImpressionCaptureCategoryCode	1..1
13.013	FGP	biom:FingerPositionCode [108]	1..6
"	FGP	biom:PalmPositionCode [110]	1..6
"	FGP	biom:PlantarPositionCode [111]	1..6
"	FGP	biom:FrictionRidgePositionCode [112]	1..6
-	-	biom:FingerprintImageMajorCasePrint	0..1
13.014[113]	SPD	-	
"	PDF	biom:FingerPositionCode	0..9
"	FIC	biom:MajorCasePrintCode	0..9
13.015	PPC	biom:MajorCasePrintSegmentOffset	0..12
"	BVC	biom:SegmentBottomVerticalCoordinateValue	1..1
"	LOS	biom:SegmentLocationCode	1..1
"	FVC	biom:SegmentFingerViewCode	1..1
"	LHC	biom:SegmentLeftHorizontalCoordinateValue	1..1
"	RHC	biom:SegmentRightHorizontalCoordinateValue	1..1
"	TVC	biom:SegmentTopVerticalCoordinateValue	1..1
13.024	LQM	biom:FingerprintImageQuality [108]	0..9
13.024	LQM	biom:PalmprintImageQuality [110]	0..9
13.024	LQM	biom:PlantarImageQuality [111]	0..9
13.024	LQM	biom:FrictionRidgeImageQuality [112]	0..9
"	FRMP	biom:FingerPositionCode [108]	1..1
"	FRMP	biom:PalmPositionCode [110]	1..1
"	FRMP	biom:PlantarPositionCode [111]	1..1
"	FRMP	biom:FrictionRidgePositionCode [112]	1..1
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
"	QVU	biom:QualityValue	1..1

[113] This is a structural anomaly, where there is no element to represent the **Field 13.014: Search position descriptors / SPD** repeating subfield, and instead each information item repeats. This anomaly is retained for backward compatibility purposes.

Type-14

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageFingerprintImageRecord	0..*
14.001	-	biom:RecordCategoryCode	1..1
14.002	IDC	biom:ImageReferenceIdentification	1..1
14.200-14.900	UDF	itl:UserDefinedFields[114]	0..*
14.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
14.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
14.996	HAS	biom:ImageHashValue	0..1
14.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:FingerImpressionImage	1..1
14.999	DATA	nc:BinaryBase64Object	0..1
14.012	BPX	biom:ImageBitsPerPixelQuantity	0..1
-	-	biom:ImageCaptureDetail	1..1
14.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1

[114] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
14.005	FCD	biom:CaptureDate	1..1
14.903	DUI	biom:CaptureDeviceIdentification	0..1
14.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
14.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
14.004	SRC	nc:OrganizationIdentification	1..1
14.993	SAN	nc:OrganizationName	0..1
14.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
14.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
14.026	SCF	biom:CaptureIdentification	0..1
14.020	COM	biom:ImageCommentText	0..1
14.011	CGA	biom:ImageCompressionAlgorithmText	0..1
14.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	0..1
14.009	THPS	biom:ImageHorizontalPixelDensityValue	0..1
14.008	SLC	biom:ImageScaleUnitsCode	0..1
14.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	0..1
14.010	TVPS	biom:ImageVerticalPixelDensityValue	0..1
14.003	IMP	biom:FingerprintImageImpressionCaptureCategoryCode	1..1
14.013	FGP	biom:FingerPositionCode	1..1
-	-	biom:FingerprintImageMajorCasePrint	0..1
14.014	PPD	-	
"	DFP	biom:FingerPositionCode	0..1
"	FIC	biom:MajorCasePrintCode	0..1
14.015	PPC	biom:MajorCasePrintSegmentOffset	0..12
"	BVC	biom:SegmentBottomVerticalCoordinateValue	1..1
"	LOS	biom:SegmentLocationCode	1..1
"	FVC	biom:SegmentFingerViewCode	1..1
"	LHC	biom:SegmentLeftHorizontalCoordinateValue	1..1
"	RHC	biom:SegmentRightHorizontalCoordinateValue	1..1
"	TVC	biom:SegmentTopVerticalCoordinateValue	1..1
14.018	AMP	biom:FingerprintImageFingerMissing	0..5
"	FRAP	biom:FingerPositionCode	1..1

Field ID	Mnemonic	XML element name	Cardinality
"	ABC	biom:FingerMissingCode	1..1
14.021	SEG	biom:FingerprintImageSegmentPositionSquare	0..5
"	FRSP	biom:FingerPositionCode	1..1
"	BVC	biom:SegmentBottomVerticalCoordinateValue	1..1
"	LHC	biom:SegmentLeftHorizontalCoordinateValue	1..1
"	RHC	biom:SegmentRightHorizontalCoordinateValue	1..1
"	TVC	biom:SegmentTopVerticalCoordinateValue	1..1
14.022	NQM	biom:FingerprintImageNISTQuality	0..5
"	FRNP	biom:FingerPositionCode	1..1
"	IQS	biom:NISTQualityMeasure	1..1
14.023	SQM	biom:FingerprintImageSegmentationQuality	0..5
"	FRQP	biom:FingerPositionCode	1..1
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
"	QVU	biom:QualityValue	1..1
14.024	FQM	biom:FingerprintImageQuality	0..5
"	FRMP	biom:FingerPositionCode	1..1
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
"	QVU	biom:QualityValue	1..1
14.025	ASEG	biom:FingerprintImageSegmentPositionPolygon	0..5
"	FRAS	biom:FingerPositionCode	1..1
"	NOP	biom:PositionPolygonVertexQuantity	1..1
"	-	biom:PositionPolygonVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
14.031	FAP	biom:FingerprintImageAcquisitionProfileCode	0..1
14.027	SIF	biom:FingerprintImageStitchedIndicator	0..1

Type-15

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackagePalmprintImageRecord	0..*
15.001	-	biom:RecordCategoryCode	1..1
15.002	IDC	biom:ImageReferenceIdentification	1..1
15.200-15.900	UDF	itl:UserDefinedFields[115]	0..*
15.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1

[115] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	PRO	biom:ProcessDescriptionText	1..1
15.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
15.996	HAS	biom:ImageHashValue	0..1
15.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:PalmprintImage	1..1
15.999	DATA	nc:BinaryBase64Object	0..1
15.012	BPX	biom:ImageBitsPerPixelQuantity	0..1
-	-	biom:ImageCaptureDetail	1..1
15.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
15.005	PCD	biom:CaptureDate	1..1
15.903	DUI	biom:CaptureDeviceIdentification	0..1
15.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1

Field ID	Mnemonic	XML element name	Cardinality
15.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
15.004	SRC	nc:OrganizationIdentification	1..1
15.993	SAN	nc:OrganizationName	0..1
15.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
15.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
15.020	COM	biom:ImageCommentText	0..1
15.011	CGA	biom:ImageCompressionAlgorithmText	0..1
15.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	0..1
15.009	THPS	biom:ImageHorizontalPixelDensityValue	0..1
15.008	SLC	biom:ImageScaleUnitsCode	0..1
15.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	0..1
15.010	TVPS	biom:ImageVerticalPixelDensityValue	0..1
15.003	IMP	biom:FingerprintImageImpressionCaptureCategoryCode	1..1
15.013	FGP	biom:PalmPositionCode	1..1
15.018	AMP	biom:PalmprintImageMissingArea	0..9
"	FRAP	biom:PalmPositionCode	1..1
"	ABC	biom:PalmMissingAreaReasonCode	1..1
15.024	PQM	biom:PalmprintImageQuality	0..9
"	FRMP	biom:PalmPositionCode	1..1
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1

Type-16

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageUserDefinedTestingImageRecord	0..*
16.001	-	biom:RecordCategoryCode	1..1
16.002	IDC	biom:ImageReferenceIdentification	1..1
16.200-16.900	UDF	itl:UserDefinedFields[116]	0..*
16.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
16.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
16.996	HAS	biom:ImageHashValue	0..1
16.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:TestImage	1..1
16.999	DATA	nc:BinaryBase64Object	1..1
16.003	UDI	nc:BinaryDescriptionText	1..1
16.012	BPX	biom:ImageBitsPerPixelQuantity	1..1
-	-	biom:ImageCaptureDetail	1..1
16.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode[99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName[100]	0..1
"	-	nc:LocationUTMCoordinate	0..1

[116] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
16.005	UTD	biom:CaptureDate	1..1
16.903	DUI	biom:CaptureDeviceIdentification	0..1
16.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
16.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
16.004	SRC	nc:OrganizationIdentification	1..1
16.993	SAN	nc:OrganizationName	0..1
16.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
16.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
16.013	CSP	biom:ImageColorSpaceCode	0..1
16.020	COM	biom:ImageCommentText	0..1
16.011	CGA	biom:ImageCompressionAlgorithmText	1..1
16.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
16.009	THPS	biom:ImageHorizontalPixelDensityValue	1..1
16.024	UQS	biom:ImageQuality	0..9
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
16.008	SLC	biom:ImageScaleUnitsCode	1..1
16.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
16.010	TVPS	biom:ImageVerticalPixelDensityValue	1..1

Type-17

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageIrisImageRecord	0..*
17.001	-	biom:RecordCategoryCode	1..1
17.002	IDC	biom:ImageReferenceIdentification	1..1
17.200-17.900	UDF	itl:UserDefinedFields[117]	0..*
17.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
17.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
17.996	HAS	biom:ImageHashValue	0..1
17.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:IrisImage	1..1
17.999	DATA	nc:BinaryBase64Object	0..1
17.012	BPX	biom:ImageBitsPerPixelQuantity	0..1
-	-	biom:ImageCaptureDetail	1..1
17.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode[99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName[100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1

[117] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
17.005	ICD	biom:CaptureDate	1..1
17.017	DUI	biom:CaptureDeviceIdentification	0..1
17.019	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
17.022	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
17.004	SRC	nc:OrganizationIdentification	1..1
17.993	SAN	nc:OrganizationName	0..1
17.023	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
17.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
17.013	CSP	biom:ImageColorSpaceCode	0..1
17.021	COM	biom:ImageCommentText	0..1
17.011	CGA	biom:ImageCompressionAlgorithmText	0..1
17.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	0..1
17.009	THPS	biom:ImageHorizontalPixelDensityValue	0..1
17.024	IQS	biom:ImageQuality	0..9
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
17.008	SLC	biom:ImageScaleUnitsCode	0..1
17.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	0..1
17.010	TVPS	biom:ImageVerticalPixelDensityValue	0..1
17.003	ELR	biom:IrisEyePositionCode	1..1
17.014	RAE	biom:IrisEyeRotationAngleText	0..1
17.015	RAU	biom:IrisEyeRotationUncertaintyValueText	0..1
17.016	IPC	biom:IrisImageCapture	0..1
"	IHO	biom:IrisImageHorizontalOrientationCode	1..1
"	IST	biom:IrisImageScanCategoryCode	1..1
"	IVO	biom:IrisImageVerticalOrientationCode	1..1
17.020	ECL	biom:IrisEyeColorAttributeCode	0..1
-	-	biom:IrisImageAcquisitionLightingSpectrum	0..1
17.025	EAS	biom:AcquisitionLightingSpectrumCode	0..1
17.027	SSV	-	

Field ID	Mnemonic	XML element name	Cardinality
"	LOW	biom:AcquisitionLightingSpectrumLowerMeasure	0..1
"	HIG	biom:AcquisitionLightingSpectrumUpperMeasure	0..1
17.026	IRD	biom:IrisDiameterPixelQuantity	0..1
17.028	DME	biom:IrisImageMissingReasonCode	0..1
17.031	IAP	biom:IrisImageAcquisitionProfileCode	0..1
17.032	ISF	biom:IrisImageStorageFormatCode	0..1
17.033	IPB	biom:IrisImageIrisPupilBoundary	0..1
"	BYC	biom:IrisBoundaryShapeCode	1..1
"	NOP	biom:ImageFeatureVertexQuantity	1..1
"	-	biom:ImageFeatureVertex	2..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
17.034	ISB	biom:IrisImageIrisScleraBoundary	0..1
"	BYC	biom:IrisBoundaryShapeCode	1..1
"	NOP	biom:ImageFeatureVertexQuantity	1..1
"	-	biom:ImageFeatureVertex	2..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
17.035	UEB	biom:IrisImageIrisUpperEyelidBoundary	0..1
"	BYC	biom:IrisBoundaryShapeCode	1..1
"	NOP	biom:ImageFeatureVertexQuantity	1..1
"		biom:ImageFeatureVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
17.036	LEB	biom:IrisImageIrisLowerEyelidBoundary	0..1
"	BYC	biom:IrisBoundaryShapeCode	1..1
"	NOP	biom:ImageFeatureVertexQuantity	1..1
"	-	biom:ImageFeatureVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
17.037	NEO	biom:IrisImageOcclusion	0..*
"	OCY	biom:IrisImageOcclusionOpacityCode	1..1
"	OCT	biom:IrisImageOcclusionCategoryCode	1..1
"	NOP	biom:ImageFeatureVertexQuantity	1..1
"	-	biom:ImageFeatureVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
17.040	RAN	biom:IrisImageRangeMeasure	0..1
17.041	GAZ	biom:IrisImageGazeAngleMeasure	0..1

Type-18

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageDNARecord	0..*
18.001	-	biom:RecordCategoryCode	1..1
18.002	IDC	biom:ImageReferenceIdentification	1..1
18.200-18.900	UDF	itl:UserDefinedFields[118]	0..*
18.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
18.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
-	-	biom:DNASample	1..1
-	-	biom:BiometricCaptureDetail	1..1
18.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode[99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName[100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1

[118] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
18.013	SCD	biom:CaptureDate	1..1
-	-	biom:CaptureOrganization	1..1
18.004	SRC	nc:OrganizationIdentification	1..1
18.993	SAN	nc:OrganizationName	0..1
18.003	DLS	biom:DNALaboratory	1..1
"	NOO	nc:OrganizationName	0..1
"	-	nc:OrganizationPrimaryContactInformation	0..1
"	POC	nc:ContactInformationDescriptionText	1..1
"	UTY	biom:DNALaboratoryUnitCategoryCode	1..1
"	LTY	biom:DNALaboratoryCategoryCode	0..1
"	ACC	biom:DNALaboratoryAccreditation [119]	0..*
"	"	biom:DNALaboratoryAccreditationLevelCode	1..1
"	"	biom:DNALaboratoryAccreditationScopeCode	0..*
"	CSC	biom:DNALaboratoryProcessingCountryISO3166Alpha2Code [120]	0..1
"	CSC	biom:DNALaboratoryProcessingCountryISO3166Alpha3Code [121]	0..1
"	CSC	biom:DNALaboratoryProcessingCountryISO3166NumericCode [122]	0..1
"	ION	biom:DNALaboratoryInternationalOrganizationName	0..1
18.005	NAL	biom:DNAAnalysisQuantityCode	1..1
18.006	SDI	biom:DNADonor	1..1
"	DOB	nc:PersonBirthDate	0..1
"	EGP	nc:PersonEthnicityText	0..1
"	GID	nc:PersonSexCode	0..1
"	DSD	biom:DNADonorCategoryCode	1..1
"	DLC	biom:DNADonorLastContactDate	0..1
"	DRA	biom:DNADonorDentalRecordsAvailableCode	0..1
"	LLC	biom:DNADonorCollectionLocationDescriptionText	0..1
"	SDS	biom:DNADonorStatusCode	0..1
18.007	COPR	biom:DNAClaimedRelationshipCode	0..1
18.008	VRS	biom:DNAValidatedRelationshipCode	0..1
18.009	PED	biom:DNAPedigree	0..1
"	PID	biom:DNAPedigreeIdentification	1..1
"	PMI	biom:DNAPedigreeMemberIdentification	1..1
"	PMS	biom:DNAPedigreeMemberStatusCode	1..1
"	SID	biom:DNAPedigreeSampleIdentification	1..1

[119] Each instance of this element represents one of the comma-separated values described in the specification.
[120] Used for 2-character representations of *ISO 3166-1*.
[121] Used for 3-character representations of *ISO 3166-1*.
[122] Used for numeric representations of *ISO 3166-1*.

Field ID	Mnemonic	XML element name	Cardinality
"	FID	biom:DNAPedigreeFatherIdentification	0..1
"	MID	biom:DNAPedigreeMotherIdentification	0..1
"	PCM	biom:DNAPedigreeCommentText	0..1
18.010	STY	biom:DNASampleOrigin	1..1
"	SCT	biom:DNACellularCategoryCode	1..1
"	SMO	biom:DNASampleOriginCode	0..1
18.011	STI	biom:DNATypingTechnologyCategoryCode	01/05/11
18.012	SCM	biom:DNASampleCollectionMethodText	0..1
18.014	PSD	biom:DNAProfileStorageDate	1..1
18.015	DPD	biom:DNAProfile	1..1
"	PTP	biom:DNAProfileCategoryCode	1..1
"	RES	biom:DNAProfileResultCode	0..1
"	PRF	biom:DNAProfileIdentification	1..1
"	SUP	biom:DNAProfileSupplementalText	0..1
"	DPC	biom:DNAProfileCommentText	0..1
18.016	STR	biom:DNASTRProfile	0..*
"	DST	biom:DNASTRProfileCategoryCode	1..1
"	DLR	biom:DNALocusIdentification	1..1
"	ALL	biom:DNAAlleleIndicator	1..1
"	LAI	biom:DNALocusAnalysisIndicator	1..1
"	PCDT	biom:DNAPreciseCallIndicator	1..1
"	AL1	biom:DNAAlleleCall1Text	0..1
"	AL2	biom:DNAAlleleCall2Text	0..1
"	AL3	biom:DNAAlleleCall3Text	0..1
"	BID	biom:DNABatchIdentification	0..1
"	ECR	biom:DNAElectropherogramIdentification	0..1
"	LCR	biom:DNAElectropherogramLadderIdentification	0..1
"	-	biom:DNAKit	1..1
"	KID	biom:DNAKitIdentification	1..1
"	KNM	biom:DNAKitName	0..1
"	KMF	biom:DNAKitManufacturerName	0..1
"	KDS	biom:DNAKitDescriptionText	0..1
18.017	DMD	biom:DNAMitochondrialData	0..1
"	MT1	biom:DNAMitoControlRegion1Text	1..1
"	MT2	biom:DNAMitoControlRegion2Text	1..1
"	BSP	biom:DNAMitoBaseStartNumeric	1..1
"	BEP	biom:DNAMitoBaseEndNumeric	1..1
"	BCA	biom:DNAMitoBaseAdenineQuantity	1..1
"	BCG	biom:DNAMitoBaseGuanineQuantity	1..1
"	BCC	biom:DNAMitoBaseCytosineQuantity	1..1
"	BCT	biom:DNAMitoBaseThymineQuantity	1..1

Field ID	Mnemonic	XML element name	Cardinality
18.018	UDP	biom:DNAUserDefinedProfile[123]	0..*
18.019	EPD	biom:DNAElectropherogram	0..*
"	EIR	biom:DNAElectropherogramIdentification	1..1
"	EST	biom:DNAElectropherogramFileStorageText	1..1
"	IDD	biom:DNAElectropherogramDataDescriptionText	1..1
"	ELPD	biom:DNAElectropherogramBinaryObject	1..1
"	-	biom:DNAElectropherogramScreenshotImage	0..1
"	EPS	nc:BinaryBase64Object	1..1
18.023	EPL	biom:DNAElectropherogramLadder	0..*
"	LIR	biom:DNAElectropherogramIdentification	1..1
"	LST	biom:DNAElectropherogramFileStorageText	1..1
"	LDD	biom:DNAElectropherogramDataDescriptionText	1..1
"	LEPD	biom:DNAElectropherogramBinaryObject	1..1
"	-	biom:DNAElectropherogramScreenshotImage	0..1
"	LES	nc:BinaryBase64Object	1..1
18.020	DGD	biom:DNAGenotypeDistributionCode	0..1
18.021	GAP	biom:DNAGenotypeAllelePair	0..*
"	GLR	biom:DNALocusIdentification	1..1
"	ALP	biom:DNAGenotypeAllelePairText	1..1
"	GNW	biom:DNAGenotypeWeightNumeric	1..1
18.022	COM	biom:DNACommentText	0..1

Type-19

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackagePlantarImageRecord	0..*
19.001	-	biom:RecordCategoryCode	1..1
19.002	IDC	biom:ImageReferenceIdentification	1..1
19.200-19.900	UDF	itl:UserDefinedFields[123]	0..*
19.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
19.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
19.996	HAS	biom:ImageHashValue	0..1
19.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1

[123] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	RSP	biom:ImageSegmentIdentification	0..1
-	-	biom:PlantarImage	1..1
19.999	DATA	nc:BinaryBase64Object	0..1
19.012	BPX	biom:ImageBitsPerPixelQuantity	0..1
-	-	biom:ImageCaptureDetail	1..1
19.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
19.005	PCD	biom:CaptureDate	1..1
19.903	DUI	biom:CaptureDeviceIdentification	0..1
19.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
19.016	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
19.004	SRC	nc:OrganizationIdentification	1..1
19.993	SAN	nc:OrganizationName	0..1
19.017	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
19.030	DMM	biom:CaptureDeviceMonitoringModeCode	0..1
19.020	COM	biom:ImageCommentText	0..1

Field ID	Mnemonic	XML element name	Cardinality
19.011	CGA	biom:ImageCompressionAlgorithmText	0..1
19.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	0..1
19.009	THPS	biom:ImageHorizontalPixelDensityValue	0..1
19.008	SLC	biom:ImageScaleUnitsCode	0..1
19.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	0..1
19.010	TVPS	biom:ImageVerticalPixelDensityValue	0..1
19.003	IMP	biom:FingerprintImageImpressionCaptureCategoryCode	1..1
19.013	FGP	biom:PlantarPositionCode	1..1
19.018	AMP	biom:PlantarImageMissingArea	0..8
"	FRAP	biom:PlantarPositionCode	1..1
"	ABC	biom:PlantarMissingAreaReasonCode	1..1
19.024	FQM	biom:PlantarImageQuality	0..9
"	FRMP	biom:PlantarPositionCode	1..1
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
"	QVU	biom:QualityValue	1..1
19.019	FSP	biom:PlantarImageSegmentPositionPolygon	0..5
"	FRSP	biom:PlantarPositionCode	1..1
"	NOP	biom:PositionPolygonVertexQuantity	1..1
"	-	biom:PositionPolygonVertex	3..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1

Type-20

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageSourceRepresentationRecord	0..*
20.001	-	biom:RecordCategoryCode	1..1
20.002	IDC	biom:ImageReferenceIdentification	1..1
20.100-20.900	-	itl:UserDefinedFields[124]	0..*
20.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
20.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
20.996	HAS	biom:ImageHashValue	0..1
20.003	CAR	biom:SourceRecordCardinalityCode	1..1

[124] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
20.014	AQS	biom:SourceAcquisition	1..9
"	AQT	biom:AcquisitionSourceCode	1..1
"	A2D	biom:AcquisitionDigitalConversionDescriptionText	0..1
"	FDN	biom:AcquisitionFormatDescriptionText	0..1
"	AQSC	biom:AcquisitionSpecialCharacteristicsText	0..1
20.015	SFT	biom:SourceFileFormat	1..1
"	FTY	biom:SourceFileCategoryText	1..1
"	DEI	biom:SourceFileDecodingInstructionsText	0..1
20.020	COM	biom:SourceCommentText	0..1
20.021	SRN	biom:SourceIdentification	1..1
20.994	EFR	biom:SourceExternalFileReferenceText	0..1
-		biom:SourceImage [125]	0..1 [126]
-		biom:SourceAudio [127]	0..1
-		biom:SourceVideo [128]	0..1
20.999	DATA	nc:BinaryBase64Object	0..1
20.012	BPX	biom:ImageBitsPerPixelQuantity	0..1
	-	biom:BiometricCaptureDetail [129]	0..1
	-	biom:ImageCaptureDetail [125]	0..1
20.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1

[125] Use this element if the source is a still image.
[126] One and only one of biom:SourceImage, biom:SourceAudio or biom:SourceVideo must appear.
[127] Use this element if the source is an audio file.
[128] Use this element if the source is a video file.
[129] Use this element if the source is a video or audio file.

Field ID	Mnemonic	XML element name	Cardinality
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
20.005	SRD	biom:CaptureDate	0..1
20.903	DUI	biom:CaptureDeviceIdentification	0..1
20.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
20.017	SHPS	biom:CaptureHorizontalPixelDensityValue	0..1
-	-	biom:CaptureOrganization	1..1
20.004	SRC	nc:OrganizationIdentification	1..1
20.993	SAN	nc:OrganizationName	0..1
20.018	SVPS	biom:CaptureVerticalPixelDensityValue	0..1
20.013	CSP	biom:ImageColorSpaceCode	1..1
20.011	CGA	biom:ImageCompressionAlgorithmText	1..1
20.006	HLL	biom:ImageHorizontalLineLengthPixelQuantity	1..1
20.009	HPS	biom:ImageHorizontalPixelDensityValue	1..1
20.008	SLC	biom:ImageScaleUnitsCode	1..1
20.007	VLL	biom:ImageVerticalLineLengthPixelQuantity	1..1
20.010	VPS	biom:ImageVerticalPixelDensityValue	1..1
20.016	SEG	biom:ImageSegment	0..99
"	RTV	biom:ImageSegmentIdentification	1..1
"	IPT	biom:ImageSegmentInternalIdentification	1..1
"	NOP	biom:PositionPolygonVertexQuantity	0..1
"	-	biom:PositionPolygonVertex	0..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
20.019	TIX	biom:TimeSegment	1..99
"	TIS	biom:TimeSegmentStartTimeValue	1..1
"	TIE	biom:TimeSegmentEndTimeValue	1..1

Type-21

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageAssociatedContextRecord	0..*

Field ID	Mnemonic	XML element name	Cardinality
21.001		biom:RecordCategoryCode	1..1
21.002	IDC	biom:ImageReferenceIdentification	1..1
21.100-21.900	UDF	itl:UserDefinedFields[130]	0..*
21.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
21.996	HAS	biom:ImageHashValue	0..1
21.015	ACF	biom:ContextFileFormat	1..1
"	FTY	biom:ContextFileCategoryText	1..1
"	DEI	biom:ContextFileDecodingInstructionsText	0..1
21.020	COM	biom:ContextCommentText	0..1
21.021	ACN	biom:ContextIdentification	1..1
21.994	EFR	biom:ContextExternalFileReferenceText	0..1
-		biom:ContextImage [125]	0..1[131]
-		biom:ContextAudio [127]	0..1
-		biom:ContextVideo [128]	0..1
21.999	DATA	nc:BinaryBase64Object	0..1
	-	biom:BiometricCaptureDetail [129]	0..1
		biom:ImageCaptureDetail [125]	0..1
21.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode [99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName [100]	0..1
"	-	nc:LocationUTMCoordinate	0..1

[130] This element is abstract and must be substituted with a user-defined element.

[131] One and only one of biom:ContextImage, biom:ContextAudeo or biom:ContextVideo must appear.

Field ID	Mnemonic	XML element name	Cardinality
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
21.005	ACD	biom:CaptureDate	0..1
-	-	biom:CaptureOrganization	1..1
21.004	SRC	nc:OrganizationIdentification	1..1
21.993	SAN	nc:OrganizationName	0..1
21.016	SEG	biom:ImageSegment	0..99
"	ASP	biom:ImageSegmentIdentification	1..1
"	IPT	biom:ImageSegmentInternalIdentification	1..1
"	NOP	biom:PositionPolygonVertexQuantity	0..1
"	-	biom:PositionPolygonVertex	0..99
"	HPO	biom:PositionHorizontalCoordinateValue	1..1
"	VPO	biom:PositionVerticalCoordinateValue	1..1
21.019	TIX	biom:TimeSegment	1..99
"	TIS	biom:TimeSegmentStartTimeValue	1..1
"	TIE	biom:TimeSegmentEndTimeValue	01/01/11

Type-98

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageInformationAssuranceRecord	0..*
98.001	-	biom:RecordCategoryCode	1..1
98.002	IDC	biom:ImageReferenceIdentification	1..1
98.200-98.899	UDF	itl:UserDefinedFields[132]	0..*
98.003	DFO	biom:AssuranceFormatOwnerIdentification	1..1
-	-	biom:AssuranceOrganization	1..1
98.004	SRC	nc:OrganizationIdentification	1..1
98.993	SAN	nc:OrganizationName	0..1
98.005	DFT	biom:AssuranceFormatIdentification	1..1
98.006	DCD	biom:AssuranceDateTime	1..1
98.900	ALF	biom:AssuranceLogEntry	0..*
"	EVT	biom:AssuranceLogEventCode	1..1
"	EVR	biom:AssuranceLogEventReasonText	0..1
"	IID	biom:AssuranceLogEventLocationText	1..1
"	AGT	biom:AssuranceLogAgentText	1..1

[132] This element is abstract and must be substituted with a user-defined element.

Field ID	Mnemonic	XML element name	Cardinality
"	OLD	biom:AssuranceLogEventOriginalValueText	0..1
98.901	ARN	biom:AssuranceAuditRevisionIdentification	0..1

Type-99

Field ID	Mnemonic	XML element name	Cardinality
		itl:PackageCBEFFBiometricDataRecord	0..*
99		biom:RecordCategoryCode	1..1
99.002	IDC	biom:ImageReferenceIdentification	1..1
99.200-99.900	UDF	itl:UserDefinedFields[132]	0..*
99.902	ANN	biom:ProcessAnnotation	0..*
"	GMT	biom:ProcessUTCDate	1..1
"	NAV	biom:ProcessName	1..1
"	OWN	biom:ProcessOwnerText	1..1
"	PRO	biom:ProcessDescriptionText	1..1
99.995	ASC	biom:AssociatedContext	0..255
"	ACN	biom:ContextIdentification	1..1
"	ASP	biom:ImageSegmentIdentification	0..1
99.996	HAS	biom:ImageHashValue	0..1
99.997	SOR	biom:SourceRepresentation	0..255
"	SRN	biom:SourceIdentification	1..1
"	RSP	biom:ImageSegmentIdentification	0..1
-		biom:CBEFFImage	1..1
99.999	DATA	nc:BinaryBase64Object	1..1
-		biom:ImageCaptureDetail	1..1
99.998	GEO	biom:CaptureLocation	0..1
"	GRT	nc:LocationDescriptionText	0..1
"	-	nc:LocationGeographicElevation	0..1
"	ELE	nc:MeasurePointValue	1..1
"	-	biom:LocationTwoDimensionalGeographicCoordinate	0..1
"	-	nc:GeographicCoordinateLatitude	0..1
"	LTD	nc:LatitudeDegreeValue	0..1
"	LTM	nc:LatitudeMinuteValue	0..1
"	LTS	nc:LatitudeSecondValue	0..1
"	-	nc:GeographicCoordinateLongitude	0..1
"	LGD	nc:LongitudeDegreeValue	0..1
"	LGM	nc:LongitudeMinuteValue	0..1
"	LGS	nc:LongitudeSecondValue	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemCode[99]	0..1
"	GDC	biom:GeodeticDatumCoordinateSystemName[100]	0..1

Field ID	Mnemonic	XML element name	Cardinality
"	-	nc:LocationUTMCoordinate	0..1
"	GCE	nc:UTMEastingValue	0..1
"	GCM	nc:UTMGridZoneID	0..1
"	GCN	nc:UTMNorthingValue	0..1
"	-	biom:LocationAlternateGeographicSystemValue	0..1
"	OSI	biom:GeographicLocationSystemName	1..1
"	OCV	biom:GeographicLocationText	1..1
"	UTE	biom:CaptureUTCDateTime	0..1
99.005	BCD	biom:CaptureDate	1..1
99.903	DUI	biom:CaptureDeviceIdentification	0..1
99.904	MMS	-	
"	MAK	biom:CaptureDeviceMakeText	0..1
"	MOD	biom:CaptureDeviceModelText	0..1
"	SER	biom:CaptureDeviceSerialNumberText	0..1
-	-	biom:CaptureOrganization	1..1
99.004	SRC	nc:OrganizationIdentification	1..1
99.993	SAN	nc:OrganizationName	0..1
99.102	BDQ	biom:ImageQuality	0..9
"	QAP	biom:QualityAlgorithmProductIdentification	1..1
"	QVU	biom:QualityValue	1..1
"	QAV	biom:QualityAlgorithmVendorIdentification	1..1
99.103	BFO	biom:CBEFFFormatOwnerIdentification	1..1
99.104	BFT	biom:CBEFFFormatCategoryIdentification	1..1
99.100	HDV	biom:CBEFFVersionIdentification	1..1
99.101	BTY	biom:CBEFFCategoryCode	1..1

Annex H: Conformance Specifications

This Annex is reserved for future use.

Annex I: Bibliography

Informative

The following bibliography includes documents not listed as normative references in **Section 3**.

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