NIST Special Publication 500-290
Edition 3 (2015)

ANSI/NIST-ITL 1-2011
Update: 2015

Information Technology:
American National Standard for Information Systems

ANSI/NIST-ITL 1-2011 Update:2015
Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information

This publication is available free of charge from:
http://dx.doi.org/10.6028/NIST.SP.500-290e3

Approved American National Standard
ANSI

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

NIST Special Publication 500-290e3

ANSI/NIST-ITL 1-2011
Update: 2015

Approved November 2011
Sup:Dental and Sup:Voice approved September 2013
Update:2013 approved December 2013
Update:2015 approved July 2016

American National Standards Institute

Information Technology:

American National Standard for Information Systems -

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

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United States Department of Commerce

This publication is available free of charge from:
http://dx.doi.org/10.6028/NIST.SP.500-290e3

Cover Photography by Brad Wing and Ralf Meier
January 2011; Subway Station - Stockholm, Sweden
"The Art of Biometrics"

Reports on Information Technology

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National Institute of Standards and Technology Special Publication 500-290e3 (2015)
Natl. Inst. Stand. Technol. Spec. Pub. 500-290e3 (2015)
CODEN: NSPUE2

This publication is available free of charge from: http://dx.doi.org/10.6028/NIST.SP.500-290e3

Contents: ANSI/NIST-ITL 1-2011 Update: 2015

[2013a>]

Hints for the reader of a PDF copy of the standard

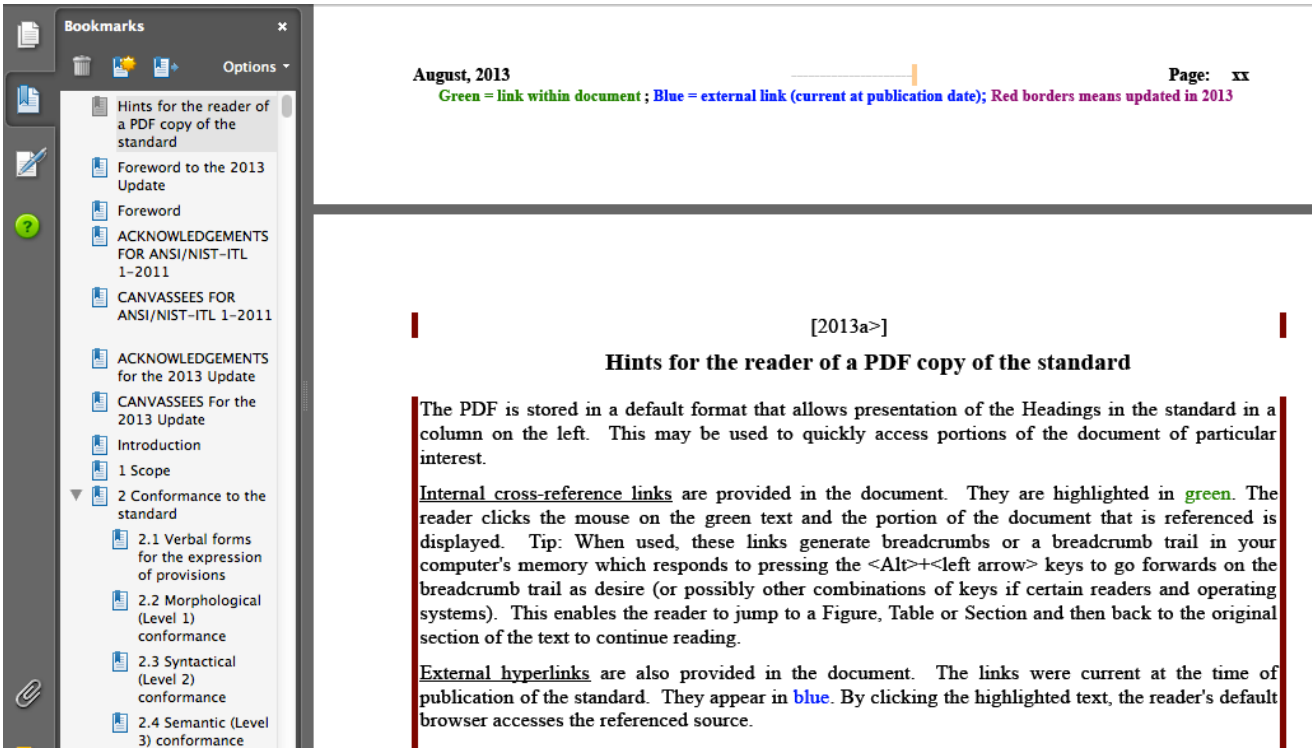
The PDF is stored in a default format that allows presentation of the Headings in the standard in a column on the left. This may be used to quickly access portions of the document of particular interest.

Internal cross-reference links are provided in the document. There are highlighted in green. The reader clicks the mouse on the green text and the portion of the document that is referenced is displayed.

These links generate breadcrumbs or a breadcrumb trail in your computer's memory, which on some systems responds to pressing the <Alt>+<left/right arrow> keys or <⌘>+<left/right arrow> keys to go backwards/forwards on the breadcrumb trail as desired. This enables the reader to jump to a Figure, Table or Section and then back to the original section of the text to continue reading.

External hyperlinks are also provided in the document. The links were current at the time of publication of the standard. They appear in blue. By clicking the highlighted text, the reader's default browser accesses the referenced source.

Many PDF readers have an option for bookmark listings next to the document. This can be very useful for navigation through the document as shown below:



[<2013a]

Foreword to the 2015 Update

[2015a>]

Areas of the text with changes from the base 2011 version are marked with bars in the margins (red for 2013 and purple for 2015). Note that minor changes, such as when 'this version' was used in 2011 and is changed to 'the base 2011 version' are not so indicated. Simple grammatical and typographical corrections are not marked either.

The **Type-1**: **Field 1.002: Version number / VER** can have three values: "0500" for the base 2011 version; "0501" if content of the 2013 Update is included in the transaction and the XML schema based upon NIEM 2.1 is used (if using XML encoding). " 0502" represents the 2015 Update. The leading zeros shall be included in the Traditional encoding as ASCII characters, but need not be included in XML encoding. See Section **8 Record type specifications**.

The XML encoding for the 2015 Update allows both NIEM 2.1 and NIEM 3.1 versions.

Some error correction does have an impact upon coding and conformance. Errata corrections are marked by [2015e>] followed by [<2015e] for quick reference.

In some parts of the standard, additional text has been added to clarify ambiguities in the original text and to add information that may be of assistance to the user of the standard. These are marked by [2015a>] and [<2015a].

Additions of new records and fields to the standard that were not part of the 2013 Update are marked by [2015n>] and [<2015n].

Changes to hyperlinks in the document are not marked as updates.

The following are the principal revisions for the 2015 Update:

- Revision of the friction ridge impression types in **Section** 7.7.4.1. This simplifies the list of codes and separates impression types from capture technology, which is reflected in a new section **(**7.7.4.5**).** The capture technology codes may be entered in **Field 13.901: Friction ridge capture technology / FCT, Field 15.901: Friction ridge capture technology / FCT**, and / or **Field 19.901: Friction ridge capture technology / FCT** – all of which are new to this Update.
- Fingerprint Acquisition Profiles (FAP), Palm print Acquisition Profiles (PAP), and Toe and Plantar Acquisition Profiles (TAP) have been updated in **Section** 7.7.5 to include separate levels for 1000 ppi devices. Level 50 in previous versions had a minimum dimension of 1.6" x 1.5" and was specified for 1-3 fingers. It is now specified as having a minimum dimension of 3.2" x 2" since no devices were created to match the earler specification. PAP and TAP are new to the 2015 Update as are the corresponding fields: **Field 15.031: Subject acquisition profile – palm print / PAP** and **Field 19.031: Subject acquisition profile – toe and plantar print / TAP**.
- The Iris Acquisition Profile (IAP) has been updated to be consistent with ISO specifications. It now specifies profiles for spatial sampling rate in addition to pixel counts. There is also extended text describing iris acquisition equipment in **Section** 7.7.5.3**.**

- **Field 10.040: NCIC code / SMT** has been updated to include image codes CONDITION, MISSING and OTHER as defined in **Field 10.003: Image type / IMT**. See section **8.10.36.**
- **Annex C: NIEM-conformant encoding rules** has been substantially shortened to remove XML examples specific to only NIEM 2.1. A principal reason for this Update is to accommodate NIEM 3.1 which is incompatible with NIEM 2.1 (the version used in previous versions of the standard).
- **Type-8** records now allow signature images in other than facsimilie format. See **8.8.8.2 Compressed scanned image data.**
- External files (referenced in field xx.994) are now added for **Type-10**, **Type-13**, **Type-14**, **Type-15**, **Type-17**, and **Type-19.**
- **Table 105 Amputation / bandaged fingerprinting codes** in **Field 14.018: Amputated or bandaged / AMP** has been updated to include a new code SR to indicate a scar.
- Annex E, **E.4.6 Glasses and eye patches** is revised to recommend taking images of persons without glasses, when possible.

Foreword to the 2013 Update

[2013a>] The 2013 Update to the *ANSI/NIST-ITL* standard incorporates the Dental and Voice Supplements directly into the text, as well as corrects miscellaneous errors that were noticed after publication of the 2011 version. Some additional capabilities have been added to the standard that were not part of the Supplements, but have been requested by users of the standard.

Overview of the changes and modifications

Areas of the text with changes from the base 2011 version are marked with bars in the margins, as in this Foreword. Note that minor changes, such as when 'this version' was used in 2011 and is changed to 'the base 2011 version' are not so indicated. Simple grammatical and typographical corrections are not marked either.

The **Type-1**: **Field 1.002: Version number / VER** can have two values: "0500" for the base 2011 version; "0501" if content of the 2013 Update is included in the transaction and/or the updated XML schema is used.

Some error correction does have an impact upon coding and conformance, such as changing the range values for **DUP**, **DLF** and **DRT** in **Table 42 Type-9 Fields for EFS** for **Field 9.321: EFS deltas / DEL**. (They were listed as ranging from 1 to 180 in 2011 and should have been 1 to 359). Errata corrections are marked by [2013e>] followed by [<2013e] for quick reference.

In some parts of the standard, additional text has been added to clarify ambiguities in the original text and to add information that may be of assistance to the user of the standard. These are marked by [2013a>] and [<2013a].

The 2013 Dental Forensics Supplement (*ANSI/NIST-ITL 1-2011 Sup:Dental*) is integrated into the document and indicated by [2013d>] prior to the text and [<2013d] at the end of the insertion. This supplement also includes some capabilities that extend beyond purely dental forensics, such as the new **Type-22** record, which can handle images to support Disaster Victim Identification (DVI) operations using imagery that may be from other sources, such as X-rays of other parts of the body.

The 2013 Forensic and Investigatory Voice Supplement (*ANSI/NIST-ITL 1-2011 Sup:Voice*) is integrated into the document and indicated by [2013v>] prior to the text and [<2013v] at the end of the insertion.

Additions of new records and fields to the standard that were not part of the 2013 Supplements are marked by [2013n>] and [<2013n].

The updates for *ANSI/NIST-ITL 1-2011 Update:2013* can be summarized as:

Type-1: Addition of a new field to signal when country code fields in the data for a transaction are specified according to GENC[1] as opposed to the default *ISO 3166-1*

[1] GENC is the Geopolitical Entities, Names, and Codes Standard issued by the National Geospatial-Intelligence Agency. It is the U.S. Government profile of *ISO 3166* Codes for the representation of names of countries and their subdivisions. It

Type-9: Addition of new fields to support the Extended Feature Set

Type-10: Additional fields for cheiloscopic images, suspected patterned injuries, and capability to transmit extra-oral and intra-oral images. New fields containing subject information and capture organization data.

Type-11: A new record type introduced to handle forensic and investigatory voice data.

Type-12: A new record type introduced to handle forensic dental and oral data.

Type-13: Addition of new fields to support the forensic markups of friction ridge images. New fields containing subject information and capture organization data.

Type-14: New fields containing subject information and capture organization data. New capability to handle plain fingertip exemplars added.

Type-15: New fields containing subject information and capture organization data. New field to allow for segementation of a full palm print.

Type-18: Addition of a field to allow cross reference to a particular **Type-2** record associated with the DNA information in a particular instance of the **Type-18** record.

Type-19: New fields containing subject information and capture organization data. New field to allow for segementation of a full plantar print.

Type-21: Addition of a new field to record information about medical devices found in or on a person that may be used to assist in identification of unknown deceased. New fields containing subject information and capture organization data.

Type-22: Addition of a new record to enable transmission of imagery that is not a standard photograph (which would be transmitted in a **Type-10** record). Examples include radiographs, CT scans, PET scans, sonograms, 3D orthodontic cast models, DICOM[2] records, infrared images, and 3D face data.

Annex C: Establishment of the NIEM Biometrics Domain[3]

Annex G: Establishment of the NIEM Biometrics Domain and inclusion of the new fields and record types.

Other portions of the standard are updated to reflect their interrelationships with this new content.

Note that the code definition for 'Alphabetic' is modified. Spaces are now listed as Special Characters (code S) in the two fields affected: **Field 10.023: Photo acquisition source / PAS** and **Field 10.026: Subject facial description / SXS**. This was done to conform to the standard programming definition of alphabetic characters being limited to the letters of the English alphabet. The character codes in

specifies an authoritative set of country codes and names for use by the US Federal Government for information exchange, using *ISO 3166 (Parts 1 and 2)* names and code elements wherever possible, with modifications where necessary to comply with U.S. law and U.S. Government recognition policy. See

https://nsgreg.nga.mil/genc/discovery

[2] DICOM is the standard "*Digital Imaging and Communications in Medicine"* published by the National Electrical Manufacturers Association (NEMA).

[3] Part of the National Information Exchange Model. See https://www.niem.gov/communities/biometrics/Pages/about-bm.aspx

Table 70 Type-10 record layout for these two fields were changed to AS, with the special character listed as a space. **Table 128 Character encoding set values** in **Annex A: Character encoding information** was also updated to reflect that the space is a special character.

Foreword

This foreword is not part of the American National Standard ANSI/NIST-ITL 1-2011

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), palm prints, 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, palm print 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.

[2013a>] The 2011 version of the standard replaces ANSI/NIST-ITL 1-2007 and ANSI/NIST-ITL 2-2008 standards and the amendment ANSI/NIST-ITL 1a-2009. The 2013 Update incorporates the Dental and Voice Supplements to the 2011 version of the standard as well as some other new material. [<2013a]

[2015a>] The 2015 Update incorporates changes concerning friction ridge impression types and further de-linkages of the text to NIEM versions, since NIEM has released a new version that is incompatible with the version used up to 2015 by the standard for XML encoding. [<2015a]

Send suggestions and comments about the standard to:

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ACKNOWLEDGEMENTS FOR ANSI/NIST-ITL 1-2011

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[2015e>] The conformance testing methodology and test assertions for the 2011 version are documented in NIST SP 500-296 R.1 and were developed by the following team: Fernando Podio, Christofer J. McGinnis and Dylan Yaga.

The conformance testing methodology framework and assertions for the 2013 version area documented in NIST SP 500-304, and were developed by Christofer J. McGinnis, Dylan Yaga and Fernando Podio. [<2015e]

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Note: Canvassee organization names are listed as they were in 2011

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[2013a>]

ACKNOWLEDGEMENTS for the 2013 Update

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The Dental and Oral Supplement was prepared by a joint group comprised of the Forensic Dental Working Group of ANSI/NIST-ITL, co-chaired by Pedro Janices and Virginia Kannemann of the Argentine National Office of Information Technologies (which originally proposed the development of a forensics dental record for the standard[4]); and by the American Dental Association Standards Committee on Dental Informatics Working Group 10.12 Forensic Odontology Informatics, chaired by Kenneth Aschheim. He not only served as editor of the *ANSI/NIST-ITL* material, but also for the *ADA Standard Number 1058*, which forms the core of much of the capabilities of Record **Type-12**. It is largely due to his continued stewardship of both groups and his ability to reach out to all parts of the forensic dental community that this project has come to fruition.

There was extensive coordination with: American Academy of Forensic Sciences (AAFS) Odontology Section; the American Board of Forensic Odontology (ABFO); the American Board of Orthodontics (ABO), American Society of Forensic Odontology (ASFO); American Dental Association (ADA); American Dental Hygienists' Association; Department of Defense (DoD), including the Defense Forensics and Biometrics Agency and the National Museum of Health and Medicine; Federal Bureau of Investigation (FBI) – including the Biometrics Center of Excellence (BCOE), the Criminal Justice Information Center (CJIS) and the National Crime Information Center (NCIC); Harris County Medical Examiners (Texas); International Association for Identification (IAI); INTERPOL; Louisiana State University School of Dentistry; Maryland Office of the Chief Medical Examiner; Miami-Dade Medical Examiner Department; National Institute of Justice (NIJ) – including NamUs; National Institute of Standards and Technology (NIST); New York City Office of the Chief Medical Examiner – including UVIS/UDIM; Plass Data; Québec Ministère de la Sécurité publique; Scientific Working Group for Disaster Victim Identification (SWGDVI); University of Illinois at Chicago School of Dentistry; University of Texas Health Sciences Center; and WinID.

[4] See http://biometrics.nist.gov/cs_links/standard/ansi_2011/WORKSHOP/kannmann-dentistry.pdf

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Work on a proposed Supplement for voice data evolved out of the NIST / FBI co-sponsored '*US Government Interagency Symposium for Investigatory Voice Biometrics*' which occurred in 2009. The Symposium created four working groups, one of which dealt with interoperability. That working group's report stated: "One of the fundamental goals of the Symposium on Investigatory Voice Biometrics was to initiate 'a multi-year program to develop investigatory voice biometric collection and interoperability standards'". That Working Group recommended the further examination of adding a voice data capability to the *ANSI/NIST-ITL* standard. Subsequent to that Symposium, the FBI's Biometric Center of Excellence (BCOE) initiated a multi-year sponsorship to form the Investigatory Voice Biometric Committee (IVBC) in collaboration with the NIST to define the U.S. government agency's technical requirements for voice data collection, transmission format, and analysis. One of its key recommendations was to develop a standardized approach for voice data exchange.

Concurrently, certain stakeholders involved in the *ANSI/NIST-ITL* process had recognized the need for a standardized way to exchange voice data. An *ANSI/NIST-ITL* working group was formed in 2010 to develop text for inclusion in the standard, under the leadership of Bonny Scheier. That working group agreed that the 2011 update to the standard would proceed without a new voice record, since there was still substantial work to be done in creating a new record type. Note that the record for the 2010 workshop recognized the need for a voice record by establishing a placeholder for a new voice record type (http://www.nist.gov/itl/iad/ig/ansi-nist_2010-archive.cfm). The Workshop summary (http://biometrics.nist.gov/cs_links/standard/ansi-overview_2010/Summary.pdf) notes that a working group would further pursue development of a new Voice data record type.

The IVBC developed the first draft of the **Type-11** record. In August, 2012, the IVBC turned over its work to a newly re-formed *ANSI/NIST-ITL* Voice Working Group, in order to allow participation of a wider group in the development process. It is the result of the combined work of all of these groups that this Supplement was produced. The development of Record **Type-11** owes much to the dedicated effort of Jim Wayman, who served as editor throughout the process, and to Hiro Nakasone, who directed the IVBC activity and championed the development of the Supplement.

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[<2013a]

[2015a>]

ACKNOWLEDGEMENTS for the 2015 Update

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And special thanks to Jim Cambier, Greg Cannon, Pat Flanagan, Mike Garris, C J McGinnis, John Mayer Spain, Jennifer Stathakis, Rachel Wallner and Dylan Yaga for their assistance to the editor in preparing the text.

Following publication of this Update, a working group is to be established that will generate the XML encodings.

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[<2015a]

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, palm prints, 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.

The 2011 version of the standard 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.

[2015a>] The 2015 Update specifically generalizes the XML encoding instructions, since NIEM has introduced a new version that is incompatible with previous versions of NIEM. There are two schemas for the 2015 Update available on the standard's website – one for NIEM 2.1 (which was used in previous versions of the standard) and one based on NIEM 3.1. To handle this, several modifications have been made to the Annexes in order to refer to external files that can be updated without causing a revision to the standard each time that NIEM is changed. [<2015a]

1 Scope

This standard defines the content, format, and units of measurement for the electronic exchange of fingerprint, palm print, 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.

[2013a>] One transaction may pertain to a specific subject, or contain information for multiple subjects. The definition for a given transaction should specify clearly whether all records apply to a single subject (such as in a criminal arrest transaction), have multiple records each of which applies to a different subject (such as a search result transaction), or have records that themselves contain multiple subjects (such as a **Type-11** recording with multiple speakers). [<2013a]

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 Morphological (Level 1) conformance

Morphological[5] 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 morphologically 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 36: Type-9 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length[6]; 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 #
4.004	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	T=B; X=N	T=1 X=1	T=1 X=3	0 ≤ FGP ≤ 15 or FGP = 255 non-negative integer See Table 9	T = 6; X= 1	6

The excerpt above is taken from **Table 36 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 36.** 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

[5] [2013e>] Morphological and Syntactical header labels were reversed in these sections in the 2011 text. The explanatory text was correct. [<2013e]

[6] [2013e>] Revised character type for Traditional format to Binary. [<2013e]

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 9**.

Table 2 Excerpt from Table 118: 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 non-negative 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 118 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 morphologically 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 Syntactical (Level 2) conformance

Syntactical[82] conformance deals with explicit requirements that check for internal consistency and ensure that values are compatible with this standard. Specifically, syntactical 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 syntactical 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 syntactical requirements of either **Annex B: Traditional encoding** or **Annex C: NIEM-conformant encoding rules**, as appropriate.

An example of this type of conformance is:

- [2013a>] **Field 17.026: Iris diameter / IRD** is restricted to values between 10 and 9999, inclusive. A value of 200 for **Field 17.026** is in the allowable range for **IRD** and would therefore be morphologically conformant. [<2013a] However, 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 15** for **IAP** constraints by level). Testing for syntactical conformance involves comparing values within a transaction, therefore, if **IAP** is 40, an **IRD** value of 200 is not syntactically 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/2013DLIDCardDesignStandard/

[2013d>]

American Board of Forensic Odontology, *Diplomates Reference Manual*. It is available at http://www.abfo.org/wp-content/uploads/2012/08/ABFO-Reference-Manual-1-22-2013-revision.pdf

ANSI/ADA Standard No. 1058, *Forensic Dental Data Set.* It is available at http:webstore.ansi.org

ANSI/ADA Specification No. 1067 *Standard Functional Requirements for an Electronic Dental Record System*. It is available at http:webstore.ansi.org

ANSI/ADA Specification No. 3950, *Designation System for Teeth and Areas of the Oral Cavity*. It is available at http:webstore.ansi.org This contains the same information as: ISO 3950:2009 *Dentistry – Designation system for teeth and areas of the oral cavity*. It is available at http://www.iso.org/

[<2013d]

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

ANSI/EIA - 538-1988 *Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Equipment.*[7]

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*

[7] ANSI and ISO documents are available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

Interchange of Fingerprint, Facial and Other Biometric Information – Part 1. [8]
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.*[8]

ANSI/NIST ITL 1-2011 NIEM IEPD Exchange and Subset Schemas[8]

[2013n>]

ANSI/NIST ITL 1-2011 Update:2013 NIEM IEPD Exchange and Subset Schemas[8]

[<2013n]

[2013a>]

Code of Federal Regulations Title 21, Part 58, 21CFR58, *Title 21 Food and Drugs, Chapter I – Food and Drug Administration, Department of Health and Human Services, Subchapter A, Part 58, Good Laboratory Practice for Nonclinical Laboratory Studies.* It is available at www.accessdata.fda.gov

[<2013a]

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.[9]

Federal Information Processing Standards Publication, FIPS PUB 180-3, *Secure Hash Standard (SHS)*, October 2008. It is available at http://csrc.nist.gov/publications/PubsFIPS.html#fips180-4

NGI-DOC-01078-x.x Criminal Justice Information Services (CJIS) Electronic Biometric Transmission Specification (EBTS). [9]

IAFIS-IC-0110 (V3.1) *WSQ Gray-scale Fingerprint Image Compression Specification*, October 4, 2010. [9]

IEC 61966-2-4, *Multimedia systems and equipment – Colour measurement and management – Part 2-4 Colour management – Extended-gamut YCC colour space for video applications – xcYCC.* It is available at http://webstore.iec.ch

[8] ANSI/NIST-ITL documents are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm
[9] These documents are available at https://www.fbibiospecs.cjis.gov

[2013v>]

IEEE 754-2008, *IEEE Standard for Floating-Point Arithmetic.* It is available at http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=4610933

[<2013v]

INCITS 378-2009, *Information Technology - Finger Minutiae Format for Data Interchange.*[7]

INCITS 378-2009/AM1-2010, *Information Technology - Finger Minutiae Format for Data Interchange.*[7]

International Biometrics & Identification Association, *CBEFF Registry*, It is available at http://www.ibia.org/cbeff/

International Civil Aviation Organization, *Document 9303, Machine Readable Travel Documents*. It is available at http://www.icao.int/publications/pages/publication.aspx?docnum=9303

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[2013v>]

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[<2013v]

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ISO/IEC 10918, *Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines.*[7]

[2013d>]

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[<2013d]

ISO/IEC 14496-2, *MPEG4 Feature Points, Annex C.*[7]

ISO/IEC 15444-1, *JPEG 2000, Information Technology - Digital Compression and Coding of Continuous-Tone Still Images Part 1: Requirements and Guidelines.*[7]

ISO/IEC 15444-2, *Information technology — JPEG 2000 image coding system: Extension, available at:* http://www.iso.org/iso/catalogue_detail.htm?csnumber=33160

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[2013v>]

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[<2013v]

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[2013d>]

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[<2013d]

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[2013n>]

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[<2013n] [10]

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http://dx.doi.org/10.6028/NIST.SP.800-76-2 [<2013a]

[2013a>]

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[<2013a]

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[10] [2013n>] The references to specific NIEM documents were removed, and replaced with a reference to the set of NIEM normative specifications, which may be updated on a different cycle than ANSI/NIST-ITL. [<2013n]

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W3C XML Schema (Second Edition), World Wide Web Consortium. It is available in two parts at: http://www.w3.org/TR/xmlschema-1/ and http://www.w3.org/TR/xmlschema-2

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.

[2013v>]

µ-law

A companding algorithm used in North America and Japan that optimizes an analog telephone band signal while digitizing.

3G2

A container format used for multimedia applications. It was developed by the *Third Generation Partnership Project 2(3GPP2)* and is similar to 3GP.

3GP

A container format used for multimedia applications. It was developed by the *Third Generation Partnership Project (3GPP).* It is used on 3G mobile phones, and some 2G and 4G phones.

[<2013v]

AABB

The American Association of Blood Banks.

AAMVA

The American Association of Motor Vehicle Administrators.

[2013d>]

ABFO

The American Board of Forensic Odontology

ABFO # 2 Reference Scale

A right angle ruler designed by the ABFO that is used for patterned injury imagery. It

includes three circles that are useful to determine distortion due to photography at different angles. The ruler itself is manufactered by several different sources. The correct name is the ABFO #2 Reference Scale, but it is commonly known as the ABFO # 2 ruler.

ABO

The American Board of Orthodontics

[<2013d] [2013v>]

acoustic signal

Pressure waves in a media that have information content.

[<2013v] [2013d>]

ADA

The American Dental Association

[<2013d]

AFIS

Automated Fingerprint Identification System.

[2013v>]

AGC

Automatic gain control is an adaptive system that effectively reduces the amplitude or energy of an audio signal if it is strong and raises it when it is weaker.

AIFF

The Audio Interchange File Format stores audio data in uncompressed pulse-code modulation (PCM). The file extensions commonly used are '.aiff' and 'aif'. There is a compressed variant which has the extension '.aifc', but in reality, sometimes a compressed version is stored with the file extension '.aiff'. See http://www-mmsp.ece.mcgill.ca/Documents/AudioFormats/AIFF/Docs/AIFF-1.3.pdf

A-law

A companding algorithm used outside of North America and Japan that optimizes an analog telephone band signal while digitizing.

[<2013v]

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.

[2013d>]

antemortem

Prior to death.

[<2013d]

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*. [2013a>] See https://www.fbibiospecs.cjis.gov for Appendix F, CJIS Image Quality Specifications. [<2013a] The listing of approved devices is available at https://www.fbibiospecs.cjis.gov

ASCII

The American National Standard Code for Information Interchange.

ASCLD

The American Association of Crime Lab Directors.

[2013v>]

assigned voice

A voice to which an identifier has been attached. The identifier may or may not point to the person with that voice. For instance, the voice of an unknown speaker that has been previously encountered can be considered an 'assigned voice' by attaching an identifier to it in earlier transactions.

[<2013v]

aspect ratio

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

[2013v>]

audio signal

Information in analog or digital form that contains acoustic content (voice or otherwise)

audio recording

A stored audio signal capable of being transduced into an acoustic signal.

automatic speech recognition

The process or technology which accepts speech as input and determines what was spoken.[11]

[<2013v] [2013a>]

BCOE

The FBI's Biometric Center of Excellence.

[<2013a]

BDB

Biometric Data Block used in CBEFF.

[2013a>]

C-216C

Form C-216C is a fingerprint form used in Canada to have background record checks performed. See https://reliabilityscreening.ca/downloads/RCMP_GRC_C-216C_Form.pdf

[<2013a]

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.

[2013a>]

CIE

The International Commission on Illumination. The color space that they defined is called **CIELab.** They have also developed a metric for color distance called ΔE_{1976} (Delta E) with 1976 indicating the version of the formula. They have developed more detailed and precise distance metrics in later years. For more information, see http://en.wikipedia.org/wiki/Color_difference.

CJIS

The Criminal Justice Information Services Division of the FBI.

[11]See definitions developed by the IEEE Acoustics, Speech and Signal Processing Society as presented in David S. Pallett, *Performance Assessment of Automatic Speech Recognizers,* Journal of Research of the National Bureau of Standards, Volume 90, Number 5, September-October 1985.

[<2013a]

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).

[2013v>]

codec

A codec is a computer program that encodes and decodes a data signal, usually in a compressed format.

codec format

A codec format is the data structure produced by a codec.

companding algorithm

An algorithm that allows signals with a large dynamic range to be transmitted over facilities with a smaller dynamic range. It is used in telephony (see μ-law and A-law) and some other types of communications.

[<2013v]

constraint schema

This is a NIEM schema 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. 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.

[2013v>]

container

A format that describes how the data and metadata are stored in a computer file.

contemporaneous

Existing at or occurring at the same period of time. In Record **Type-11**, the phrase

"contemporaneous capture of a voice signal" indicates recording of the voice signal at the time of the speaker vocalization.

[<2013v]

context data

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

[2013d>]

CT scan

Computerized tomography scan.

current data

Data for the individual in his/her current state, not necessarily data recorded or created on the current date. For instance, current data on a subject may be a radiograph of a decedent taken at the time of burial several years ago that is now being compared to radiographs that had been provided for a missing person prior to the assumed date of death of the subject.

[<2013d]

deprecated

The record type / field / subfield / information item / value / file shall not be used when claiming conformance to this version of the standard. (different than '**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.

[2013v>]

diary

A list giving the start and stop times of speech segments within the voice signal, pertaining to the subject of the record. Diarization of segments from multiple speakers requires multiple **Type-11** records, one for each speaker. These multiple **Type-11** records may be contained in a single transaction, as long as the transaction is focused upon a single subject.

[<2013v] [2013d>]

DICOM

The standard "*Digital Imaging and Communications in Medicine*" published by the

National Electrical Manufacturers Association (NEMA).

DICOS

The standard "*Digital Imaging and Communications in Security"* published by the National Electrical Manufacturers Association (NEMA)

[<2013d] [2013v>]

digital sample (n)

A representative value of a signal at a chosen instant, derived from a portion of that signal. From the *Vocabulary of Digital Transmission and Multiplexing, and Pulse Code Modulation (PCM) Terms*, ITU-T Recommendation G.701 (March, 1993)

digitally sample (v)

Obtain the values of a function for regularly or irregularly spaced distinct values from its domain. From: *ISO 2382-2-1976, Information technology – Vocabulary – Part 2:Arithmetic and logic operations*

[<2013v]

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 [2015a>]as defined in fields 9.300-9.399 [<2015a]

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 (for example: <CaptureDate>) and an end-tag (for example: </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.

[2013a>]

endian (big or little)

The order of significance in a number. Big endian places the most significant byte (or digit) first. Little endian places the most significant byte (or digit) last. Humans tend to represent numbers as big-endian, with 10 representing ten and not one.

[<2013a]

exchange schema

Although NIEM contains thousands of elements it does not contain everything needed in an XML exchange. It contains the most common building blocks. In addition, implementers can define, in other exchange schemas, "user-defined" elements from the implementer's domain.

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').

[2013d>]

FastID

A European Union-funded project designed to develop an operational commonality of identification data between INTERPOL member countries in the event of a disaster. See http://www.interpol.int/contentinterpol/search?SearchText=FASTID&x=0&y=0

[<2013d] [2013a>]

FD-249

The FD-249 is an Arrest and Institution Fingerprint card (white card with red ink) used for criminal submissions to the FBI and certain other law enforcement organizations. See http://www.fbi.gov/about-us/cjis/forms/description-fd249

FD-258

The FD-258 is the Applicant Fingerprint Card (white card with blue ink) used for submission to the FBI and certain other law enforcement organizations as part of a background check. See http://www.fbi.gov/about-us/cjis/forms/description-fd258

[<2013a]

fingerprint

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

FAP

Acronym for Fingerprint Acquisition[12] Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to fingerprint acquisition. [2015a>] In the *Mobile ID Best Practices Recommendations Version 1*, face, finger and iris application profiles were all referred to as SAP. They are referred to separately in this standard. This was changed in *Mobile ID Best Practices Recommendations Version 2* to be consistent with this standard. [<2015a]

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).

[12] [2013a>] In the 2011 version this was labeled Fingerprint Application Profile. For consistency with SAP, it is now called an acquisition profile. [<2013a]

Frankfurt horizon

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 includes four full finger view images: one rolled; left, center, and right plain.

[2013n>]

GENC

Acronym for Geopolitical Entities, Names and Codes, which is the United States Government profile of the *ISO 3166* standards. This reflects the United States (U.S.) Government requirement to use names of countries, dependencies, areas of special sovereignty, and administrative subdivisions that have been approved by the U.S. Board on Geographic Names (BGN), the authority established under Public Laws 80-242 to provide for uniformity in geographic nomenclature and orthography throughout the Federal Government. GENC is available at https://nsgreg.nga.mil/genc/registers.jsp

[<2013n]

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.

[2013v>]

Hz

Abbreviation for Hertz, which is the measure of the frequency of oscillations. It is the fundamental property of sound that determines pitch.

[<2013v] [2013a>]

IAFIS

Acronym for the Integrated Automated Fingerprint Identification System of the FBI.

[<2013a]

IAP

Acronym for Iris Acquisition Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to iris acquisition. [2015a>] In the *Mobile ID Best Practices Recommendations Version 1*, face, finger and iris application profiles were all referred to as SAP. They are referred to separately in this standard. This was changed in *Mobile ID Best Practices Recommendations Version 2* to be consistent with this standard. [<2015a]

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.

[2013v>]

interlocutor

A person who takes part in a dialog (Oxford English Dictionary Thumb Edition, 10th Edition, 2002). In Record **Type-11,** an interlocutor is any speaker in the recording who is not the subject of the *ANSI/NIST-ITL* transaction. An interlocutor may be the subject of the record, within the transaction, however.

[<2013v]

INTERPOL

International Criminal Police Organization.

INT-I

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

[2013v>]

IPA

International Phonetic Alphabet

[<2013v]

IREX

Iris Exchange Program. This is a program at NIST in support of iris-based applications based on standardized interoperable iris imagery. See http://www.nist.gov/itl/iad/ig/irex.cfm

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. See http://www.nist.gov/itl/

IUPAC

International Union of Pure and Applied Chemistry. See http://www.iupac.org

JFIF

JPEG File Interchange Format. See http://www.jpeg.org

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.

[2013v>]

known voice signal

A voice signal from an individual who has been "identified", or individuated in a way that allows linking to additional, available information about that individual.

[<2013v]

(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

[2013v>]

linear PCM

Linear pulse code modulation is a digital encoding methodology for audio waveforms based upon amplitudes of the signal.

[<2013v]

locus (plural loci)

A unique physical location on the DNA molecule.

[2013a>]

lux

The unit of illuminance and luminous emittance, measuring luminous flux per unit area. It is equal to one lumen per square meter

[<2013a]

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.

[2013a>]

metadata

Documentation relevant to the biometric data, but not the biometric data itself. Metadata may include both signal/sample-related and content-related information. Examples are the format of the data file, such as WAV and the scope of accreditation of a DNA processing laboratory.

[<2013a]

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, palm print, 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

[2013d>]

morphological tooth numbering

Assignment of tooth numbers based upon the shape of the teeth. This is in contrast to **positional tooth numbering**, which assigns a tooth number based solely upon position, and does not consied the shape of the tooth. For most cases, the tooth number assignment would be the same. Differences arise only in unusual cases.

[<2013d] [2013v>]

MP3

An encoding format commonly used for audio recordings. It is also called MPEG-1 or MPEG-2 Audio Layer III. It has used the file extension '.mp3' since 1995.

[<2013v] [2013d>]

MRI

Magnetic resonance imaging.

[<2013d]

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.

[2013d>]

NamUs

The National Missing and Unidentified Persons System, which is a national repository for missing persons and unidentified decedent records. It is operated by the National Institute of Justice. See www.namus.gov.

[<2013d]

NCIC

National Crime Information Center of the FBI.
See www.fas.org/irp/agency/doj/fbi/is/ncic.htm

[2013d>]

NEMA

The National Electrical Manufacturers Association.

[<2013d]

NFIQ

NIST Fingerprint Image Quality. See www.nist.gov/itl/iad/ig/bio_quality.cfm.

[2013a>]

NGI

The FBI's Next Generation Identification, which provides an incremental replacement of IAFIS technical capabilities, while introducing new functionality.

[<2013a]

NIEM

National Information Exchange Model. It is a partnership of US Federal agencies. 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.

[2013n>]

NIEM biometrics domain

One of the subject-matter domains of NIEM. It was established in July 2012 to support biometric-related alignment of XML standards. The Biometric domain develops a standardized data model and code lists that form the foundation of the biometrics schema within NIEM. The ombudsman of the NIEM biometrics domain is the convener of ANSI/NIST-ITL, according to its charter.

[<2013n]

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.

[2013a>]

non-negative integer

The range of integers including zero and those greater than or equal to 1.

[<2013a] [2013d>]

non-photographic image

For purposes of this standard, it is any image or model that is other than defined as a **photographic image**. A photographic image is conveyed in a **Type-10** record. A **non-photographic image** is conveyed in a **Type-22** record. Non-photographic images can include (but are not limited to) such diverse items as 3D point cloud representations of the face, radiographs, sonograms, PET scans and 3D orthodontic models. Note that 2D iris images are handled in **Type-17** records and 2D friction ridge images in **Type-4, Type-13, Type-14, Type-15** and **Type-19** records; they should not be included in a **Type-22** record.

odontology

Forensic dentistry – a specialized discipline in dentistry to identify individuals based upon characteristics of their dentition and oral region.

[<2013d]

[2015a>]

OSAC

The Organization of Scientific Area Committees is part of an initiative by NIST and the Department of Justice to strengthen forensic science in the US. The organization is a collaborative body of more than 500 forensic science practicioners and other experts. NIST established OSAC to support the development and promulgation of forensic science consensus documentary standards and guidelines, and to ensure that a sufficient scientific basis exists for each discipline. See www.nist.gov/forensics/osac/index.cfm

[<2015a]

palm print

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

[2015n>]

PAP

Acronym for Palm print Acquisition Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to palm print acquisition.

[<2015n]

pedigree

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

[2013d>]

PET

Positron emission tomography.

[<2013d] [2013v>]

physical medium

Any external storage material of the voice signal and content information in either analog or digital form. Examples include reel-to-reel recording tape, cassette tape, Compact Disc, and phonograph record.

[<2013v] [2013d>]

photographic image

A standard two-dimensional image illuminated and captured in the visible wave lengths (380 to 780 nm). This definition is specific to this standard – other references may refer to images captured using non-visible wavelengths converted to visible wavelengths as photographic images, but they are not so classified for purposes of this standard. A photographic image is conveyed in a **Type-10** record (unless it is an iris image conveyed in **Type-17**, or a friction ridge image conveyed in one of **Types 4, 13, 14, 15,** or **19)**. A non-photographic image is conveyed in a **Type-22** record. Original source images are conveyed in **Type-20** records and non-biometric associated context images are conveyed in **Type-21** records, regardless of the format or source of the image.

[<2013d]

PIV

Personal Identity 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.

[2013d>]

positional tooth numbering

Assignment of tooth numbers based upon the location of the teeth. This is in contrast to **morphological tooth numbering**, which assigns a tooth number based upon position, the shape of the tooth. For most cases, the tooth number assignment would be the same. Differences arise only in unusual cases.

[<2013d] [2013a>]

positive integer

An integer greater or equal to 1. The value 0 is not included in this use of the term.

[<2013a] [2013d>]

postmortem

After death.

[<2013d]

ppi

Pixels per inch.

ppmm

Pixels per millimeter.

[2013d>]

prior data

Data collected when the subject was in a different, previous state/condition than the current state of the subject. Examples are antemortem data, when postmortem data exists or facial images of a missing person that are compared to those of the person being interviewed.

[<2013d]

proximal segment

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

[2013a>]

quality

An ordinal estimate of the usefulness of biometric data for the purpose of automated recognition.

[<2013a] [2013v>]

questioned voice signal

A voice signal from an individual who is unknown and has not yet been linked to any previously encountered individual. Note: The task of speaker identification is to link a questioned voice signal to a known voice signal through determination of a common speaker.

QuickTime

A multimedia framework developed by Apple, Inc. It allows the use of many different codec formats. The native file format for QuickTime video specifies a multimedia container file that contains one or more tracks. Each track either contains a digitally encoded media stream using a specific format or a data reference to the media stream located in another file.

RAW audio format

A format that stores uncompressed audio without header information. The most common file extensions for RAW audio format are '.raw' and '.pcm'.

[<2013v] [2013a>]

RAW image format

A family of file formats, often specific to different models of digital imagery equipment, that are not yet processed for storage in a 'printable' image format such as JPEG or TIFF. The file extension '.raw' is only one such format.

[<2013a]

RCMP

Royal Canadian Mounted Police.

record (n)

A defined set of fields that contain data as defined in this standard.

[2013v>]

record (v)

The act of converting an acoustic voice signal directly from an individual into a storage media, perhaps through contemporaneous, intermediate (transient) signal types. Note: This definition is retained because of its entrenchment in natural language use. Consequently, a record (n) is not recorded, it is created. Transcoding is the term used for further processing of the voice signal and any digital or analog representation of that signal.

[<2013v] [2013a>]

record creation

The act of creating a record contained in an ANSI/NIST-ITL transaction.

[<2013a] [2013v>]

recording (n)

A stored acoustic signal in either analog or digital form.

redaction

Over-writing of segments of a voice signal for the purpose of masking speech content in a way that does not disrupt the time record of the original recording.

[<2013v]

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.

[2013v>]

RIFF

The Resource Interchange File Format is a generic file container format that is sometimes used in audio and video recordings. The most common implementation of RIFF is WAV, which uses the file extension '.wav'.

[<2013v]

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.

[2013v>]

sample (v)

Obtain the values of a function for regularly or irregularly spaced distinct values from its domain. From: *ISO 2382-2:1976*.

[<2013v]

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. [2015a>] In the *Mobile ID Best Practices Recommendations Version 1*, face, finger and iris application profiles were all referred to as SAP. They are referred to separately in this standard. This was changed in *Mobile ID Best*

Practices Recommendations Version 2 to be consistent with this standard. [<2015a]

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.

[2013v>]

snip (v)

Extraction of an audio signal from an original recording in a way that disrupts the continuity and time record of the original recording.

[<2013v]

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.

[2013v>]

speaker

A vocalizing human, whether or not the vocalizations contain speech. An interlocutor might be a synthesized voice, which can be considered a "speaker" within the context of this standard.

speech

Audible vocalizations made with the intent of communicating information through linguistic content. Nonsensical vocalizations with linguistic content will be considered as speech (including singing and chanting). Speech can be made by humans, by machine synthesizers, or by other means.

SPH - sphere

Sphere audio data format. Information is available at ftp://jaguar.ncsl.nist.gov/pub/sphere_2.6a.tar.Z

[<2013v]

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.

[2013a>]

subject of the record

The person to whom the data in the record applies. The subject of the record need not be the subject of the transaction.

subject of the transaction

The person to whom the transaction applies. The subject of a record need not be the subject of the transaction.

[<2013a] [2013d>]

SWGDVI[13]

Scientific Working Group for Disaster Victim Identification.

[<2013d]

SWGFAST[13]

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

[2013v>]

SWG-Voice[13]

Scientific Working Group for Forensic and Investigatory Voice.

[<2013v]

syntactical[14] **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.

[2015n>]

TAP

Acronym for Toe and foot print Acquisition Profile. It is a series of sets of progressively more stringent parameters and requirements relevant to plantar print acquisition.

[<2015n]

tattoo

An indelible image on the skin that was applied to the skin. [2015a>] This is the definition of tattoo as used in **Field 10.003: Image type / IMT**.

Field 10.042: SMT descriptors / SMD breaks this down into subsets, one of which is

[13] [2015a>] The Forensic Science Standards Board was estabilised in 2014. Reporting to it are the Organization of Scientific Area Committees (OSAC). The former SWGs have been transitioned to become OSACs. See www.nist.gov/forensics/osac/index.cfm [<2015a]

[14] [2013e>] Changed 'Syntactic' to "Syntactical' to conform to usage in the document. [<2013e]

also called tattoo. See **Table 71 Type-10 image types** for more detail.[<2015a]

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 indicates 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%.

[2013v>]

track

A path associated with a single read/write head on a data medium.

[<2013v]

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: Traditional encoding**.

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.

[2013v>]

transcoding

Any transfer, compression, manipulation, re-formatting or re-storage of the original data. Transcoding can be lossless or lossy.

[<2013v] [2013d>]

transillumination

Imaging technique with light transmitted through an excised specimen.

[<2013d] [2013v>]

turn

A conversation is a sequence of conversational turns. A turn is when an individual speaks for a continuous period of time. Individual turns from different people may overlap when they speak simultaneously. However, typically a turn is referred to in a question / response environment.

[<2013v]

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 **A**.

URI

Uniform Resource Identifier.

URL

Uniform Resource Locator.

UTC

Coordinated Universal Time.

UTF

Unicode Consortium Standard Transmission Format

[2013d>]

UVIS / UDIM

The Unified Victim Identification System developed by the Office of the Chief Medical Examiner of New York City and its built-in Dental Identification Model.

[<2013d]

valley

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

[2013v>]

voice data file

The digital, encoded file primarily containing the sounds of vocalizations of both speech and non-speech content, convertible to an acoustic signal replicating the original

acoustic signal. A voice data file is extracted from an audio recording, but not all audio recordings contain voice signals and not all voice data is speech. A physical medium, such as a phonograph record, contains a voice signal but is not a voice data file.

voice recording

A signal, stored on a digital or analog medium, of vocalizations containing both speech and non-speech content.

voice signal

Any audible vocalizations emanating from the human mouth, throat and nasal cavity with or without speech content.

[<2013v]

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.

[2013v>]

Windows Media

There are several proprietary formats developed by Microsoft. Windows Media Video (WMV) was developed for Internet streaming applications. Windows Media Audio (WMA) has four distinct codecs: WMA Pro, WMA Lossless, WMA Voice and the original codec also referred to as WMA. The Advanced Systems Format (.asf) is a container format designed for streaming media. The Advanced Stream Redirector (ASX) is a type of XML designed to store a playlist for a multimedia presentation.

[<2013v][2013d>]

WinID

A computer system that uses dental and anthropometric characteristics to rank possible matches for missing persons and unidentified human remains.

[<2013d]

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.[15] [2013a>] For most record types, an individual record generally contains biometric and/or forensic data for a single subject. However, in some cases a record may pertain to multiple subjects, such as a **Type-11** recording with multiple speakers, or a **Type-20** image of evidence with fingerprints from various people. A given transaction may require that all records apply to a single subject, or may contain records from different subjects. Thus, there is a difference between the subject of the transaction and the subject of the record. [<2013a]

A transaction[16] 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 Type is **Type-1**, which is used to describe the transaction. There shall be at least one other record of another 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**

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

[15] [2013a>] The following sentences were deleted for the Update, since Record **Type-11** also allows the counting of the number of individuals speaking in a recording as a valid use for a transaction: "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."[<2013a]

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

limit due to the field size limits specified in the 2007 version (but not the 2008 version). This limit was 3 ASCII[17] 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 the 2011 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 [2013a>] and forensic [<2013a] modalities, and has reserved record identifiers for the possible future addition of other modalities.

Table 3 Record types

Record Identifier	Record Contents
1	Transaction information
2	User-defined descriptive text
3	(Deprecated)
4	High-resolution grayscale fingerprint image
5	(Deprecated)
6	(Deprecated)
7	User-defined image
8	Signature image
9	Minutiae data
10	Photographic body part imagery (including face and SMT)[18]
11	Forensic and investigatory voice data[117]
12	Forensic dental and oral data[117]
13	Variable-resolution latent friction ridge image
14	Variable-resolution fingerprint image
15	Variable-resolution palm print image
16	User-defined variable-resolution testing image
17	Iris image
18	DNA data
19	Variable-resolution plantar image

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

[18] [2013a>] The name of the record is changed from "facial, other body part and SMT image record" to clarify the distinction between **Type-10** records and **Type-22** records, which are added in the 2013 Update [<2013a]

Record Identifier	Record Contents
20	Source representation
21	Associated context
22	Non-photographic imagery[19]
23-97	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.

[2013n>] A new field has been added in the 2013 Update to allow use of alternate reference codes for nations and other geographic areas. This was needed to accommodate the U.S. Government requirement to use the GENC list in lieu of *ISO 3166* when possible. [<2013n]

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

[19] [2013v>] [2013d>] New record types for the 2013 update. [<2013d] [<2013v]

included in each transaction.[20]

[2013n>] It may be desirable in certain transactions to have separate **Type-2** records when dealing with multiple persons whose identities are being used to establish or verify the identity of the subject of the transaction (such as persons already identified in a voice recording). The 2013 Update includes a new field (Note that in **Type-11** records it is an information item associated with segments of a recording), to associate particular record instances with an identity described in a particular instance of a **Type-2** record. The value is the **IDC** of the associated **Type-2** record, which is different from that of the record with the **Type-2 Record cross reference / T2C** contained in it. See **Type-2 Record cross reference / T2C** in Record **Types 10, 11, 12, 18** and **22**. [<2013n]

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.

[2015a>] Newer systems may need to interface with older systems still utilizing **Type-4** records. Therefore, it may be necessary to downsample 1000 ppi images to 500 ppi and transcode to WSQ format prior to transmission in a **Type-4** record. That is permissable and in conformance with this standard. [<2015a]

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.

[20] [2013a>] For an example of the use of multiple **Type-2** records in a transaction, see the description of the LFFS/LFIS transaction type used by the FBI. It is described in the EBTS specifications available at https://www.fbibiospecs.cjis.gov [<2013a]

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. The *Extended Feature Set (EFS)* for latent print markups is included in this record type. There is also a capability to have additional vendor-specified feature sets.

[2013n>] New fields have been added to the EFS in the 2013 Update to facilitate additional functionality. [<2013n]

5.3.10 Type-10 records

[2013a>] **Type-10** image records shall contain and be used to exchange 2D photographic imagery and related metadata. Textual and analytic information pertinent to the digitized image is also contained in this record type. Visible light photography is the basis for **Type-10** image data. [<2013a][2013d>] If non-visible light is required to produce the image, then a **Type-22** record shall be used in lieu of a **Type-10** record (such as infrared or X-ray). It is also possible to send 3D imagery using a **Type-22** record. Other specialized imaging techniques are likewise handled in a **Type-22** record.[<2013d]

[2013d>] The 2013 Update includes modifications to the **Type-10** image record to allow transmission of images of intra-oral origin and images of the oral region of the body and a new field for cheiloscopy (lip prints).

Source images used to derive intra-oral and extra-oral photographs in a **Type-10** record are contained in a **Type-20** record. An example would be a group image including a

smiling person who could be a disaster victim. The mouth region (showing the alignment of the front teeth) could be extracted from that first photograph, be magnified and be transmitted in a **Type-10** record. [<2013d]

5.3.11 Type-11 records

[2013v>] **Type-11** records support the transmission and / or descriptions of audio recordings containing vocalizations by one or more speakers. **Type-11** records support transactions related to detecting and recognizing speakers, extracting speech segments from an audio recording that are attributable to a single speaker, and linking speech segments by speaker. These functions can be accomplished through automated means (computers), human experts, or hybrid human-assisted systems. This standard does not specify which techniques will be used and does not specify the form of the examination report. **Type-11** does not define the transmission of features or models extracted from voice data, but does allow the user to use specific fields to contain such information.

This record type does not support streaming transactions. [<2013v]

5.3.12 Type-12 records

[2013d>] The **Type-12** record shall be used to exchange information concerning an individual's dental or oral characteristics. It is designed to use the lexicon of *ANSI/ADA Standard No. 1058 – Forensic Dental Data Set*.

A **Type-12** record is typically used in conjunction with a **Type-22** record, which can convey dental radiographs and other related imagery useful in forensic dental procedures. **Type-10** intra-oral and extra-oral photographs are also used in conjunction with a **Type-12** record. [<2013d]

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, palm print 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, [2013n>] and / or plain images of the fingertips and thumb tip taken simulatanously for each hand. [<2013n] Most domains and application profiles require information if fewer than 10 fingers were printed. **Type-14** 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 palm prints.

5.3.16 Type-16 records

The **Type-16** image record is designed for developmental purposes. This record shall contain and be used to exchange image data together with textual information fields pertinent to the digitized image. [2013n>] The **Type-16** record shall not be used for images that can be specified or described in any other record type in this standard. [<2013n] 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. [2013a> An example of the use of a **Type-16** record is transmission of an image of a subject's ear or of the subject's elbow creases. These images may be useful in establishing or verifying identity, but there are no specific fields in any existing record types of this standard to characterize the features of these images. [<2013a]

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 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.

5.3.18 Type-18 records

The **Type-18** record 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*.[21] 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 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 shall contain the source representation(s) from which other Record Types are 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

[21] [2013a>] ISO finalized its DNA data interchange standard in March, 2013. It is *ISO/IEC 19794-14:2013* and is available at www.iso.org [<2013a]

images are segmented, rescaled and gray-scaled for 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 [2013a>] after being cropped from the fused image which is stored as an original source image in a **Type-20** record. [<2013a]

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-22 records

[2013d>] The **Type-22** record is designed to transmit forensic imagery and associated data that is not included in the **Type-10** record – which contains 2D visible light (380-780 nm) images. This record type is used for imagery data, replicating data or any of the raw data that can be used to render the imagery data or 3D replicating data. **Type-22** images may be very useful in Disaster Victim Identification incidents and for the identification of Unknown Deceased or living persons unable to identify themselves (such as an amnesiac or a person in a coma). Note that 2D iris images are handled in **Type-17** records and 2D friction ridge images are handled in **Type-4, Type-13, Type-14, Type-15** and **Type-19** records; they should not be included in a **Type-22** record.

Type-22 record images and raw data can be generated from many types of sources and instrumentation, including imagery obtained via an illuminative, transilluminative, reflective or transmitive process using radiation or nuclear sources, and / or those images relying upon sonic, ultrasonic or positronic instruments. **Type-22** records shall be used for non-iris and non-friction ridge images if alternative lighting (such as ultra-violet or infra-red light) is required to produce the image. Examples of **Type-22** imagery data include (but are not limited to) the images and or the raw data for all 2D and 3D radiographs, CT scans, cone beam scans, PET Scans, MRI scans, data for 3D printing (such as used for orthodontic cast models), fiber-optic angioplasty, and sonograms. Note that still images, video and sequential / combined imagery is allowed in this record type as long as the data format is properly specified.

This record type may also be used to transmit electronic medical records, such as those stored in conformance with the DICOM standard. The format of the data is specified in the record and the data may be included directly in the record or the record may reference an external storage location.[<2013d]

5.3.23 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.

5.3.24 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)[22].

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 to a newer version of the standard.

[2013a>] **Type-1** records are required in all transactions. Since a receiving agency may have software installed that is based upon a previous version of the *ANSI/NIST-ITL* standard, the only modifications allowed to **Type-1** are new fields that may be added to the end of the record (in Traditional encoding). Systems should be designed to ignore information items, subfields, fields and records that they were not designed to recognize and process. [<2013a]

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***.' The deprecated record type, field, or information item is not included in the updated version of the standard. Deprecated records [2013a>] from versions of the standard prior to 2011 [<2013a] are **Record Types 3, 5 and 6**. **Field 17.018** is deprecated. There are two deprecated values

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

[2013a>] from the 2007 and 2008 versions of the standard [<2013a] 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**.[23]

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. [2013a>] Normally, the rule is that once an item is mandatory, it remains mandatory. However, there have been some exceptions made in order to respond to the operational needs of the canvassees. All such cases are clearly highlighted in the text of the standard. [<2013a]

Some fields and information items were made optional in the 2011 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** was made [2013a>] dependent (optional **if** it is indicated that the body part is amputated or unable to be captured). [<2013a]

[2015n>] In 2015, **Field 10.999: Body part image / DATA** in **Record Type 10** was made dependent upon whether **Field 10.994: External file reference / EFR** occurred in the record – thus allowing the storage location of the image to be referenced rather than being required to be transmited in the record. This same type of change was introduced to **Type-13, Type-14, Type-15** and **Type-19**.[<2015n]

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)[24]

[23] [2013a>] The 2011 Version also allows a ***legacy*** value of 1 for the **character encoding index / CSI** in **Field 1.015: Character encoding / DCS**. This had been specified in the 2007 and 2008 versions of the standard as '8-bit Latin'. [<2013a].

[24] [2013a>] Note that the code definition for 'Alphabetic' is modified to not include spaces. Spaces are listed as Special Characters (code S) in the three fields affected: **10.023**, **10.026,** and **10.040**. This was done to conform to the standard programming definition of alphabetic characters being limited to the letters of the English alphabet. The character codes in **Table 70**

- 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 □, ο□, Å, ϒ, ж, □, □, 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.

[2013a>] The special characters “STX”, “ETX”, “FS”, “GS”, “RS”, and “US” are reserved and shall not be included in any data (except data marked as character type B). See **Section 5.6**, **Annex A: Character encoding information**, and **Annex B: Traditional encoding.** The remaining control characters should not be used (except data marked as character type B). These characters are: NUL, SOH, EOT, ENQ, ACK, BEL, BS, HT, LF, VT, FF, CR, SO, SI, DLE, DC1, DC2, DC3, DC4, NAK, SYN, ETB, AN, EM, SUB, ESC and DEL. [<2013a]

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 128** with the exception of the reserved values.

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

Type-10 record layout for these two fields were changed to AS, with the special character listed as a space. [<2013a]

0	ASCII	7-bit (Default) with zero added in high bit position (See **Annex A: Character encoding information**)
2	UTF-16 [25]	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 do not require the use of 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: Character encoding / DCS**. See **Annex C: NIEM-conformant encoding rules**.

6 Implementation domain and application profiles

[25] 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.

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. **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 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 [2015a>](**xx.001**) contains the record length in bytes (including all information separators) and has a mnemonic of LEN. Table 5 lists the minimum and maximum permitted lengths of the field in Traditional encoding. In NIEM-conformant XML encoding, this field contains the *RecordCategoryCode*, which is the numeric representation of the Record Type.

Table 5 Record header field restrictions

Record Type	Minimum Field Length	Maximum Field Length
1	1[26]	Unrestricted
2	1	Unrestricted
4,7,8	4[27]	4[27]

[26][2015a>] In cases where there is no minimum specified, 1 is used since there must be some data present for the field to be specified. [<2015a]

[27] [2015a>] For binary types, the length refers to the number of bytes, not characters. [<2015a]

Record Type	Minimum Field Length	Maximum Field Length
9	2	Unrestricted
10 and above	2	8 characters

[<2015a]

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. [2013a>] It does not appear in **Type-18** or **Type-98**. In many record types it is possible for **Field xx.999** to be optional if **Field xx.994** is present, which states the external storage location of the data. [<2013a] [2013d>] In **Type-12** records, the field **Field 12.999: Dental chart data / DATA** is only present if the information item **dental history ADA reference code / HARC** in **Field 12.009: Dental history data detail / HDD** has been set to indicate the presence of a dental chart in the record. [<2013d].

[2015n>] In **Type-14**, **Type-15** and **Type-19** records, neither **Field xx.994** nor **Field xx.999** need appear if the field **Amputated or bandaged / AMP** in that record has a value of "UP". [<2015n]

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. [2013a>] There may be no gaps in numbering the **IDC** values; that is, they must be sequential. However, there is no requirement that the values must be in increasing numeric order. The only restrictions on order is that the **Type-1** record shall be the first record in the transaction, and that the records must appear in the order indicated in **Field 1.003: Transaction content / CNT.** The restriction on the upper limit [<2013a] 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.

Pointer indexes are used in the standard, such as to a Source Representation record (**Type-20**) and another index to one or more Associated Context records (**Type-21**). [2013n>] Another pointer exists to relate a particular instance of a record to a specific **Type-2** record. [<2013n]

- 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 **Field 21.021: 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.

- The third index (to a **Type-2** record) is described in **Section 7.3.1.1**. It is stored in **Field xx.992,** which is an optional field.

There are two fields that contain indexes to link 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**[28]. The value of the **IDC** shall be a sequentially assigned integer starting from zero and incremented

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

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. [29] Multiple images of a face, encoded in Record **Type-10**, 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, palm prints, 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** palm print 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.

[29] [2013a>] When down-sampling a fingerprint image from 1000 ppi to 500 ppi, the guidance provided in NIST Special Publication 500-289 should be followed in order to produce a 500 ppi image with the minimal effect on the image contesnts and quality (It is available at http://www.nist.gov/publication-portal.cfm Enter "500-289" in the 'Simple text search' to retrieve the document). [<2013a]

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.

7.3.1.1 Type-2 Record cross reference / T2C

[2013n>] This field exists in Record **Types 10, 12, 18** and **22**. It is used to link an instance of a record type to a particular **Type-2** record when multiple **Type-2** records for different individuals are contained in a single transaction. In a **Type-11** record, this cross-reference is an information item placed in **Field 11.037: Vocal segment speaker characteristics / SCC** in order to refer to the speakers in a specific segment of a recording.

The value for **T2C** is the **IDC** of the **Type-2** record pertaining to the subject of that particular record instance.

Field 10.992: Type-2 Record cross reference / T2C

Field 12.992: Type-2 Record cross reference / T2C

Field 18.992: Type-2 Record cross reference / T2C

Field 22.992: Type-2 Record cross reference / T2C

[<2013n]

7.3.2 Source representation / SOR

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.** [2013d>] Record **Type-12** also does not have **SOR**, since the only data that can reside in **Field 12.999: Dental chart data / DATA** is not biometric data. [<2013d] 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 illustrates 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 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

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. There may be multiple instances of associated context records associated with a single biometric sample. **Figure 2** illustrates relationships 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 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**. 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. 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

There are several capabilities to record operations performed to process the biometric sample.

7.4.1 Annotation information / ANN

Optional field **xx.902** is used to store annotation, logging, or processing information associated with one or more processing algorithms, [2013a>] processes [<2013a] 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[30] identifying the name and version of the processing algorithm / application / process or workstation. [2013a>] This may also be a name of a process or procedure, such as placing teeth found with a skeleton into a jaw. [<2013a]
- The third information item (**algorithm owner / OWN**) shall contain text of up to 64 characters listing the organization that developed / maintains the processing algorithm / application or latent workstation. [2013a>] When there is no 'algorithm owner' (such as the case of placing teeth into a jaw) enter N/A. [<2013a]
- The fourth information item (**process description / PRO)** shall contain text describing a process or procedure applied to the sample in this **Type-XX** record. [31]

[2013a>] Some examples of annotations are:

- Markup of latent friction ridge image using the universal latent workstation (ULW):

  > GMT = 2013-08-01T02:23:44Z (in XML notation)

  > NAV = ULW 2011

  > OWN = FBI

  > PRO = Used ULW Comparison Tool (CT) to prepare **Type-9** input. Original image in **Type-13**.
- Indicating the pre-processing of an audio file and related data for **Type-11**:

  Subfield 1:

[30] [2013n>] In 2011, this text was limited to 64 characters. That restriction has been removed. [<2013n]

[31] [2013n>] This was limited to 255 characters in 2011. That upper limit has been eliminated. [<2013n]

> GMT = 2013-02-04T15:23:02Z (in XML notation)

> NAV = GarageBand '11

> OWN = Apple

> PRO = Edited out when helicopter flew overhead.

Subfield 2:

> GMT = 2013-02-04T17:02:00Z (using XML notation)

> NAV = Manual translation

> OWN = N/A

> PRO = Transcript in English developed manually. Based upon transcript of discussion in English, manually translated into Spanish. [<2013a]

7.4.2 Universal latent workstation (ULW) annotation information / LAI

This optional field 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** prior to the 2011 version of this standard. **Field 9.901: Universal latent workstation annotation information / ULA** records 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. 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 [2013a>] with a 126 character maximum [<2013a] 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

[2013v>] [2013d>] The comment field for **Types 11, 12 and 22** are unrestricted in size.

Field 11.051: Comment / COM

Field 12.020: Comment / COM

Field 22.020: Comment / COM [<2013d] [<2013v]

7.5 Data Protection

7.5.1 Information assurance

The **Record Type-98: Information assurance record** 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 **Field 98.200-899: User-defined fields / UDF**.

7.5.2 Data hash / HAS

Optional field **xx.996** is designed for use in Record **Types 10 and above** that have a **Field xx.999** [2013a>] or a **Field xx.994** (if it exists for that record type), which is used to indicate the location of digital data stored external to the transaction. [<2013a] **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. 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:

- **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**.

[2013v>] **Field 11.005: Voice recording source organization / VRSO** contains information about the site or agency that created the voice recording referenced in the record. It may be different from the **Field 11.004: Source agency / SRC** and the **Field 1.008: Originating agency identifier / ORI**.[<2013v]

[2013n>] **Field 12.047: Capture organization name / CON** describes the group or organization that collected the forensic dental data, such as a disaster recovery team. That group may be different from the group that created the record (**Field 12.004: Source agency identification ID / SRC)** and from the **Field 1.008: Originating agency identifier / ORI**. **Field xx.047** has also been added to Record **Types 10, 11, 18** and **22**. [<2013n]

7.7 Metadata describing the biometric sample

7.7.1 Biometric acquisition device identification

Several record types contain fields describing the biometric acquisition device[32]:

[32] 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.

7.7.1.1 Device unique identifier / DUI

The **DUI** shall contain a string uniquely identifying the device or source of the data[33]. This field shall be one of:

- Host MAC address, identified by the first character "M"[34], 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
[2013d>] **Field 22.903: Device unique identifier / DUI** [<2013d]

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

[33] 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.
[34] 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.

[2013d>] **Field 22.904: Make/model/serial number / MMS** [<2013d]

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 6.** 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 6 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

7.7.1.4 Medical device information / MDI

[2013d>] **Field 21.006: Medical device information / MDI** is designed to transmit information concerning medical devices found on or with an unidentified person. It is contained in record **Type-21** since it is not a biometric, but is nonetheless of value in the identification process.[<2013d]

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: Traditional encoding** and **Annex C: NIEM-conformant encoding rules**).

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 (00 through 59); and ss represents the seconds (00 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.[2015a>] The local date and time is recorded as YYYYMMDD for Traditional encoding and YYYY-MM-DD for XML.

It may not be possible to know the exact date of imagery capture. In such a case, specify the date to the level known. For traditional encoding, fill the unknown portions of the date with zeros. For XML, use a date element with the correct level of precision. The fields where zeros are allowed are:

Field 10.005: Photo capture date / PHD

Field 12.006: Dental subject information / DSI

Field 20.005: Source representation date / SRD

Field 21.005: Associated context date / ACD

Field 22.003: Imagery capture date / ICD

[<2015a]

7.7.2.4 Local date & time

[2015a>] The local date and time is recorded as YYYYMMDDhhmmss for Traditional encoding and YYYY-MM-DDThh:mm:ss for XML. 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.

It may not be possible to know the exact date and time of imagery capture. In such a case, specify the date and time to the level known. For traditional encoding, fill the unknown portions of the date and time with zeros. For XML, use a date and time element with the correct level of precision. [<2015a]

7.7.2.5 Time index / TIX – measured in milliseconds

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.

7.7.2.6 Relative start time / RST, relative end time / RET and voice recording time / TIM -- measured in microseconds

[2013v>] In Record **Type-11, Field 11.022: Redaction diary / RDD, Field 11.024: Discontinuities diary / DCD** and **Field 11.026: Vocal content diary / VCD** have information items **relative start time / RST** and **relative end time / RET** that are encoded in microseconds**.** These information items indicate the time in microseconds from the beginning of the voice recording to the start and end, respectively, of the snip. These information items may contain integers of up to 11 digits.

Field 11.011: Total recording duration / TRD has an information item **voice recording time / TIM** that is measured in microseconds. It also is an integer of up to 11 digits. [<2013v]

7.7.2.7 Date offset

[2015a>] This is a date measurement representing an offset from a specific date. The format is handled differently in each encoding. See **B.1.5 Date offset** and **Annex C: NIEM-conformant encoding rules.**

7.7.2.8 Date and time offset

This represents an offset from a particular date and time. The format is handled differently in each encoding. See **B.1.6 Date and time offset** and **Annex C: NIEM-conformant encoding rules.** [<2015a]

7.7.3 Geographic sample acquisition location / GEO

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. [2013v>] Record **Type-11** contains a field, **Field 11.032: Vocal segment geographical information / SGEO** that resembles **GEO.** The information items in **SGEO t**hat are in addition to those of **GEO** are:

segment identifiers / SID

segment cell phone tower code / SCT

The following refers to the order of the standard information items for the field**.** [<2013v]

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 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. [2013a>] Also, "seconds" values [<2013a] **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 are:
    - 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, [2013a>] since **LTS** may be expressed as an integer (without a decimal) or as a real number including decimals [<2013a]. 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 are:

- 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 [2015e>] 0 (inclusive) [<2015e] 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, [2013a>] since **LGS** may be expressed as an integer (without a decimal) or as a real number (including decimals) [<2013a]. 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**[35]. 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 7** for values.

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**[36]. 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

[35] 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

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

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[37] (Military Grid Reference System)
  - USNG[37] (United States National Grid)
  - GARS[37] (Global Area Reference System)
  - GEOREF[37] (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.** [2013a>] It shall only be present if **OSI** is present in the record and **OSI** is set to LANDMARK. **OCV** is free text and may be up to 126 characters. [<2013a] For details on the formatting of **OCV** for the other coordinate systems shown in **OSI** as examples, see **Table 7 Geographic coordinate datum code values.**

Table 7 Geographic coordinate datum code values

Geodetic Datum Code	Value
Airy	AIRY
Australian National	AUST
Bessel 1841	BES

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

Geodetic Datum Code	Value
Bessel 1841 (Namibia)	BESN
Clarke 1866	CLK66
Clarke 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 8** for how the friction ridge sample was collected.

[2015n>] In 2013 and earlier versions of this standard, this field indicated both the impression types and capture technology: now this field retains the impression types but capture technology is indicated in Friction ridge capture technology (FCT), as described in section **7.7.4.5** (**Table 11**). Values from previous versions of this standard for impression types are still allowed for use but are considered to be 'legacy'. For example, the legacy value 21 indicated a rolled fingerprint using an optical livescan; now this would be indicated using IMP=1 (rolled contact) and FCT=3 (optical bright field TIR livescan. For a full list of those legacy values, see **Table 7 Geographic coordinate datum code values** of the 2013 Update of the standard. Note that the legacy values ranged from 0 to 39. This updated table includes new codes for exemplar prints captured from moving subjects (codes 41 and 42). [<2015n]

Table 8 Friction ridge impression types

Exemplar Prints		
Contact Impressions		
Plain Contact	0	Finger(s) presented on platen or paper without rolling
Rolled Contact	1	Finger rolled on platen or paper
Live-scan swipe[38]	8	Finger swiped on platen
Contactless Acquistions		
Plain contactless – stationary subject	24	Finger(s) / palm / plantar presented stationary, in view of a stationary sensor and sensor captures plain contact equivalent.
Rolled contactless – stationary subject	25	Finger(s) / palm / plantar presented stationary, in view of a stationary sensor and sensor captures rolled equivalent.
Rolled contactless – moving subject	41	Finger(s) / palm / plantar move through the capture volume of a sensor and sensor captures rolled equivalent.
Plain contactless – moving subject	42	Finger(s) / palm / plantar move through the capture volume of a sensor and sensor captures plain equivalent.
System integration exceptions		
Other	28	
Unknown	29	
Latent prints		
Latent image	4	Image or impression of friction skin deposited on a surface

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 9** specifies recommended MAXIMUM width and height. (Individual implementation domains and application profiles may use different values). In versions of this standard prior to 2011, **FGP** was used for finger position, and **PLP** for palm print position. They are now in one table, along with the codes added in the *ANSI/NIST-ITL 1a-2009 amendment*. 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.** [39]

[2013a>] Codes 11, 12, 13, 14, 15 and 40-54 do not apply to latent prints. In addition, Code 19 is not used in the Extended Feature Set of Record **Type-9**. **Field 9.134: M1**

[38] [2015a>] Renamed to "live-scan swipe" to harmonize with ISO. [<2015a]

[39] [2013a>] Deleted unclear paragraphs that followed this text in the base 2011 text [<2013a]

friction ridge generalized position / FGP uses codes 1-10 and does not allow multiple finger, unknown print, extra digit, palm or plantar codes in order to maintain consistency with *INCITS 178*. [<2013a]

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.

Table 9 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 finger	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[40]	16	40.6	1.6	38.1	1.5
Left extra digit[40]	17	40.6	1.6	38.1	1.5

[40] 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 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.

Finger Position	Finger Code	Max Width (mm)	Max Width (in)	Max Height (mm)	Max Height (in)
Unknown **friction ridge**[41]	18	139.7	5.5	213.0	8.5
EJI or tip	19	114.3	4.5	127.0	5.0

Palm Position Codes [41]

Palm Position	Palm Code	Max Width (mm)	Max Width (in)	Max Height (mm)	Max Height (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
Right full palm, including writer's palm[42]	83	165.0	6.5	213.0	8.5
Left full palm, including writer's palm[42]	84	165.0	6.5	213.0	8.5
Right wrist bracelet[43]	85	165.0	6.5	213.0	8.5

[41] [2015a>] Code 18 applies to all friction ridge types and is technically not solely a "Finger Code" [<2015a]

[42] The subject's hand is rolled so that the full palm and writer's palm are captured in a single impression. [2013e>] the mm entry had a typo in the original 2011 version [2013e]

Palm Position	Palm Code	Max Width (mm)	Max Width (in)	Max Height (mm)	Max Height (in)
Left wrist bracelet [43]	86	165.0	6.5	213.0	8.5

Plantar Position Codes [41]

Plantar Position	Plantar Code	Max Width (mm)	Max Width (in)	Max Height (mm)	Max Height (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[44]	78	139.7	5.5	152.4	6.0
Left middle of foot[44]	79	139.7	5.5	152.4	6.0

Table 9 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 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

[43] [2013n>] Added in 2013 Update [<2013n]

[44] The codes for the middle of the feet correspond to the arch and/or outside (fibular hypothenar) areas of the feet.

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)	Min Width (in)	Min Height (mm)	Min Height (in)
2-Finger Combinations Note code 15					
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
4-Finger Combinations Note codes 13 & 14					
Fingertips [43] (4 fingers simultaneously – no thumb – right hand - plain)	51	81.3	3.2	76.2	3.0
Fingertips [43] (4 fingers simultaneously – no thumb – left hand - plain)	52	81.3	3.2	76.2	3.0
5-Finger Combinations					
Fingertips [43] (4 fingers and thumb simultaneously – right hand - plain)	53	81.3	3.2	76.2	3.0

Finger position	Finger code	Min Width (mm)	Min Width (in)	Min Height (mm)	Min Height (in)
Fingertips [43] (4 fingers and thumb simultaneously – left hand - plain)	54	81.3	3.2	76.2	3.0

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), [2013a>] rolled [<2013a] extreme tip (TIP), [2013n>] or flat extreme tip (TPP) [<2013n] 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 10** 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 9**. 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 9** 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 10** 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" [2013n>] or "TPP" (used in **Type-14** only)[45] [<2013n]. **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

[45] [2013n>] For latent prints, TIP has been used historically for any type of impression of a fingertip. This has been maintained for backwards compatibility in **Type-13** records. However, in **Type-14** records, TPP is specified for use as plain impressions and TIP for rolled fingertip exemplars (which were the only types of fingertip exemplars allowed prior to the 2013 Update). [<2013n]

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.** It 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 10 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 image (Type-14) ; latent fingertip (Type-13) [46]	TIP
Plain tip image [47] (Type-14 only)	TPP
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	

[46] [2013a>] These are the same conditions as existed in versions prior to the 2013 Update; this just makes the restrictions explicit. [<2013a]

[47] [2013n>] New in 2013 Update to allow fingertip plain impressions as exemplars. [<2013n]

Type of Image	Image Code
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 /hypothenar areas of the palm.

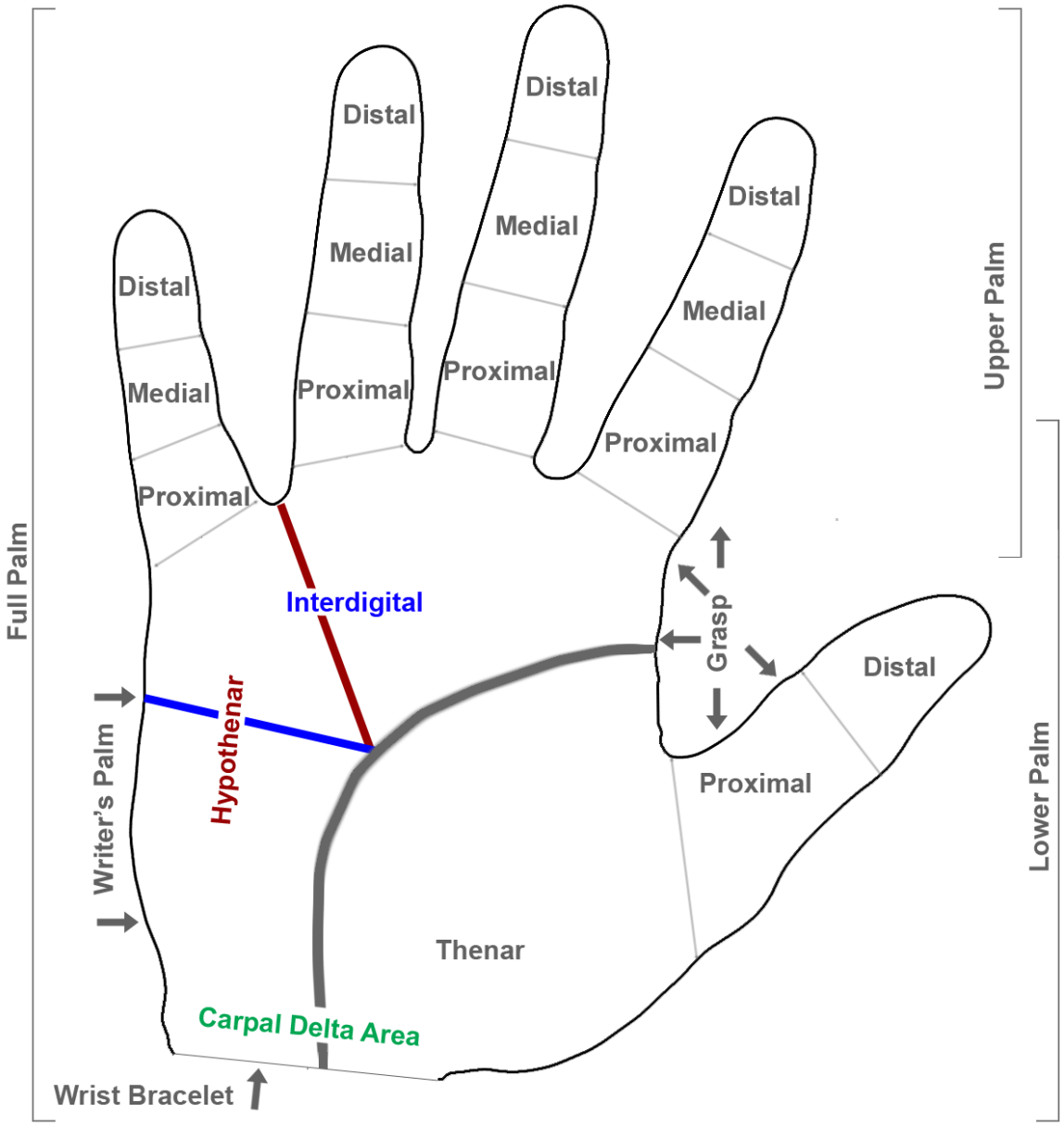
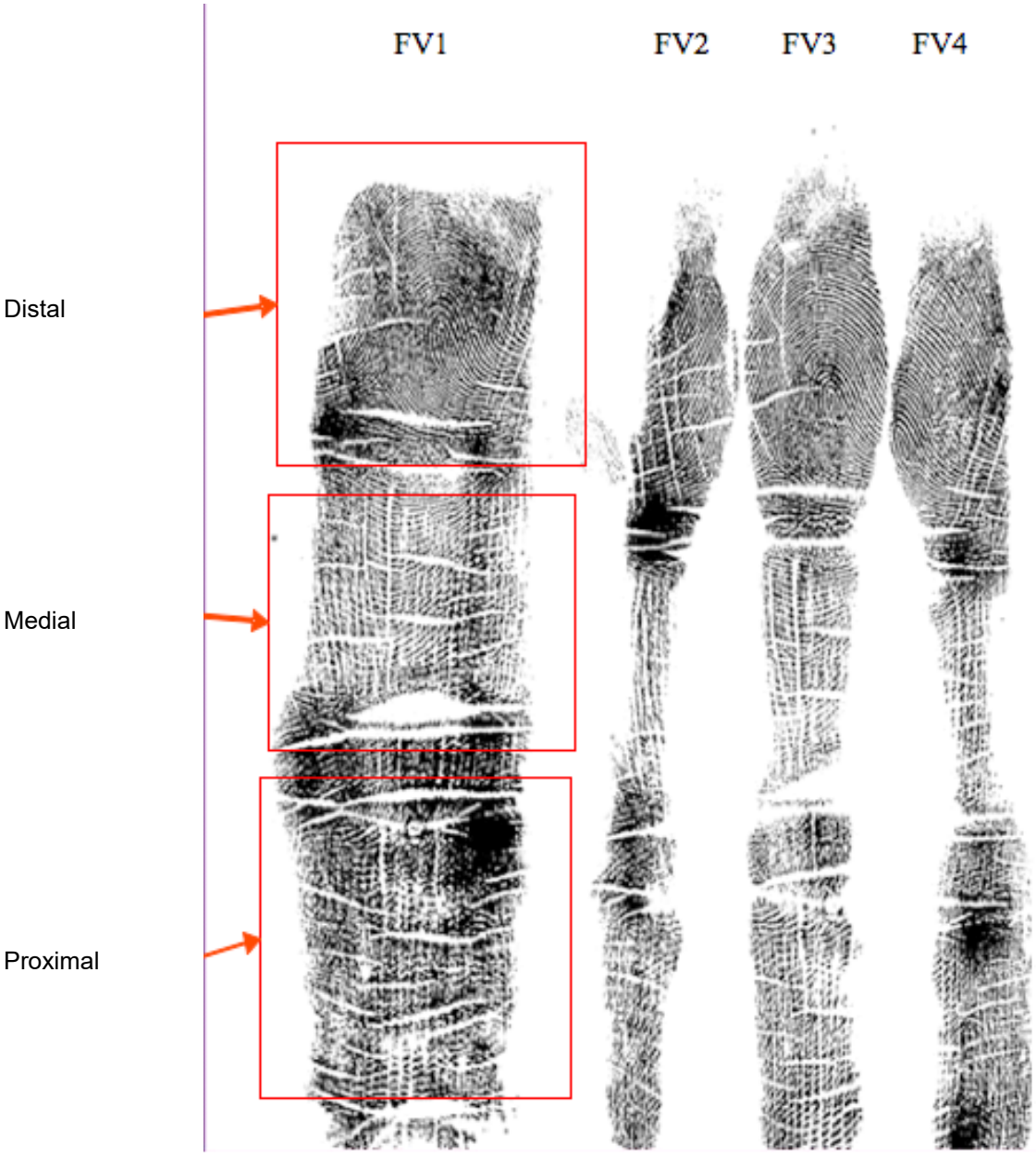


Figure 4: Entire joint image



[2015n>]

7.7.4.5 Friction ridge capture technology

The codes in **Table 11** can optionally be entered in fields **Field 13.901: Friction ridge capture technology / FCT**, **Field 14.901: Friction ridge capture technology / FCT**, **Field 15.901: Friction ridge capture technology / FCT** and / or **Field 19.901:**

Friction ridge capture technology / FCT. Note that there is no capability to encode this information in a **Type-4** record. In 2013 and earlier versions of this standard, the **IMP** field (**Impression type / IMP** , **Table 8 Friction ridge impression types**) indicated both the impression types and capture technology. Now, the **IMP** field retains the impression types, but capture technology is indicated in the **FCT** fields, new to the 2015 version of the standard.

Table 11 Friction Ridge Capture Technology

Technology	Code	Description
Unknown	0	Capture technology not provided by sensor manufacturer.
Other	1	Capture technology not sufficiently characterized by table.
Scanned ink on paper	2	Ink applied to friction ridge skin,, and then applied to paper, typically with assistance from a trained technician.
Optical – Total Interal Reflection (TIR) – bright field	3	Using optical angle of incidence effects, a contact livescan device captures ridge information such that ridges absorb light, and absence of ridges reflects light back to the sensor (dark ridges on a white background).
Optical – TIR – dark field	4	Using optical angle of incidence effects, a contact livescan device captures ridge information such that ridges reflect light, and absence of ridges absorb light (white ridges on a dark background).
Optical direct imaging - native	5	Light reflected from the friction ridge is imaged, resulting in a light gray on darker gray image. This may be performed contact or contactless, and may incorporate merging images from multiple sensors or rocking or swaying sensors / subjects.
Optical direct imaging – low frequency unwrapped	6	Light reflected from the friction ridge is imaged onto one or more sensors. This may be performed contact or contactless, and utilizes the **low frequency** 3D detail to “unwrap” or project the image texture onto a 2D grayscale image.
3-dimensional imaging – high frequency unwrapped	7	High frequency friction ridge information is collected (optically, acoustically, etc.) and then “unwrapped” to create a 2D image from the 3D point cloud or mesh.
Reserved	8	
Capacitive	9	A contact technology in which the capacitance of the friction ridge skin is assessed via a conducted AC signal.
Capactive – radio frequency (RF)	10	A contact technology in which the capacitance of the friction ridge skin is assessed via a radiated RF signal.
Electro-luminescent (EL) optical direct imaging	11	A contact technology in which the ridges and an alternating current (AC) signal cause an EL panel to emit light which is captured by an imaging system.
Reflected ultrasonic image	12	A contact technology in which the friction ridge reflects ultrasonic energy which is assessed by the sensor.

Technology	Code	Description
Ultrasonic impediography	13	A contact technology in which the absorption of ultrasonic energy is measured by changes in the impedance of a piezo-electric material.
Thermal imaging	14	A contact technology in which the sensor measures the heat reflected from the friction ridge skin in contact with the sensor.
Direct pressure sensitive	15	A contact technology in which the pressure of the fingerprint ridge skin against a material is measured.
Indirect pressure	16	A contact technology in which the pressure of the fingerprint ridge skin against a deformable material is assessed optically to produce a friction ridge image.
Live tape (one time use)	17	A technology in which tape is used on friction ridge skin to collect friction ridge detail and the tape is then subsequently imaged by traditional photography.
Latent impression	18	A capture process in which the digital image of the latent impression is acquired directly from the latent impression, using a scanner or digital camera.
Latent photo	19	Physical photograph of the latent impression subsequently scanned using a flatbed scanner or digital camera.
Latent molded / cast impression	20	A capture process in which a mold / cast is taken from a latent friction ridge and then subsequently a “duplicate” is generated from moldable / printable material and imaged.
Latent tracing	21	An older legacy latent friction ridge capture process in which a hand-drawn or computer-drawn tracing would subsequently be imaged by a flatbed scanner or photographed.
Latent lift	22	A process in which powder or a chemical is applied to a latent friction ridge print, subsequently transparent tape is applied to lift the print from the latent surface, and the tape is then placed on paper to be imaged.

7.7.5 Subject acquisition profile / SAP/ FAP / IAP / TAP / PAP

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, **IAP** for iris records, [2015n>] **PAP** for palm print and **TAP** for toe and foot (plantar).

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. **TAP** is optional in **Type-19** records. **PAP** is optional in **Type-15** records.

The values do not have the same meaning for different modalities. As is explained in the *Mobile ID Best Practice Recommendation, Version 2*[48], a multi-biometric capture

[48] It is available at http://www.nist.gov/itl/iad/ig/mobileid.cfm

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.

For friction ridge images, these profiles may apply to images collected using livescan devices or ink on paper.

[<2015n]

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 12.** The **SAP** codes 32, 42 and 52 were new for the 2011 version of the standard.

Table 12 Subject acquisition profiles for face

Subject Acquisition Profile	SAP Level
Unknown acquisition profile [2015n>] or other source not mentioned in this table [<2015n]	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 (I*SO/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

7.7.5.1.1 Level 0 (Unknown profile)

This level denotes any case when the **SAP** is unknown [2015n>] or from another source [<2015n]. 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.*[49]
- 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.*[49]
- Level-15 denotes a PIV facial image that meets requirements of *Biometric Data Specifications for Personal Identity Verification* defined in *NIST SP 800-76.*[50]

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 –**

[49] [2013a>] Both the 2005 and 2011 version of *ISO 19794-5* are consistent for purposes of SAP Level-13 and SAP Level-14 definition. [<2013a]

[50] [2013a>] This document was updated as *NIST SP 800-76-2* in 2013. The document is available at http://dx.doi.org/10.6028/NIST.SP.800-76-2 . The specifications relevant for SAP 9o9Level-15 did not change. [<2013a]

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 13** 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 13** 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.[51]

[51] 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.

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 13** for the complete requirements for **SAP** level 52.

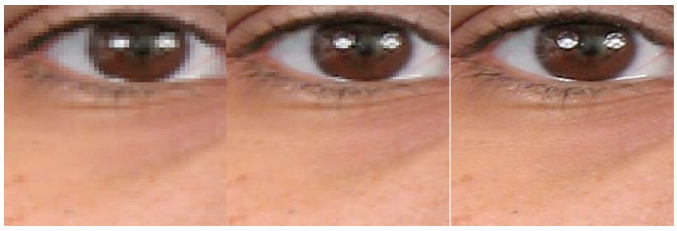


Figure 5: Examples of resolution for face SAP levels 30/32, 40/42, & 50/51/52

Table 13 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	Comments	Levels		
		32	42	52
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 frames per second (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 [2015n>] *Mobile ID Best Practice Recommendation, Version 2.* [<2015n] They are entered in **Field 14.031: Subject acquisition profile – fingerprint / FAP**, which was new for the 2011 version of the standard.

[2015n>] New FAP codes have been included for 1000 ppi devices. Note that JPEG 2000 is required for compression of 1000 ppi images. WSQ was designed for 500 ppi only. FAP codes of 100 or greater are used for 1000 ppi.

The minimum image dimension for FAP 50 has been changed to reflect the marketplace. No devices were made at the previous specification of 2.5" x 1.5". Although technically possible to capture four slap fingers on a FAP 50 device, it requires angling of the fingers, which may be problematic for certain systems. Some application profiles actively discourage slanted fingers, such as the FBI which states "All friction ridge prints should be captured as closely as possible to an upright position."

FAP 45 and higher may be used for images collected using livescan devices or ink on paper. FAP 40 and lower only apply to livescan.

Table 14 Subject acquisition profiles for fingerprint

CAPTURE	FAP 10	FAP 20	FAP 30	FAP 40
Acquire Flat Images	Yes	Yes	Yes	Yes
Acquire Rolled Images	No	No	No	Optional
Minimum Gray Levels	256	256	256	256
Acceptable Image Resolution	500 +- 2%	500 +- 2%	500 +- 2%	500 +- 2%
Minimum Image Dimension (w x h) in inches	.5" x .65"	.6" x .8"	.8" x 1.0"	1.6" x 1.5"
Maximum Compression Ratio	10:1	10:1	10:1	10:1
Compression Algorithm	WSQ 2.0+	WSQ 2.0+	WSQ 2.0+	WSQ 2.0+
Simultaneous # of Fingers	1	1	1	1 - 2
Sensor Certification	PIV	PIV	PIV	PIV

CAPTURE	FAP 45	FAP 50	FAP 60	FAP 145	FAP 150	FAP 160
Acquire Flat Images	Yes	Yes	Yes	Yes	Yes	Yes
Acquire Rolled Images	Optional	Optional	Optional	Optional	Optional	Optional
Minimum Gray Levels	256	256	256	256	256	256
Acceptable Image Resolution	500 +- 1%	500 +- 1%	500 +- 1%	1000 +- 1%	1000 +- 1%	1000 +- 1%
Minimum Image Dimension (w x h) in inches	1.6" x 1.5"	3.2"x 2"	3.2" x 3"	1.6" x 1.5"	3.2" x 2"	3.2" x 3"
Maximum Compression Ratio	15:1	15:1	15:1	10:1	10:1	10:1
Compression Algorithm	WSQ 2.0+	WSQ 3.1+	WSQ 3.1+	JPEG 2000	JPEG 2000	JPEG 2000
Simultaneous # of Fingers	1 - 4[52]	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4
Sensor Certification	Appendix F	Appendix F	Appendix F	Appendix F	Appendix F	Appendix F

[<2015n]

7.7.5.3 Subject acquisition profile for iris / IAP

The profile levels for iris acquisition are entered in **Field 17.031: Subject acquisition profile – iris / IAP.**

[2015n>] A device used to capture iris images shall be based upon near-infrared wavelength capture, approximately 700 to 900 nm. Some systems may use a portion of this range, which is acceptable.

[52]Up to four fingers may be allowed by some systems, if stitched images are acceptable according to the Organization's Application Profile. Some capture units may be capable of taking two images and stitching them into one output image. 2 fingers fit without stitching on one image for this size platen.

Iris image capture devices typically provide infrared lighting using LEDs to illuminate the iris. The illumination is in a range partly visible to the human eye. Illumination shall be compliant with illumination standard *IEC 825-1* and safety specification *ISO 60825-1*. The illumination wavelengths shall have ≥ 90% of energy within the 700-900 nm band; and > 35 % of energy in the 800-900 nm. band.

Many contemporary iris imagers are capable of capturing both left and right iris images simultaneously or quasi-simultaneously (within a few milliseconds). Others only capture one iris at a time. For mobile applications, both images should be captured simultaneously or quasi-simultaneously. This reduces the possibility of mislabeling of the individual images (right or left). It also allows for more accurate estimation of the roll angle and potentially higher accuracy and comparison speed.

In order to achieve acceptable time-to-capture and Failure to acquire (FTA) rates, the iris image sampling frequency must be at least 5 frames per second. The iris image capture sensor shall use progressive scanning. The ability for an iris image capture device to suppress motion blur and to freeze motion, is a function of exposure time. The maximum allowable value for the exposure time, expressed in milliseconds, reduces as Iris acquisition profile (IAP) levels increase, from a maximum of 33 ms. at IAP 20 to a maximum of 10 ms at IAP 40, as shown in **Table 15**. Standard I*SO/IEC 19794-6:2011* adopted the Modulation Transfer Function (MTF) specification of 0.6 with a spatial frequency of 2 cycles / mm.

In order to achieve accurate recognition accuracy, the iris acquisition sensor must achieve a signal-to-noise ratio of at least 36dB.

The new IAP levels state spatial sampling rate instead of minimum pixels. Since a typical iris is 10.2-13.0mm, a sampling rate of 10ppmm would result in an iris diameter of 102-103 pixels, lessthan the minimum requirement for IAP 20. This revision corresponds to I*SO/IEC 19794-6:2011*.

Table 15 Subject acquisition profiles for iris

Capture	IAP 10	IAP 11	IAP 12	IAP 20	IAP 30	IAP 40
Iris Diameter in true, non-upscaled pixels				≥ 140	≥ 170	≥ 210
Spatial sampling rate (pixels / mm)	10	10	10			
Number of (quasi-) simultaneously captured eyes				≥ 1	≥ 1	2
Exposure time	≤ 33 ms	≤ 15 ms	≤ 10 ms	≤ 33 ms	≤ 15 ms	≤ 10 ms

7.7.5.4 Subject acquisition profile for palm print / PAP

The capture of palm print exemplars is similar in concept to that of fingerprints. The principal differences are:

- The area of the print is larger
- The palm is not usually rolled.

This is reflected in the equipment specifications. The minimum platen area is 5.0" x 5.0" corresponding to a PAP 70 level. As with the fingerprint Acquisition Profiles, there are levels corresponding to 500 and to 1000 ppi outputs, with corresponding differences in compression ratio and compression algorithm to be used.

All PAP levels require the ability to capture flat images. Capture of rolled images is optional. The minimum grayscale level is 256.

All PAP levels may be used for images collected using livescan or ink on paper.

Table 16 Subject acquisition profiles for palm print

Capture	PAP 70	PAP 80	PAP 170	PAP 180
Acceptable Image Resolution	500 +- 1%	500 +- 1%	1000 +- 1%	1000 +- 1%
Minimum Image Dimension (w x h) inches	5.0" x 5.0"	5.0" x 8.0"	5.0" x 5.0"	5.0" x 8.0"
Maximum Compression Ratio	15:1	15:1	10:1	10:1
Compression Algorithm	WSQ 3.1+	WSQ 3.1+	JPEG 2000	JPEG 2000

7.7.5.5 Subject acquisition profile for Toe print and plantars / TAP

The capture of toe and sole (plantar) exemplars is similar in concept to that of fingerprints. The principal differences are:

- The area of the print is larger
- The foot is not usually rolled.

This is reflected in the equipment specifications. The minimum platen area is 5.0" x 5.0" corresponding to a TAP 70 level. As with the fingerprint Acquisition Profiles, there are levels corresponding to 500 and to 1000 ppi outputs, with corresponding differences in compression ratio and compression algorithm to be used.

Not included in these basic specifications are others that will be of interest to the procuring agency, including (but not limited to):

- Weight of the unit

· Ability to capture images outdoors (protection from too much sunlight)

· Ability to withstand environmental conditions typical of the conditions in which the unit will be used (dust, heat / cold exposure, humidity, etc.)

· Routine maintenance requirements

All TAP levels require the ability to capture flat images. Capture of rolled images is optional. All TAP levels require the ability to capture flat images. Capture of rolled images is optional. The minimum grayscale level is 256. All TAP levels may be used for images collected using livescan or ink on paper.

Table 17 Subject acquisition profiles for toe and foot (plantar)

Capture	TAP 70	TAP 80	TAP 170	TAP 180
Acceptable Image Resolution	500 +- 1%	500 +- 1%	1000 +- 1%	1000 +- 1%
Minimum Image Dimension (w x h) inches	5.0” x 5.0”	5.0” x 8.0”	5.0” x 5.0”	5.0” x 8.0”
Maximum Compression Ratio	15:1	15:1	10:1	10:1
Compression Algorithm	WSQ 3.1+	WSQ 3.1+	JPEG 2000	JPEG 2000

[<2015n]

7.7.6 Resolution

[2013d>] This section does not apply to **Type-22** imagery. [<2013d]

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 Scanned horizontal pixel scale / SHPS**) and **Scanned vertical pixel scale / SVPS** (See Section **7.7.8.8 Scanned vertical pixel scale / SVPS**)

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 Friction ridge resolution requirement

For Appendix F[53] 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 (495 ppi) and an upper bound of 19.89 ppmm (505 ppi). See **Table 18.** For Personal Identity Verification (PIV)[54] certified devices with fingerprint subject acquisition profile (**FAP**)[55] 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 18**). For example, a class resolution of 19.69 ppmm (500 ppi) has a lower bound of 19.30 ppmm (490 ppi) and an upper bound of 20.08 ppmm (510 ppi). 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 14** for a description of the **FAP** levels.

Table 18 Class resolution with defined tolerance

Certification	Maximum Tolerance	Class Resolution

[53] IAFIS-DOC-01078-9.1 Criminal Justice Information Services (CJIS) *Electronic Biometric Transmission Specification (EBTS)* May 25, 2010 – *Appendix F - CJIS Image Quality Specifications*

[54] Personal Identity Verification (PIV): *Image Quality Specifications For Single Finger Capture Devices*.

[55] [2015n>] NIST Special Publication 500-280 V2, *Mobile ID Device Best Practice Recommendation Version 2.0*[<2015n]

		500	1000
Appendix F	±1%	±5 ppi	±10 ppi
PIV	±2%	±10 ppi	Not Applicable

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

[2015n>] Palm print application profiles, **PAP** are shown in **Table 16 Subject acquisition profiles for palm print** and **TAP** profiles are shown in **Table 17 Subject acquisition profiles for toe and foot (plantar).** Both of them are subject to Appendix F testing.

Note that latent prints in **Type-13** records are not subject to these tolerance restrictions, since they may be generated by several different means, including direct photography. There is no field corresponding to FAP, PAP or TAP for a **Type-13** record.[<2015n]

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. 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.[56] 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 18**). 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**. **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

[56] [2013a>] When down-sampling a fingerprint image from 1000 ppi to 500 ppi, the guidance provided in NIST Special Publication 500-289 (available at http://www.itl.nist.gov/lab/specpubs/sp500.htm) should be followed in order to produce a 500 ppi image with the minimal effect on the image contesnts and quality. [<2013a]

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. [56]

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.

[2013a>] Some quality fields have information items preceding the following three information items. [<2013a]

The first information item [2013a>] of this grouping of 3 [<2013a] 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[57]. Higher values indicate better quality. An 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 [2013a>] of this grouping of 3 [<2013a] 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 [2013a>] of this grouping of 3 [<2013a] shall specify a numeric product code assigned by the vendor of the quality algorithm, which may be

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

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
[2013v>] **Field 11.033: Vocal segment quality values / SQV** [<2013v]
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

[2013d>] This section does not apply to **Type-22** imagery. [<2013d]

[2015a>] For record types where it is possible that an image is unprintable (i.e. if the friction ridge area has been amputated or bandaged), then these values do not appear in the record. [<2015a]

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[58]. [2015a>] For Traditional encoding, the record size is limited by the maximum allowed value for Field xx.001 and the total image size in bytes must be able to be accommodated in that field. [<2015a] See **Section 7.1**.

These are the **HLL** fields:

Field 4.006: Horizontal line length / HLL

[58] 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)

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 [2013>a] pixels contained in a single vertical [<2013a] line 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. [58] 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 field 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.

[2013a>] When using certain formats, such as PNG, conversion from ppm (or other scales) may result in a decimal value. Since these fields require integer values, rounding should be used. For example with the values 1.3, 1.5 and 1.8 the resulting **THPS** values would be 1, 2, and 2. Any value greater than x.0 and less than x.5 would be rounded down to x, regardless of the number of significant digits to the right of the decimal. [<2013a]

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 field 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**.

[2013a>] When using certain formats, such as PNG, conversion from ppm (or other

scales) may result in a decimal value. Since these fields require integer values, rounding up at .5 should be used. For example with the values 1.3, 1.5 and 1.8 the resulting **TVPS** values would be 1, 2, and 2. [<2013a].

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
[2015a>] **Field 17.022: Scanned horizontal pixel scale / SHPS** [<2015a]
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
[2015a>]**Field 17.023: Scanned vertical pixel scale / SVPS** [<2015a]
Field 19.017: Scanned vertical pixel scale / SVPS
Field 20.018: Scanned vertical pixel scale / SVPS

7.7.9 Compression algorithms

[2013d>] This section does not apply to the specialized imagery transmitted in a **Type-22** record. [<2013d] [2013a>] This section provides for a set of acceptable compression algorithms (See **Table 19 Compression codes** below).

Table 19 Compression codes

Code	Label	Algorithm Name	Fidelity	Standard Used
0	NONE	Uncompressed	Lossless	NA
1	WSQ20	WSQ[59] (Wavelet Scalar Quantization)	Lossy	Version 3.1:2010
2	JPEGB	JPEG (Joint Photographic Experts Group)	Lossy	*ISO/IEC 10918, JFIF 1.02:1992*
3	JPEGL	JPEG	Lossless	*ISO/IEC 10918, JFIF 1.02:1992*
4	JP2	JPEG 2000	Lossy	*ISO 15444-1:2004*
5	JP2L	JPEG 2000	Lossless	*ISO 15444-1:2004*
6	PNG	PNG (Portable Network Graphics)	Lossless	*ISO/IEC 15948:2004*

[59] Usage of WSQ 2.0 is allowable for rolled prints. Versions prior to 3.1 shall not be used for other impression types.

Lossy recompression: Only one lossy compression pass is allowable per image. If an image is received in a lossy compressed format, it shall not be uncompressed and re-compressed in the same or different lossy format.

Grayscale: Grayscale images shall be encoded to represent the luminance channel of the image (not pallette-defined grayscale) without an alpha channel. For additional information on Grayscale encoding, see Section **7.7.10.2**.

Color: See Section **7.7.10.3**.

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

Type-4 records use the *code*[60] in **Table 19 Compression codes**. Others record types use the *label*. [<2013a]

7.7.9.1 Use of compression algorithms for friction ridge images

1000 ppi friction ridge imagery (including but not limited to latent imagery, palm and Mobile ID): The specifications in *NIST Special Publication 500-289*[61] shall apply.

500 ppi friction ridge imagery (not including latent imagery): The specification in *WSQ Gray-scale Fingerprint Image Compression Specification Version 3.1* shall apply. The FBI maintains a list[62] of certified WSQ implementations, based upon testing performed at NIST[63].

latent imagery[64]: All latent imagery, [2013a>] if compressed, shall be compressed using a lossless compression algorithm. Uncompressed imagery is recommended for all[65] latent prints. [<2013a]

legacy systems: Legacy systems may use JPEGB or JPEGL for compressing 500 ppi [2015a>] exemplar class images, but no new system shall be built using JPEGB and JPEGL. JPEGB and JPEGL shall not be used for any exemplar class other than 500 ppi. [<2015a]

WSQ caveats: Any certified WSQ software is able to decode images with an encoder certified for WSQ specification versions 2.0, 3.0 or 3.1. **Field 4.008: Compression algorithm / CGA** only allows the *Code* values of 0 and 1 (See **Table 19 Compression**

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[60] [2013a>] In versions of the standard prior to 2011, **Field 4.008** was given the mnemonic GCA, meaning Grayscale Compression Algorithm. However, beginning with 2011, this was changed to CGA, to have the same mnemonic for compression fields in all record types. [<2013a]

[61] [2013a>] It is available at http://www.nist.gov/publication-portal.cfm Enter "500-289" in the 'Simple text search' to retrieve the document. [<2013a]

[62] The list is available at https://www.fbibiospecs.cjis.gov

[63] The conformance testing is described at http://www.nist.gov/itl/iad/ig/wsq.cfm

[64] [2015a>] This section has been expanded to be applicable to all latent prints, not just 500 ppi. [<2015a]

[65] [2015a>] the 2013 version only mentioned 500 ppi prints, but uncompressed imagery is acceptable for all prints. [<2015a]

codes) for new systems, since for such systems only uncompressed or WSQ compressed 500 ppi images may be transmitted in **Type-4** records. [<2013a]

For each of these fields, the entry corresponds to the appropriate entry in **Table 19 Compression codes:**

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 appropriate but not limited to those values)
Field 19.011: Compression algorithm / CGA
Field 20.011: Compression algorithm / CGA (when appropriate but not limited to those values)

[2015a>] There are currently no lossy compression methodologies recommended for resolutions greater than 1000 ppi. Until studies have been performed on compression algorithms and methodologies available, it is a best practice not to use lossy compression on such images, despite the large size of the files. Lossless compression (see **Table 22**), by definition has no effect on the images, and therefore may be used safely. It is recommended to follow guidance from NIST special Publication 500-289. [<2015a]

7.7.9.2 Summary of image compression and resolution for friction ridge records

The following tables summarize the requirements associated with compression for the various record types:

Table 20 Type-4 Transmitted Image Compression

Transmitting Resolution	None	WSQ2.0	WSQ3.1 or higher	JPEG-B Lossy	JPEG-Lossless	JPEG 2000 Lossy	JPEG 2000 Lossless	PNG	Other
500 ppi	✓	✓ [59]	✓	Legacy prints only	Legacy prints only	✗	✗	✗	✗
Other ppi	✗	✗	✗	✗	✗	✗	✗	✗	✗

Note that Type-4 ONLY allows 500 ppi transmissions (See Section **8.1.12**)

Table 21 Type-4 Resolution Constraints

	Minimum	Maximum	Tolerance

Transmitting	490 ppi – Specified in **Field 1.012: Nominal resolution / NTR**	510ppi – Specified in **Field 1.012: Nominal resolution / NTR,** not to be greater than scanning resolution	500 ppi ± 2%. For transmitting resolutions within Appendix F specification, 500 ppi ± 1%.
Scanning	490 ppi - Specified in **Field 1.011: Native scanning resolution / NSR**	Unbounded - Specified in **Field 1.011: Native scanning resolution / NSR**	For scanning resolutions within Appendix F specification (+/- 5%: 495 to 505 ppi) enter 0 in **Field 4.005: Image scanning resolution / ISR.** Otherwise a value of 1 is entered.

Table 22 Type-13 Transmitted Image Compression

Transmitting Resolution	None	WSQ2.0	WSQ3.1 or higher	JPEG-B Lossy	JPEG-Lossless	JPEG 2000 Lossy	JPEG 2000 Lossless	PNG	Other
500 ppi	Legacy only	✗	✗	✗	Legacy only	✗	Legacy only	Legacy only	✗
1000 ppi	✓	✗	✗	✗	✗	✗	✓	✓	✗
2000, 4000 ppi	✓	✗	✗	✗	✗	✗	✓	✓[66]	✗
Other ppi	✗	✗	✗	✗	✗	✗	✗	✗	✗

Allowable values for compression entered in **Field 13.011: Compression algorithm / CGA** are NONE, JPEGL, JP2L, or PNG (See **Table 19 Compression codes**).

Table 23 Type-13 Resolution Constraints

	Minimum	Maximum	Tolerance
Transmitting (For both scanned and camera images)	500 ppi for legacy systems only. 1000 ppi for new systems.	1000 ppi.	± 2%. For resolutions within Appendix F specification, ± 1%

[66] PNG is an acceptable algorithm, however, it is important to that the compression efficiency compared to JPEG 2000 at these resolutions results in images more than twice as large.

Scanning	1000 ppi[67]	No maximum (shall be down sampled to 1000 ppi)	± 2%. For resolutions within Appendix F specification, ± 1%
Photographic (camera) capture	1000 ppi	No maximum (shall be down sampled to 1000 ppi)	± 1%.

Note that it is highly recommended that latent print images be scanned and transmitted at 1000 ppi. Some older systems may only be able to receive 500 ppi images, and that is allowed by the standard.

Photos may be taken of a latent image and transmitted. The original image may be in color, or at a resolution higher than 1000ppi. **Type-13** records are designed to accommodate systems that typically assume that the image is either 500 or 1000 ppi. The image shall be post processed prior to transmission to generate a grayscale image of 1000 ppi, and may be cropped to have the friction ridge impression occupying a majority of the image. It is recommended that the resultant **Type-13** image be stored in lossless JPEG 2000.. It is highly recommended that the original image be conveyed in a **Type-20** record.

Table 24 Type-14, Type-15 and Type-19 Transmitted Image Compression

Transmitting Resolution	None	WSQ2.0	WSQ3.1 or higher	JPEG-B Lossy	JPEG-Lossless	JPEG 2000 Lossy	JPEG 2000 Lossless	PNG	Other
500 ppi	✓	Only If from a small platen	✓	Legacy prints only	Legacy prints only	✗	✓	✗	✗
1000 ppi	✓	✗	✗	✗	✗	✓	✓	✗	✗
2000, 4000 ppi[68]	✓	✗	✗	✗	✗	✗	✓	✗	✗
Other ppi	✗	✗	✗	✗	✗	✗	✗	✗	✗

[67] See Section 7.7.6.2.2

[68] Very few systems can accept 2000 or higher ppi. The sending organization should verify that the receiving organization can accept such images. If not, they shall be downsampled to the highest ppi that the receiving agency can accept.

Table 25 Type-14 Resolution Constraints

	Minimum	Maximum	Tolerance
Transmitting	500 ppi	Scanning resolution	500ppi: FAP 10, 20, 30, 40 = 2% FAP 45, 50, 60 = 1% Other: 2% 1000 ppi: FAP 145, 150, 160 = 1% Other: 1%
Scanning	500 ppi	Shall be on migration path of 500, 1000, 2000, ...	500ppi: FAP 10, 20, 30, 40 = 2% FAP 45, 50, 60 = 1% Other: 2% 1000 ppi: FAP 145, 150, 160 = 1% Other: 1%

Table 26 Type-15 Resolution Constraints

	Minimum	Maximum	Tolerance
Transmitting	500 ppi	Scanning resolution	500ppi: PAP 70, 80 = 1% Other: 2% 1000 ppi: PAP 170, 180= 1% Other: 1%
Scanning	500 ppi	Shall be on migration path of 500, 1000, 2000, ...	500ppi: PAP 70, 80 = 1% Other: 2% 1000 ppi: PAP 170, 180= 1% Other: 1%

Table 27 Type-19 Resolution Constraints

	Minimum	Maximum	Tolerance
Transmitting	500 ppi	Scanning resolution	500ppi: TAP 70, 80 = 1% Other: Not specified 1000 ppi: TAP 170, 180= 1% Other: 1%
Scanning	500 ppi	Shall be on migration path of 500,1000, 2000, ...	

[<2015a]

7.7.9.3 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.[69]

- 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.

7.7.9.4 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.

7.7.9.5 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 19 Compression codes** except WSQ20.

[<2015a>]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. [<2015a]

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

[2013d>] Data stored in a **Type-22** record may be compressed, as appropriate for the type of imagery or representational data. **Field 22.101: Non-photographic imagery type code / ITYP** specifies the type of imagery, while **Field 22.102: Non-photographic imagery data format code / IFMT** specifies the image format. [<2013d]

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

[2013d>] This section is not applicable to imagery stored in a **Type-22** record. [<2013d]

7.7.10.1 Black and white images (no grayscale)

[2013a>] Black and white (binary representation) 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 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. Compressed binary images use the *ANSI/EIA-538-1988* facsimile standard, as explained in **Section 8.8.8.2**. The **Type-8** signature record is the only record that uses this data type for images, which was previously used by several deprecated record types in previous versions of this standard. [<2013a]

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 28**). 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.

[2013a>] The images stored in **Field 9.372: EFS skeletonized image / SIM** are PNG images quantized to a depth of 1 bit, and therefore 0 = black and 1 = white. See also **F.6.7.1 Field 9.372: EFS skeletonized image / SIM instructions.** [<2013a]

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 28** 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 28 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 28**. 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[70] (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". Values for these fields shall be the alphabetic entries in the "Attribute code" column of **Table 29**.

Table 29 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

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

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**).

[2015e>]

A path is a filed containing a set of coordinates, Paths can be defined as a cricle, ellipse, closed path (polygon), or open path: (See **Table 31: Boundary definition codes**).

- A circle only requires 2 points to define it
- An ellipse requires 3 points to define it.
- 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 ot close or overlap. An open path shall have at least 2 vectices.
  - 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.

- The 2007 and 2008 version of the standard used paths for **Field 14.025: Alternate finger segment position(s) / ASEG.** That approach used repeating pairs of information items to indicate each x,y coordinate, so that the number of information items varies with the number of vertices. That approach has been retained in this version for all paths except in the **Type-9 extended feature set (EFS) paths.**
- The EFS adopted an approach expressing the path in a single information item, which is similar to the representation of lists (see Section **7.7.13**).

[<2015e]

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[71] for each of the following fields (See **Table 42 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 non-negative[72] integers in units of 10 micrometers (0.01 mm). 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

[2015>e]For each of these fields, the first one or two information items are dependent upon the Record type and Field. The next information item specifies the number of vertices. The remaining information items are pairs of *x* and *y* coordinates of vertices. [<2015e]

- 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 30.**

- 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 31**.

- 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 **Table 32.**

- In **Field 14.025: Alternate finger segment position(s) / ASEG** and **Field 19.019:**

[71] 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.

[72] [2013e>] Error correction from first edition: positive integers → non-negative integers [<2013e]

Friction ridge - toe segment position(s) / FSP the first information item contains a **friction ridge generalized position / FGP**, an integer from **Table 9.**

- 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 33**.

- 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, [2015a>] NOP and the repeating pairs of information items (HPO and VPO) shall not be present. In this case, an information item separator shall be present for NOP in Traditional encoding, but no information item separators are required for HPO and VPO pairs. [<2015a] [2013a>] This entry is free text with any special characters allowed, except for the reserved characters and the control characters listed in **Section 5.5 Character types**. [<2013a]

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 30: 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 31: 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 32: 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 33: 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

[2013n>]

7.7.13 Lists of values in a single information item

In record **Types 10, 11** and **12**, some information items are defined as lists of values. These are similar in concept to paths, as described in **Section** 7.7.12. In XML encoding, these information items are represented by a group of elements, each with an individual value in the list. In Traditional encoding, the list of values is entered as a single string, with individual values delimited by "|" (vertical bar).

[2015e>]The fields containing information items defined as lists are: [<2015e]

- **Field 10.049: Cheiloscopic image data / CID**
- **Field 11.012: Physical media object / PMO**
- **Field 11.024: Discontinuities diary / DCD**
- **Field 11.026: Vocal content diary / VCD**
- **Field 11.028: Other content diary / OCD**
- **Field 11.032: Vocal segment geographical information / SGEO**
- **Field 11.033: Vocal segment quality values / SQV**
- **Field 11.035: Vocal segment processing priority / PPY**
- **Field 11.036: Vocal segment content description / VSCD**
- **Field 11.037: Vocal segment speaker characteristics / SCC**
- **Field 11.038: Vocal segment channel / SCH**
- **Field 12.010: Tooth data detail / TDD**
- **Field 12.011: Mouth data detail / MDD**

[<2013n]

[2015n>]

7.8 External File References

Record types 10-16 and 19-22 all provide for including data (usually an image) within the record in field xx.999 / **DATA**, or in an external file, as indicated in the External file reference field (xx.994 / **EFR). EFR** allows the storage location of the image to be referenced rather than being required to be transmitted in the record. **EFR** contains the **URL/URI** or other unique reference to a storage location for the image. The use, restrictions and content of **EFR** fields is the responsibility of the application profile, which would define the specifics of how **EFR** refers to the external data, and may restrict the conditions under which **EFR** can be used.

The **DATA** and **EFR** fields are conditional:

- If **DATA** is present, **EFR** shall not be used, and vice versa.
- The same metadata fields within a record are used to describe the data regardless of whether **EFR** or **DATA** is used.
- **EFR** or **DATA** shall always be present in record types 1**0,13,16, 20,21,22**. In record t**ypes 11,12,14,15,19**, there are specific conditions in which both **EFR** and **DATA** should be omitted, such as for amputations; see those record descriptions for details.

[<2015n]

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)[73]:

- M = Field's, subfield's or information item's presence with data is mandatory;
- O = Field's, subfield's or information item's presence with data is optional;
  - M↑ = Mandatory presence with data, of subfield / information item within the optional field / subfield;
  - O↑ = Optional presence with data, of subfield / information item within the optional field / subfield;
- D = Field, subfield or information item's presence and/or its data is dependent upon certain conditions stated in the text.

The 'Character count' does NOT include special information separator[74] 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 contain 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 XX.003: Information Designation Character / IDC

[73] [2013a>] In Traditional format for non-binary record types (See **Table 132 Logical record types**), the presence with data of a field, subfield and information item is determined by the sequential position of data and separators (with fields being indicated by the field number followed by a colon). Subfields and information items are defined by their sequential position between a record separator ($^{F}_{S}$). Only if data is present in the location in the file indicated by the appropriate separator is a mandatory (M) or positive presence dependence (D) condition fulfilled. See **Annex B: Traditional encoding, *How the separators are used.***

Note that Record **Types 4**, **7** and **8** are binary records, with the structure defined by byte offset, with all bytes being necessarily present. For the user-defined fields in **Type-7**, the receiving organization must know prior to receipt of the data which fields are present and what their structure is.

In NIEM-conformant XML, a field, subfield or information item does not meet the mandatory or positive presence dependence condition if the corresponding element tag and associated data is not in the Information Exchange Package. [<2013a]

[74] [2013a>] added the words 'information separator' for clarity. [<2013a]

For all records, Treated as an integer in NIEM-conformant XML encoding and 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 set of integers in NIEM-conformant XML encoding and as ASCII characters in Traditional encoding.

[2015a>] Numeric values (values contained in fields with a numeric character type) shall not contain leading zeros, other than those listed above. Application profiles may permit or require leading zeros in user-defined fields.. [<2015a]

[2013a>]The record layout tables indicate the requirements for condition code, character constraints (type and count), value constraints, and occurrences for field structures found in Traditional and NIEM-conformant XML encodings. However, the structure of the fields as shown in the record layout tables applies only to the Traditional encoding. See **Annex G: Mapping to the NIEM IEPD** for the XML element names, order and structure. Note that the NIEM encoded structure may insert elements that do not have a direct correspondence to the record layout tables (such as biom:FaceImage (when a **Type-10** record instance contains a face image) and biom:PhysicalFeatureImage (for all other images). In some cases, there is a mapping of a value to two elements in XML. An example is **Field 1.002: Version number / VER** which is split into the elements biom:TransactionMajorVersionValue and biom:TransactionMinorVersionValue. [<2013a]

8.1 Record Type-1: Transaction information record

Record **Type-1** is mandatory. Only one **Type-1** record is present per transaction. **Table 34** 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 128** 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.

[2013n>] **Field 1.018: Geographic name set / GNS** has been added in the 2013 Update. It allows the user to select whether GENC or *ISO 3166-1* is used in the transaction to define country codes. [<2013n]

Table 34 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 = 1 [75]	4	VER = 0500 or 0501 [2015n>] or 0502 [<2015n] [76]	1	1
1.003	**CNT**	**TRANSACTION CONTENT**	M					1	1

[75] Traditional encoding (T) requires a leading zero. XML (X) encoding does not.
[2015a>] The Min # of characters for XML is shown as 1 because each of the two XML elements may have a one character value (biom:TransactionMajorVersionValue and biom:TransactionMinorVersionValue). [<2015a]

[76] [2013n>] Transactions conforming to the 2013 update shall specify **VER** = 0501 in Traditional encoding. In XML, biom:TransactionMajorVersionValue is 5 and biom:TransactionMinorVersionValue is 1.[<2013n]

[2015n>] Transactions conforming to the 2015 update all specify VER = 0502 in Traditional encoding. In XML, biom:TransactionMajorVersionValue is 5 and biom:TransactionMinorVersionValue is 2 [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
		Subfield: Single set of information items	M					1	1
	FRC	first record category code	M	N	1	1	FRC = 1 integer	1	1
	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 ≤ 22; or REC = 98 or 99; integer [77]	1	1
	IDC	information designation character	M	N	1	2	0 ≤ IDC ≤ 99 non-negative 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	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1

[77] [2013n>] New record types added so range of allowable values is extended. [<2013n][2015>a] See Table 3 Record types[<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
1.008	**ORI**	**ORIGINATING AGENCY IDENTIFIER**	M	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
1.009	**TCN**	**TRANSACTION CONTROL NUMBER**	M	ANS[78]	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
1.010	**TCR**	**TRANSACTION CONTROL REFERENCE NUMBER**	O	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	0	1
1.011	**NSR**	**NATIVE SCANNING RESOLUTION**	M	NS	T=5 X=4	5	NSR = 00.00 if no **Type-4** records in transaction; otherwise xx.xx[75]	1	1
1.012	**NTR**	**NOMINAL RESOLUTION**	M	NS	T=5 X=4	5	NTR = 00.00 if no **Type-4** records in transaction; otherwise xx.xx[75]	1	1
1.013	**DOM**	**DOMAIN NAME**	O					0	1
	DNM	domain name	M↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
	DVN	domain version number	O↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	0	1

[78] [2013e>] Typographical correction from 2011 edition: AN → ANS [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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 ≤ CSI ≤ 4 or 128 ≤ CSI ≤ 999 non-negative integer See **Table 4**	1	1
	CSN	character encoding set name	M↑	ANS	1	16	See **Table 4**	1	1
	CSV	character encoding set version	O↑	ANS	1	16	Any character with type A, N or S in **Table 128 Character encoding set values**	0	1
1.016	**APS**	**APPLICATION PROFILE SPECIFICATIONS**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	99

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	APO	application profile organization	M↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
	APN	application profile name	M↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
	APV	application profile version number	M↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	1	1
1.017	**ANM**	**AGENGY NAMES**	O					0	1
	DAN	destination agency name	O↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	0	1
	OAN	originating agency name	O↑	ANS	1	*	Any character with type A, N or S in **Table 128 Character encoding set values**	0	1
1.018[79]	**GNS**	**GEOGRAPHIC NAME SET**	O	AN	3	4	GNS = ISO, GENC	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

[79] [2013n>] Field added to allow transactions to use the GENC country codes rather than the country codes from *ISO 3166*. [<2013n]

to specify the minor revision number. [2013n>] The 2011 version of the standard without any of the record types or fields introduced for the 2013 Update has the entry "0500". The 2013 Update uses "0501". [2015n>] The 2015 Update uses "0502".[76][<2015n]

8.1.3 Field 1.003: Transaction content / CNT

This mandatory field[80] shall specify 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.

- 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 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. Versions of this standard prior to 2011 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.**

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

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 128 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 128 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) 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. [2013a>] All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 128 Character encoding set values** may be used. [<2013a]

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. [2013a>] All characters marked "A" ,"N" or "S" in the 'Type' column of **Table 128 Character encoding set values** may be used. [<2013a]

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. [2013a>] This field may be used to apply to **Type-7** records if specified by the domain or application profile. [<2013a] The special character that is allowed is "." (the period).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 [2013n>] *should not* [<2013n] be transmitted using Record **Type-4** [2013a>] unless being transmitted at 500 ppi class to a system incapable of receiving **Type-14** records at 1000 ppi class or greater.". [81] [<2013a]

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. [2013a>] This field may be used to apply to **Type-7** records if specified by the domain or application profile. [<2013a] The special character that is allowed is "." (the period).

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 (ppmm). 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 508 ppi would show both **NSR** and **NTR** as 20 ppmm (508 ppi). These images should not be sampled down to exactly 500 ppi. 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." [2013a>] This version of the standard specifically prohibits transmission resolution above 510 ppi (the upper limit of the 500 ppi class) for **Type-4** records; a higher transmission resolution for **Type-7** records may be specified by the application profile. [<2013a] (See **Table 18 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 128 Character encoding set values** may be used.

- The mandatory first information item (**domain name / DNM**) will uniquely identify

[81] [2013a>] When down-sampling a fingerprint image from 1000 ppi to 500 ppi, the guidance provided in NIST Special Publication 500-289 should be followed in order to produce a 500 ppi image with the minimal effect on the image contesnts and quality (It is available at http://www.nist.gov/publication-portal.cfm Enter "500-289" in the 'Simple text search' to retrieve the document). [<2013a] [2013n>] The restriction is changed from 'shall not' to 'should not' to allow for this type of condition. [<2013n]

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 [2013a>] of the transaction [<2013a] 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 128 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 128 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 128 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 128 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 128 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. 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 128 Character encoding set values** may be used.

- 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**.

8.1.18 Field 1.018: Geographic name set / GNS

[2013n>] This optional field is used if the transaction uses GENC in lieu of *ISO 3166-1* as a code set for country code specifications. *ISO 3166-1* is the default country code set used for the transaction when this field is not contained in Record **Type-1**. GENC is available at https://nsgreg.nga.mil/genc/registers.jsp. The values for this field are:

ISO = *ISO 3166-1* (default[82])
GENC = GENC

Information items affected by this choice have "Values from *ISO 3166-1* or GENC" specified in the value constraints column of the record layout tables. [<2013n]

[82] [2013n>] The default does not specify as to whether it is 2-alpha, 3-alpha or numeric format [<2013n]

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.**

[2013a>] Multiple **Type-2** records may be contained in a transaction. Each instance of record **Type-2** may concern a different individual; however, at least one instance should concern the subject of the transaction. [<2013a]

[2013n>] See **Type-2 Record cross reference / T2C** for information about how the **IDC** value for a particular **Type-2** record may be referenced in another record Type, in order to connect data in a record **Type-2** instance to the subject of the record for another record type instance. An example is when DNA from a purported relative is used to establish the identity of a Disaster Victim. [<2013n]

Table 35 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 ≤ IDC ≤ 99 non-negative 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 **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.

[2013a>] For Traditional encoding, please see **Annex B: Traditional encoding, Section B.2.2 Type-4 record**. For XML encoding, please see **Annex C: NIEM-conformant encoding rules**. [<2013a]

Table 36 Type-4 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length[83]; 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).

[83] [2013a.] The Character Type column for **Fields 4.001** through **4.008** makes explicit that in Traditional format, the data is binary, as is stated here. [<2013a]

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	T=B; X=N	T=1 X=1	T=1 X=2	0 ≤ IDC ≤ 99 non-negative integer	1	1
4.003	**IMP**	**IMPRESSION TYPE**	M	T=B; X=N	T=1 X=1	T=1 X=2	0 ≤ IMP ≤ 3 or IMP = 8 or 20 ≤ IMP ≤ 29 [2915n>] 40 ≤ IMP ≤ 41 [<2015n] non-negative integer See **Table 8**	1	1
4.004	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	T=B; X=N	T=1 X=1	T=1 X=3	0 ≤ FGP ≤ 15 or FGP = 255 non-negative integer See **Table 9**	T = 6; X= 1	6
4.005	**ISR**	**IMAGE SCANNING RESOLUTION**	M	T=B; X=N	T=1 X=1	T=1 X=1	ISR = 0 or 1 non-negative integer	1	1
4.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	T=B; X=N	T=2 X=2	T=2 X=5	10 ≤ HLL ≤ 65535 positive integer	1	1
4.007	**VLL**	**VERTICAL LINE LENGTH**	M	T=B; X=N	T=2 X=2	T=2 X=5	10 ≤ VLL ≤ 65535 positive integer	1	1
4.008	**CGA**	**COMPRESSION ALGORITHM**	M	T=B; X=N	T=1 X=1	T=1 X=1	0 ≤ value ≤ 1 non-negative integer[84]	1	1
4.009	**DATA**	**IMAGE DATA**	M	B	T=1 X=1	T=* X=*	none	1	1

[84] [2013a>] For legacy systems only, values of 2 and 3 are allowed. [<2013a]

8.4.1 Field 4.001: Record header

The content of this mandatory field is dependent upon the encoding used. 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 9.** Only finger numbers 0-15 apply to **Type-4**[85]. 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. Record **Type-4** shall not be used to transmit a fingerprint image at greater than 20.08 ppmm (510 ppi)[86]. 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 18 Class resolution with defined tolerance**), a 0 shall be entered in this field.

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[85] The 2007 and 2008 versions of this standard restricted the FGP to a range of 0 to 14. Code 15 is included in this version.

[86] [2013a>] Sentence reworded for clarity. [2013a>] When down-sampling a fingerprint image from 1000 ppi to 500 ppi, the guidance provided in NIST Special Publication 500-289 (available at http://www.itl.nist.gov/lab/specpubs/sp500.htm) should be followed in order to produce a 500 ppi image with the minimal effect on the image contesnts and quality. [<2013a] [<2013a]

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**.

[2015a>] Note that the nominal transmitting resolution shall not be greater than the scanning resolution. [<2015a]

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 [2013e>] vertical [<2013e] line of the transmitted image. See **Section 7.7.8.2.**

8.4.8 Field 4.008: Compression algorithm / CGA

This is a mandatory field[87] , 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.

[87] [2013e>] Typographical error in mnemonic in 2011 [<2013e]

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 37 Type-7 record layout

Traditional format requires the data in binary form (not text) with a fixed byte length for **Field 7.002**[88]; 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	T=B; X=N	T=1 X=1	T=1 X=2	0 ≤ IDC ≤ 99 non-negative 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 **Section 7.1**.

[88][2013a.] The Character Type column for **Field 7.002** makes explicit that in Traditional format, the data is binary, as is stated here. [<2013a]

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 mm^2. 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 38 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**[89]; 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	T=B; X=N	T=1 X=1	T=1 X=2	0 ≤ IDC ≤ 99 non-negative integer	1	1
8.003	**SIG**	**SIGNATURE TYPE**	M	T=B; X=N	T=1 X=1	T=1 X=1	SIG = 0 or 1 non-negative integer	1	1

[89] [2013a.] The Character Type column for **Fields 8.002** through **8.007** makes explicit that in Traditional format, the data is binary, as is stated here. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
8.004	SRT	SIGNATURE REPRESENTATION TYPE	M	T=B; X=N	T=1 X=1	T=1 X=1	SRT = 0 or 1 or 2 non-negative integer	1	1
8.005	ISR	IMAGE SCANNING RESOLUTION	M	T=B; X=N	T=1 X=1	T=1 X=1	ISR = 0 or 1 non-negative integer	1	1
8.006	HLL	HORIZONTAL LINE LENGTH	M	T=B; X=N	T=2 X=1	T=2 X=5	HLL = 0 or 10 ≤ HLL ≤ 65535 non-negative integer	1	1
8.007	VLL	VERTICAL LINE LENGTH	M	T=B; X=N	T=2 X=1	T=2 X=5	VLL = 0 or 10 ≤ VLL ≤ 65535 non-negative 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. 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[90]. 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 [2013e>] pixels contained on a single vertical [<2013e] line 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.

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.

[2015n>] Previous editions specified that the image be in compressed form using the *ANSI/EIA-538-1988 facsimile compression algorithm*. Other data image formats are now allowed. Whatever format is chosen should be agreed upon by the sending and receiving agencies. [<2015n]

8.8.8.3 Vectored image data

If the **SRT** field contains the value of two, then this field shall contain a set 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)

[90] 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.

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 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 39** 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[91]. 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.

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[91] may be used with or without the fields associated with registered implementations.

[91]New for the 2011 version of the standard.

Table 39 Type-9 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	$0 \leq IDC \leq 99$ non-negative integer	1	1
9.003	**IMP**	**IMPRESSION TYPE**	M	N	1	2	value from **Table 8**	1	1
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 40**					
9.151-9.175		**L1 / IDENTIX FEATURE SET** [92]	O	user-defined			user-defined	user-defined	
9.176-9.225		**OTHER FEATURE SETS - DEFINED FIELDS**	O	See **Table 41**					
9.226-9.299		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

[92] [2013a>] In 2013 this was listed as MorphoTrust USA. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.300-9.399		**EXTENDED FEATURE SET**	O	See **Table 42**					
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	*
	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
9.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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 40 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 fields 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	$0 \leq FVW \leq 15$ non-negative integer	1	1
9.134	**FGP**	**M1 FRICTION RIDGE GENERALIZED POSITION**	M	N	1	2	$1 \leq FGP \leq 10$ non-negative integer[93] See Table 9	1	1

[93] [2015e>] Range corrected to correspond to text. (Typographical error) [<2015e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FQD	**M1 FRICTION RIDGE QUALITY DATA**	M					1	1
		Subfields: Repeating sets of information items	M					1	9
9.135	QVU	quality value	M	N	1	3	0 ≤ QVU ≤ 100 or QVU = 254 or QVU = 255 non-negative 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	0 [94] ≤ MXC < HLL non-negative integer	1	1
	MYC	Y coordinate	M	N	1	5	0 [94] ≤ MYC < VLL non-negative integer	1	1
	MAV	minutia angle	M	N	1	3	0 ≤ MAV ≤ 179 integer	1	1
	M1M	minutia type	M	N	1	1	M1M [95] = 0, 1 or 2 non-negative integer	1	1

[94] [2013n>] Lower bound changed to 0 from 1 to correspond with INCITS 378-2009. [<2013n]

[95] [2013e>] Corrected typographical error [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	QOM	quality of minutia	M	N	1	3	0 ≤ QOM ≤ 100 non-negative 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 non-negative integer	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
	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	0[96] ≤ NRC ≤ 99 non-negative 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	0[94] ≤ XCC < HLL non-negative integer	1	1
	YCC	Y coordinate	M↑	N	1	5	0[94] ≤ YCC < VLL non-negative integer	1	1

[96] [2013n>] INCITS 378-2009 permits ridge counts of zero, so the lower bound is changed from 1 to match this. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	ANGC	angle of the core	M↑	N	1	3	0 ≤ ANGC ≤ 179 non-negative 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	0^{94} ≤ XCD < HLL; non-negative integer	1	1
	YCD	Y coordinate	M↑	N	1	5	0^{94} ≤ YCD < VLL ;non-negative integer	1	1
	ANG1	First angle of the delta	M↑	N	1	3	0 ≤ ANG1 ≤ 179 non-negative 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 non-negative integer	1	1
	ANG3	Third angle of the delta	M↑	N	1	3	0 ≤ ANG3 ≤ 179 non-negative integer	1	1

Table 41 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 fields is present'.

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 42 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 fields is present'.

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	0[97] ≤ EHO ≤ 50000 non-negative integer	0	1
	EVO	ROI vertical offset	O	N	1	5	0[97] ≤ EVO ≤ 50000 non-negative integer	0	1
	ROP	ROI polygon	O	NS	1[98]	5[98]	special characters allowed are: - and , (traditional encoding only – not applicable to XML encoding)	0	99[98]
9.301	**ORT**	**EFS ORIENTATION**	O					0	1
	EOD	direction	M↑	NS	1	4	-179 ≤ EOD ≤ 180 integer; allowed special character: -	1	1
	EUC	uncertainty	O↑	N	1	3	0 ≤ EUC ≤ 180 non-negative integer	0	1

[97] [2013e>] Lower bound changed from 1 to 0 for both horizontal and vertical offsets. [<2013e]

[98] [2015a>] Each path can contain up to 99 coordinates. Each coordinate can contain up to 5 characters. In traditional encoding, coordinates are delimited using commas and dashes. See Section 7.7.12. [<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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	Values are limited to the following ranges: 0 ≤ 10, 16 ≤ 18, 20 ≤ 38, 81 ≤ 86 See **Table 9**	1	1
	FSM	image segment	O	A	3	3	FSM = DST, PRX, MED or UNK See **Table 10**	0	1
	OCF	off-center print	O	A	1	1	OCF = T, R or L See **Table 43**	0	1
	SGP	segment polygon	O	NS	1[99]	5[99]	special characters allowed are: - and , (traditional encoding only – not applicable to XML encoding)	0	99[99]
9.303	FSP	**EFS FEATURE SET PROFILE**	O					0	1
		Subfields: Repeating values	M↑	N	1	2	none	1	9
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 44**	1	1

[99] [2015a>] Each path can contain up to 99 coordinates. Each coordinate can contain up to 5 characters. In traditional encoding, coordinates are delimited using commas and dashes. See Section **7.7.12**. [<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SUB	subclass	D	A	2	2	values from **Table 44**	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↑	H 10 0	1	50000	See **Table 137: Definitions for ridge quality map values** and **Table 45**	1	ROUND-UP (EHI ÷ GSZ)[101]
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 46**	1	1
9.310	**RFM**	**EFS RIDGE FLOW MAP**	O					0	1
		Subfields: Repeating values (one entry for each row)	M↑	Base 64 10 2	1	100000	See **Table 47**	1	ROUND-UP (EHI ÷ SFQ)[101]
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	1	1
9.312	**RWM**	**EFS RIDGE WAVELENGTH MAP**	O					0	1

[100] [2013e>] Corrected to hexadecimal (was listed as AN) and range restated to make it clear that it is a hexadecimal range [<2013e]

[101] [2013e>] Corrected formula [<2013e]

[102] [2013e>] Correct character type is Base 64. [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
		Subfields: Repeating values	M↑	AN	1	100,000	string containing 2 digit positive integers or XX characters	1	ROUND-UP (EHI ÷ FWS) [101]
9.313	**RWF**	**EFS RIDGE WAVELENGTH MAP FORMAT**	O					0	1
	FWS	sampling frequency	M↑	N	1	2	1 ≤ FWS ≤ 41 positive 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 [2015n>] or U [<2015n] see **Table 48**	0	1
9.315	**PLR**	**EFS POSSIBLE LATERAL REVERSAL**	O	A	1	1	PLR = L or U see **Table 49**	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 or QVU = 254 or 255 non-negative 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
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 50**	1	1
	CGS	growth or shrinkage comment	O↑ [103]	U	1	1000	none	0 [103]	1
9.318-9.319		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

[103] [2013e>] Changed to Optional to correspond to text [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.320	**COR**	**EFS CORES**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	CXC	X coordinate	M↑	N	1	5	0 ≤ CXC < EWI non-negative integer	1	1
	CYC	Y coordinate	M↑	N	1	5	0 ≤ CYC < EHI non-negative integer	1	1
	CDI	direction	O↑	N[104]	1	3	0 ≤ CDI ≤ 359[104] non-negative integer	0	1
	RPU	radius of position uncertainty	O↑	N	1	3	0 ≤ RPU ≤ 999 non-negative integer	0	1
	DUY	direction uncertainty	O↑	N	1	3	0 ≤ DUY ≤ 180 non-negative 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 non-negative integer	1	1
	DYC	Y coordinate	M↑	N	1	5	0≤ DYC < EHI non-negative integer	1	1
	DUP	direction up	O↑	N	1	3	0 ≤ DUP ≤ 359[105] non-negative integer	0	1
	DLF	direction left	O↑	N	1	3	0 ≤ DLF ≤ 359 non-negative integer	0	1

[104] [2013e>] Changed NS to N; max character from 4 to 3; change range from -179 → 180 to 0 → 359 [<2013e]

[105] [2013e>] Changed from a range of 1 → 180 to a range of 0 → 359. [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	DRT	direction right	O↑	N	1	3	0 ≤ DRT ≤ 359 non-negative integer	0	1
	DTP	type	M↑[152]	AN	0[106]	3	value from Table 52	0	1
	RPU	radius of position uncertainty	O↑	N	1	3	0[107] ≤ RPU ≤ 999 non-negative integer	0	1
	DUU	direction uncertainty up	O↑	N	1	3	0 ≤ DUU ≤ 180 non-negative integer	0	1
	DUL	direction uncertainty left	O↑	N	1	3	0 ≤ DUL ≤ 180 non-negative integer	0	1
	DUR	direction uncertainty right	O↑	N	1	3	0 ≤ DUR ≤ 180 non-negative integer	0	1
9.322	**CDR**	**EFS CORE-DELTA RIDGE COUNTS**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	* [108]
	CIX	core index	M↑	AN	1	2	1 ≤ CIX ≤ 99 positive integer or CIX = L or U	1	1
	DIX	delta index	M↑	AN	1	2	1 ≤ DIX ≤ 99 positive integer or DIX = L or R	1	1
	MNRC	min ridge count	M↑	N	1	2	0[107] ≤ MNRC ≤ 99 non-negative integer	1	1

[106] [2015e>] Changing minimum to 0 characters to allow for a "<NULL>" value. [<2015e]
[107] [2013e>] Changed lower bound to 0 [<2013e]

[108] [2013e>] Changed max occurrence from 255 to * [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	MXRC	max ridge count	O↑	N	1	2	$0^{107} \leq$ MXRC $\leq$ 99 non-negative 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	CPM = L or 0 or 1 or H see **Table 53**	1	1
	PXC	X coordinate	M↑	NS	1	5	-EHO $\leq$ PXC $\leq$ 50,000 [109] integer; allowed special character: -	1	1
	PYC	Y coordinate	M↑	NS	1	5	-EVO $\leq$ PYC $\leq$ 50,000 integer allowed special character: -	1	1
	CRU	radius of position uncertainty	O↑	N	1	3	0 $\leq$ CRU $\leq$ 999 non-negative integer	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 54**	1	1

[109] [2013e>] Lower limit modified from less than to less than or equal to [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	DFP	distinctive features polygon	O↑	NS	1[110]	5[110]	special characters allowed are: - and , (traditional encoding only – not applicable to XML encoding)	0	99[110]
	DFC	distinctive features comment	O↑	U	1	1000	none	0	1
9.325	**NCOR**	**EFS NO CORES PRESENT[111]**	D	A	1	1	NCOR = Y	0	1
9.326	**NDEL**	**EFS NO DELTAS PRESENT[111]**	D	A	1	1	NDEL = Y	0	1
9.327	**NDIS**	**EFS NO DISTINCTIVE FEATURES PRESENT 111**	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						
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 non-negative integer	1	1
	MYC	Y coordinate	M↑	N	1	5	0≤ MYC < EHI non-negative integer	1	1
	MTD	Theta degrees	M↑	N	1	3	0 ≤ MTD ≤ 359[105] non-negative integer	1	1
	MTY	minutia type	M↑	A	1	1	MTY = E, B or X see **Table 55**	1	1

[110] [2015a>] Each path can contain up to 99 coordinates. Each coordinate can contain up to 5 characters. In traditional encoding, coordinates are delimited using commas and dashes. See Section **7.7.12**. [<2015a]

[111] [2015a>] NIEM requires that anything that is an 'indicator' shall be Boolean. Thus, in NIEM-conformant encoding this has a value of 'true' or '1'. Therefore the maximum character count becomes 4 and the type becomes AN for NIEM-conformant XML encoding. [<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	MRU	radius of position uncertainty	O↑	N	1	3	0 ≤ MRU ≤ 999 non-negative integer	0	1
	MDU	minutiae direction uncertainty	O↑	N	1	3	0 ≤ MDU ≤ 180 non-negative integer	0	1
9.332	**MRA**	**EFS MINUTIAE RIDGE COUNT ALGORITHM**	D	AN	5	8	MRA = OCTANT, EFTS7 or QUADRANT see **Table 56**	0	1
9.333	**MRC**	**EFS MINUTIAE RIDGE COUNTS**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	* [112]
	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 non-negative integer	1	1
	MRN	reference number	O↑	N	1	1	0 ≤ MRN ≤ 7 [113] non-negative integer	0	1
	MRS	residual	O↑	N	1	1	MRS = 0 or 1 non-negative integer	0	1
9.334	**NMIN**	**EFS NO MINUTIA PRESENT** [111]	D	A	1	1	NMIN = Y	0	1
9.335	**RCC**	**EFS RIDGE COUNT CONFIDENCE**	D[136]					0	1
		Subfields: Repeating sets of information items	M↑					1	7992

[112] [2013e>] Maximum repeat count changed to * [<2013e]
[113] [2013e>] Revised to correspond to the text: the eight octants are numbered 0 through 7 in **Table 56 EFS codes for minutiae ridge count algorithms** [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	ACX	X coordinate Point A	M↑	N	1	5	0 ≤ ACX < EWI non-negative integer	1	1
	ACY	Y coordinate Point A	M↑	N	1	5	0 ≤ ACY < EHI non-negative integer	1	1
	BCX	X coordinate Point B	M↑	N	1	5	0 ≤ BCX < EWI non-negative integer	1	1
	BCY	Y coordinate Point B	M↑	N	1	5	0 ≤ BCY < EHI non-negative integer	1	1
	MORC	method of ridge counting	M↑	A	1	1	MORC = A, T or M see Table 57	1	1
	MCV	confidence value	M↑	N	1	2	0 ≤ MCV ≤ 99 non-negative 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 non-negative integer	1	1
	DOY	dot Y coordinate	M↑	N	1	5	0 ≤ DOY < EHI non-negative 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 non-negative integer	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	Y1C	Y coordinate Point 1	M↑	N	1	5	0 ≤ Y1C < EHI non-negative integer	1	1
	X2C	X coordinate Point 2	M↑	N	1	5	0 ≤ X2C< EWI non-negative integer	1	1
	Y2C	Y coordinate Point 2	M↑	N	1	5	0 ≤ Y2C < EHI non-negative 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 non-negative integer	1	1
	Y1D	Y coordinate Point 1	M↑	N	1	5	0 ≤ Y1D <EHI non-negative integer	1	1
	X2D	X coordinate Point 2	M↑	N	1	5	0 ≤ X2D < EWI non-negative integer	1	1
	Y2D	Y coordinate Point 2	M↑	N	1	5	0 ≤ Y2D < EHI non-negative integer	1	1
	TPD	type	M↑	AN	2	5	See values in **Table 58**	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 non-negative integer	1	1
	CLY	Y coordinate	M↑	N	1	5	0 ≤ CLY < EHI non-negative integer	1	1
	CLT	type	M↑	A	1	1	CLT = P, I or D	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.344	**NPOR**	**EFS NO PORES PRESENT** [111]	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 non-negative integer	1	1
9.346	**NDOT**	**EFS NO DOTS PRESENT** [111]	D	A	1	1	NDOT = Y	0	1
9.347	**NINR**	**EFS NO INCIPIENT RIDGES PRESENT** [111]	D	A	1	1	NINR = Y	0	1
9.348	**NCLD**	**EFS NO CREASES PRESENT** [111]	D	A	1	1	NCLD = Y	0	1
9.349	**NREF**	**EFS NO RIDGE EDGE FEATURES PRESENT** [111]	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 59**	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 60**	1	9
9.353	**EAA**	**EFS EXAMINER ANALYSIS ASSESSMENT**	O					0	1
	AAV	value assessment code	M↑	A	5	8	see **Table 61**	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 62**	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 63**	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	$0 \leq TOM \leq 10$ non-negative integer see **Table 64**	1	1
	CLA	comment	O↑	U	1	1000	none	0	1
9.357	**LQI**	**EFS LOCAL QUALITY ISSUES**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	LQT	type	M↑	A	4	10	see **Table 65**	1	1
	LQP	polygon	M↑	NS	1[114]	5[114]	special characters allowed are: - and , (traditional encoding only – not applicable to XML encoding)	1	99[114]

[114] [2015a>] Each path can contain up to 99 coordinates. Each coordinate can contain up to 5 characters. In traditional encoding, coordinates are delimited using commas and dashes. See Section **7.7.12**. [<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 ≤ CIR ≤ 99 non-negative integer	1	1
	AOP	polygon (closed path)	M↑	NS	1^{114}	5^{114}	special characters allowed are: - and , (traditional encoding only – not applicable to XML encoding)	1	99^{114}
	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 67**	1	1
	CFN	corresponding field number	D	N	3	3	value from **Table 66**	0	1
	FOC	corresponding field occurrence	D	N	1	3	1 ≤ FOC ≤ 999 positive integer	0	1
	CXC	corresponding x coordinate	D	N	1	5	0 ≤ CXC < EWI non-negative integer	0	1
	CYC	corresponding y coordinate	D	N	1	5	0 ≤ CYC < EHI non-negative integer	0	1
	COC	comment	O↑	U	1	1000	none	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
9.362	**ECD**	**EFS EXAMINER COMPARISON DETERMINATION**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	EDC	IDC reference	M↑	N	1	2	0 ≤ EDC ≤ 99 non-negative integer	1	1
	EDE	determination	M↑	AS	4	6	value from **Table 68**	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	*

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	RIR	rotation IDC reference	M↑	N	1	2	0 ≤ RIR ≤ 99 non-negative integer	1	1
	ROR	relative overall rotation	M↑	NS	1	4	-179 ≤ ROR ≤ 180 integer allowed special character: -	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
		Subfields: Repeating values	M↑	NS	1[115]	5[115]	In Traditional encoding, allowed special characters are the comma and the dash. This is not applicable to XML encoding. See **Section 7.7.12.1**	1	*
9.374-9.379		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
9.380[116]	**TPL**	**EFS TEMPORARY LINES**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	999
	TXA	x coordinate point A	M↑	N	1	5	0 ≤ TXA < EWI[117] non-negative integer	1	1
	TYA	y coordinate point A	M↑	N	1	5	0 ≤ TYA < EHI[117] non-negative integer	1	1

[115] [2015a>] Each path can contain multiple coordinates. Each coordinate can contain up to 5 characters. In traditional encoding, coordinates are delimited using commas and dashes. See Section **7.7.12**. [<2015a]

[116] [2013n>] New fields (380 and 381) [<2013n]

[117] [2015a>]These corrected a typographical error in AN2013[<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	TXB	x coordinate point B	M↑	N	1	5	0 ≤ TXB < EWII[117] non-negative integer	1	1
	TYB	y coordinate point B	M↑	N	1	5	0 ≤ TYB < EHII[117] non-negative integer	1	1
	TLC	line color	M↑	H	6[118]	6	000000 ≤ TLC ≤ FFFFFF	1	1
	TLT	line thickness	M↑	N	1	2	1 ≤ TLT ≤ 99 positive integer	1	1
9.381[116]	**FCC**	**EFS FEATURE COLOR [2015a>] AND COMMENT [<2015a]**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	999
	FTF	feature – field number	M↑	N	3	3	Field number from **Table 69 EFS codes for field numbers used for feature color**	1	1
	FTO	feature - field occurrence	M↑	N	1	3	1 ≤ FTO ≤ 999 positive integer	1	1
	FTC	feature - color	D	H	6	6	000000 ≤ FTC ≤ FFFFFF	0	1
	COM	feature - comment	D	U	1	1000	none	0	1
9.382 –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. 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

[118] [2015e>] Value is 6 (for Hexadecimal 000000) [<2015e]

Section 7.3.1.

8.9.3 Field 9.003: Impression type / IMP

This mandatory field shall indicate the manner by which the friction ridge[119] 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 fields is present'. "Optional" in this block of fields shall mean 'optional if this block of fields 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 sets this value at the IBIA website (www.ibia.org), if it is posted. [2013a>] If it is not posted, enter 0000. [<2013a]

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 I*NCITS 378-2009* is specified as two bytes

[119] [2013a>] Fingerprint changed to friction ridge to be more inclusive [<2013a]

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[120]. 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.

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.

[120] See the list of certified products at http://www.fbibiospecs.cjis.gov

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 9** 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 item **(minutia type / M1M)** has a value of "0" to represent a minutia[121] 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

[121] [2013e>] Corrected typographical error [<2013e]

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 number/ 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[122].

[122] In earlier versions of this standard, only one angle was referenced; however, the 2004 and 2009 versions

- 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. [2013a>] (i.e., pointing upwards) [<2013a]

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.[122] This field has been added to handle the two additional angle specifications of *INCITS 378* while maintaing 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**.

[2013a>] The values, recorded in units of two degrees, shall be between 0 and 179, inclusive. [<2013a]

- 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[123].

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 beginning with *EBTS 9.3*; see https://www.fbibiospecs.cjis.gov .

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.

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of INCITS 378 standard specify three angles for each delta. The second two angles are contained in **Field 9.141: M1 additional delta angles / ADA**.

[123] 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.

8.9.6.4 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 has 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 fields is present". 'Optional' in this block of fields shall mean "optional if this block of fields 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 Instructions** for specific instructions on entering data in these fields.

8.9.7.1 EFS coordinate system

The relative position of all EFS features shall be expressed as integers[124] in units of 10 micrometers (10 µm = 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. With the exception of **Field 9.323: EFS center point of reference / CPR** 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-ITL* **Type-9 Fields 9.005** through **9.012** (legacy fields), which used 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)[125]. In all cases

[124] [2013e>] The sentence is modified from the original 2011 text to allow zero as a coordinate and moves the exception for **Field 9.323** to another part of the paragraph, for clarity. [<2013e]

[125] 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/])

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).

8.9.7.2 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. [2013a>] 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. With the exception of **Field 9.323: EFS center point of reference / CPR**, the X and Y values for an EFS feature may not equal or exceed the width and height of the ROI. The X and Y values for CPR are the only EFS values that may be negative, or greater than the ROI width or height; however, the center point of reference must be within the bounds of the overall image itself. The ROI may be identical to the dimensions of the image[126]. [<2013a]

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.

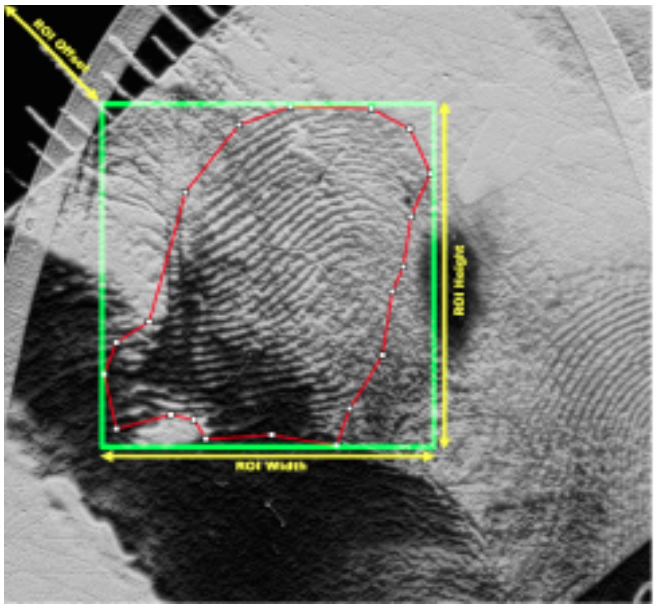


Figure 6: Region of interest

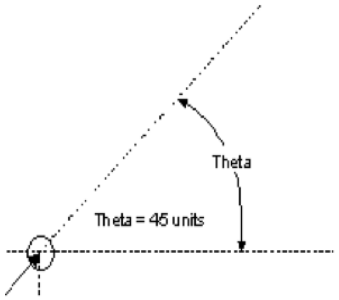
[126] [2013a>] New explanation updates the 2011 base text [<2013a]

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**.

8.9.7.3 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 [2015a>] friction ridge print of interest [<2015a]and separates it from the background and any other prints 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 (0.01 mm)
- The second information item **(height / EHI)** is the height of the region of interest in units of 10 micrometers (0.01 mm).
- 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**. [2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma.[<2013a]. 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.**

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**) which 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 9**. See **Section 7.7.4.2**. [2013a>] The valid codes for **FGP** in this field are limited to 0 through 10 (inclusive), 16 through 18 (inclusive), 20 through 38 (inclusive) and 81 through [<2013a][2015n>] 86 (inclusive) [<2015n].

- The second information item **fingerprint 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 10** is used to indicate the finger segment position (DST, PRX, or MED). DST is Distal; MED is Medial; and PRX is Proximal. See **Figure 4: Entire joint image** for an illustration[127]. UNK for "Unknown" may also be specified. 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 43** 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. [2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma.[<2013a]. 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.**

Table 43 Off-center fingerprint positions

Name	Code	Description
Tip	T	The plain or rolled tip of the finger or thumb[128]
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.

[2013a>] The valid values for this field are available in the *EFS Profile Specification, NIST Special Publication 1134.* See **Section 3 Normative references.** [<2013a]

8.9.7.5 Field 9.307: EFS pattern classification / PAT

[127] [2013a>] Definitions of segments and reference to the Figure added [<2013a]

[128] [2013a>] Reworded for clarity [<2013a]

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 44**.

- 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 44**.

- 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 44 Pattern classification codes

Type	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 45**. 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 46.** See **Field 9.309: EFS ridge quality map format / RQF** for the definition of the grid size and data representation.

Table 45 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" (0.01 mm) through "41" (0.41 mm). The recommended grid size is 0.20mm (0.008") – note this is 4 pixels at 500 ppi, or 8 pixels at 1000 ppi.

- The second information item (**data format / RDF**) defines the format used in **Field 9.308**, using the codes defined in **Table 46.** 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 46 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 45**, 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" 00000000000112233455555544444221000000000000000 (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 0.41 mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01 mm) through "41" (0.41 mm) [2013a>], inclusive [<2013a].
- The second information item (**data format / RDF**) defines the format used in the Ridge Flow Map field, as defined in **Table 47**. The default is the uncompressed ("UNC") format.

Table 47 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.

8.9.7.10 Field 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 (0.01 mm). 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" (0.01 mm) through "99" (0.99 mm 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 0.41 mm (0.016"). This information item may be used to define higher resolution sampling frequencies than the default: valid settings range from "1" (0.01 mm) through "41" (0.41 mm), [2013a>] inclusive. [<2013a]
- 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, in [2015a>]which case this field is omitted. [<2015a] 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 48**. [2015a>] The Unknown code is used in the unusual cases that it cannot be determined whether ridges or valley are represented as dark or light areas in the image. ,[<2015a]

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.[129] 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.[130]

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.

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

Table 48 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
[2015n>] U	Unknown [<2015n]

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 49** 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 49 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 50.** 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 50 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 51**. 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 136: Features and Corresponding presence fields.**

For palm prints 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 51 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 (0.01 mm).
- The second information item (**'y' coordinate / CYC**) shall be expressed in integer units of 10 micrometers (0.01 mm).
- The third information item (**direction / CDI**) is optional. This shall be set to the average tangent direction of the two closest ridges as measured 1.63 mm (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 (0.01 mm), 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

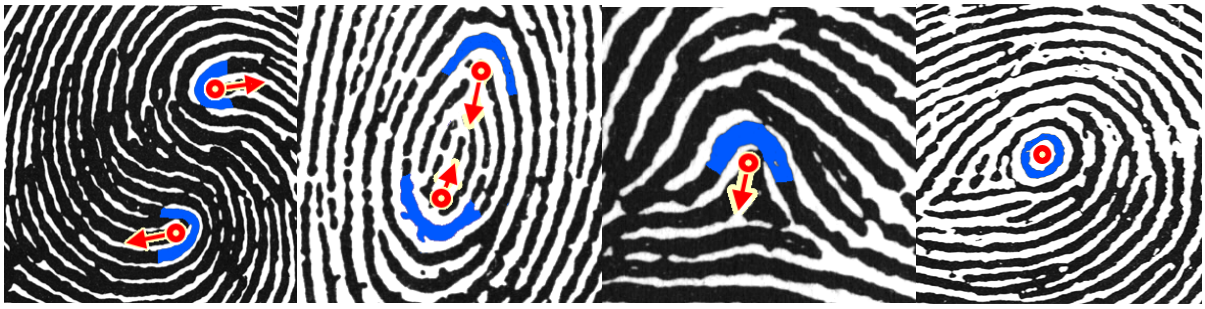


Figure 9: Examples of core locations for a double loop whorl, plain whorl, tented arch, and central pocket loop whorl

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 52**. For palm prints 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 136: 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 (0.01 mm) and is mandatory.

- The second information item **('y' coordinate / DYC**) is expressed in units of 10 micrometers (0.01 mm) and is mandatory.

- The third information item **(direction up / DUP**) is optional and is expressed in degrees counterclockwise from the right[131].

- The fourth information item **(direction left / DLF**) is optional and is expressed in degrees counterclockwise from the right[131].

- The fifth information item **(direction right / DRT**) is optional and is expressed in degrees counterclockwise from the right[131].

- The sixth information item **(type / DTP**) is optional and contains the type of delta, as defined in **Table 52**.

- 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 (0.01 mm), 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.

- 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.

[131] 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).

Table 52 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 9 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	<NULL>[132]	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.

[132] [2013a>] This means that there is no value. It does not mean a space. [<2013a]

- 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 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 friction ridge print, which may be used to define how centered a print 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 53**. It is a one character value.

- The second information item (**'x' coordinate / PXC**) is in units of 10 micrometers (0.01 mm)

- The third information item (**'y' coordinate / PYC**) is in units of 10 micrometers (0.01 mm)

- 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 (0.01 mm). The radius of uncertainty may overlap the edge of the image.

Table 53 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 1.63 mm (0.064 in) 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 0[133] 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 136: 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 54**.
- The second information item (**distinctive features polygon / DFP**) is

[133] [2013e>] typographical error corrected [<2013e]

optional. It is a closed path polygon that outlines the area of the distinctive feature. See **Section 7.7.12.** [2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma. [<2013a]. 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.**

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

Table 54 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[134]

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 136: Features and Corresponding presence fields.**

8.9.7.22 Field 9.326: EFS no deltas present / NDEL[134]

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

[134][2015a>] NIEM requires that anything that is an 'indicator' shall be Boolean. Thus, in NIEM-conformant encoding this has a value of 'true' or '1'. Therefore the maximum character count becomes 4 and the type becomes AN for NIEM-conformant XML encoding. [<2015a]

will be omitted. See **Table 136: Features and Corresponding presence fields.**

8.9.7.23 Field 9.327: EFS no distinctive features present / NDIS[134]

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 136: 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 136: 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 (0.01 mm).
- The second information item **('y' coordinate / MYC)** is expressed in units of 10 micrometers (0.01 mm).
- The third information item **(theta / MTD)** is expressed in degrees [2013a>] in the range 0 to 359. If **MDU** is set to 180, **MTD** is undefined and should not be displayed to the user.[<2013a].
- The fourth information item **(type / MTY)** is selected from the "Code" column of **Table 55.**
- 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 **([2015a>] minutiae [<2015a] 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°. [2013a>] If **MDU** is set to 180, **MTD** is undefined and should not be displayed to the user. [<2013a]

Table 55 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 56**.

Table 56 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 (1-based)[135] index of the first minutia.
- The second information item (**minutia index B / MIB**) contains the (1-based)[135] 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 algorithm, 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 136: Features and Corresponding presence fields.**

8.9.7.28 Field 9.335: EFS minutiae ridge count confidence / RCC

This field is optional if **Field 9.333: EFS minutiae ridge counts / MRC** appears in the record[136] [2015a>] and shall not otherwise be included. [<2015a]. It 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 is not used, the default assumption is that the ridge counts were manually determined. This field provides a means to state when only a portion of ridge counts have been manually checked. This field consists of six information items:

[135] [2013a>] Text added for clarity [<2013a]

[136] [2013a>] clarification of when the field can appear, even though it is optional [<2013a]

- The first information item (**ax / ACX**) contains the x coordinates for Point A, in units of 10 micrometers (0.01 mm).
- The second information item (**ay / ACY**) contains the y coordinates for Point A, in units of 10 micrometers (0.01 mm).
- The third information item (**bx / BCX**) contains the x coordinates for Point B, in units of 10 micrometers (0.01 mm).
- The fourth information item (**by / BCY**) contains the y coordinates for Point B, in units of 10 micrometers (0.01 mm).
- The fifth information item (**method of ridge counting / MORC**) states the method by which ridge counts were determined and / or validated. The value is selected from **Table 57.**
- 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 57 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 136: 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 (0.01 mm).

- The second information item (**dot 'y' coordinate / DOY**) is the y coordinate of the center of the dot, expressed in units of 10 micrometers (0.01 mm).

- 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 ridge 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.

[2013a>] An incipient ridge is marked with a line segment along its longest dimension. If the incipient is composed of a series of segments:

- Mark the incipient ridge as a single line when the segments of the incipient are close together or the separations between segments are indistinct.
- Mark the incipient ridge segments individually when they are clearly separate, with distinct lines drawn for each one.
- Mark the incipient ridge as a series of adjoining, unbroken line segments when it curves. [<2013a][137]

When no incipient ridges are present, this field shall not be used. See **Table 136: 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 (0.01 mm).

- The second information item (**y1 / Y1C)** contains the 'y' coordinate of one endpoint, in units of 10 micrometers (0.01 mm).

- The third information item (**x2 / X2C**) contains the 'x' coordinate of the other endpoint, in units of 10 micrometers (0.01 mm).

- The fourth information item (**y2 / Y2C**) contains the 'y' coordinate of the other endpoint, in units of 10 micrometers (0.01 mm).

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

[137] [2013a>] Detailed clarification added.[<2013a]

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 136: 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 (0.01 mm).
- The second information item (**dy1 / Y1D**) shall contain the 'y' coordinate of one endpoint, in units of 10 micrometers (0.01 mm).
- The third information item (**dx2 / X2D**) shall contain the 'x' coordinate of the other endpoint, in units of 10 micrometers (0.01 mm).
- The fourth information item (**dy2 / Y2D**) shall contain the 'y' coordinate of the other endpoint, in units of 10 micrometers (0.01 mm).
- The fifth information item (**type / TPD**) shall be noted using the codes from **Table 58**[138] [2015n] for permanent flexion creases, but is omitted for linear discontinuites.[<2015n]

[2015a>] **TPD** may be set to **RLC**, **PTC**, **DTC**, **WC** or **DPC** only if any instances of **Field 9.302: EFS finger - palm - plantar position / FPP** finger – palm – plantar positon / **FPP** indicates a palm (values 20-38, 81-86). **TPD** may be set to **DIP**, **PIP** or **PDC** only if any instances of **FPP** indicate a finger (values 0-10, 16,17). [<2015]

[138] 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.

Table 58 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 9** 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

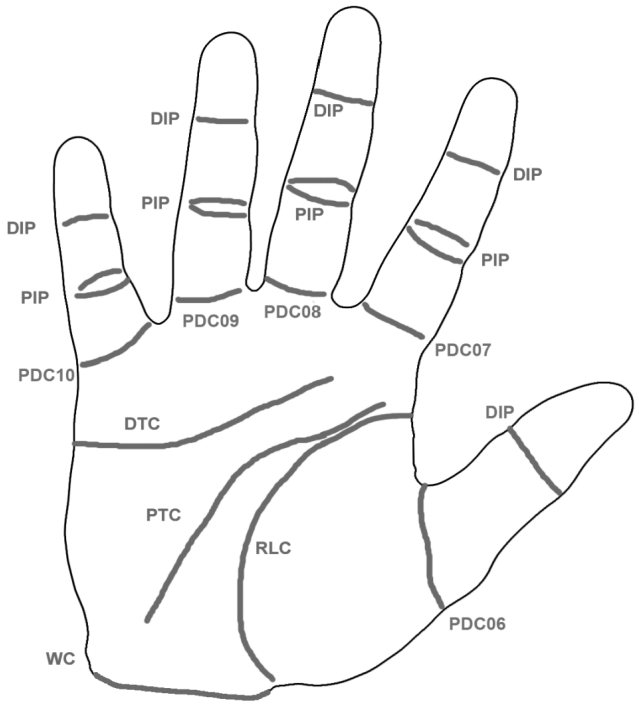


Figure 10: EFS locations of major flexion creases

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 edges are present, this field shall not be used. See **Table 136: 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 (10 µm = 0.01 mm).
- The second information item **(y coordinate / CLY**) contains the 'y' coordinate of the center of the feature, in units of 10 micrometers (0.01 mm).
- 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 [2013e>] pores [<2013e] could be discerned in the image, this field shall be set to Y; otherwise, this field will be omitted. See **Table 136: 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 136: Features and Corresponding presence fields.**

Each pore 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 (0.01 mm).
- The second information item **(y coordinate / POY**) contains the 'y' coordinate of the center of the pore, in units of 10 micrometers (0.01 mm).

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 136: 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 136: 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 136: 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 136: 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 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).[139] 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 print features were detected and encoded, using the values from

[139] 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 "Code" column of **Table 59**.

- 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 print 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 print 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".
- 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 59 EFS codes for methods of feature detection

Code	Usage
AUTO	The 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 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 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 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 one or more three-letter codes[140] from **Table 60** indicating the technique(s) used to process the latent print. This field is only used for latent images. Unprocessed impressions (latent 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 compilation 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 61**.
- The second information item **(examiner last name / ALN**) shall contain the surname (last name) of the print examiner.
- The third information item **(examiner first name / AFN**) shall contain the first name (given name, or first and middle names) of the print 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.

[140] [2013e>] Text corrected to correspond to **Table 42 Type-9 Fields for EFS** occurrence maximum for this field [<2013e]

- 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 friction 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 62.**

- 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 63**.

- 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 64**. 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 60 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[141]	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	RUV[142]	Reflective ultra-violet imaging system (RUVIS)
DAB	Diaminobenzidine	SAO	Safranin O
DFO	1,8-diazafluoren-9-one	SDB	Sudan black
FLP	Fluorescent powder	SGF	Superglue fuming (cyanoacrylate)
GEN	Genipin	SPR	Small particle reagent
GRP	Gray powder	SSP	Stickyside powder
GTV	Gentian violet	SVN	Silver nitrate
HCA	Hydrochloric acid fuming	TEC	Theonyl Europiom Chelate
IOD	Iodine fuming	TID	Titanium dioxide
ISR	Iodine spray reagent	VIS	Visual (latent image, not processed by other means)
LAS	Laser	WHP	White powder
LCV	Leucocrystal violet	ZIC	Zinc chloride

[141] [2013n>] This is an unknown type of light source. Use LAS or RUV when source is known. [<2013n]

[142] [2013n>] New in the 2013 Update [<2013n]

Table 61 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 62 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 63 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 64 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 65**.
- The second information item (**polygon / LQP**) is a closed path outlining the area of the quality issue. See Section 7.7.12. [2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma. [<2013a]. 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.**
- The third information item (**comment / LQC**) is optional and may contain text describing the quality issue.

Table 65 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.**[143]

- 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. [2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma.[<2013a]. 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.**

- The third information item **(corresponding area comment / CAC)** is optional and allows a free text comment or description related to the **AOC**.

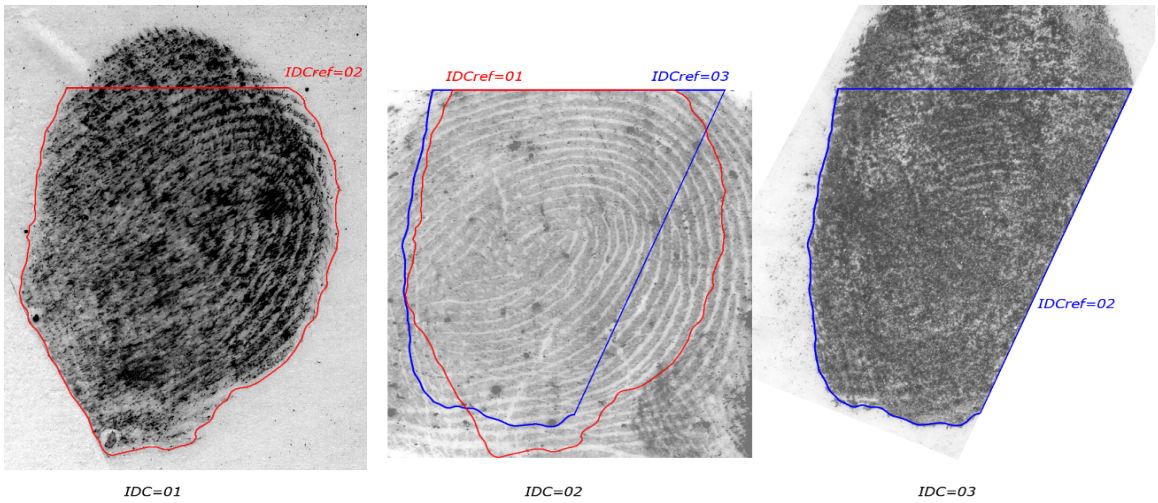


Figure 11 EFS IDC references in areas of correspondence for more than 2 images

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**

[143] **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 (**IDC** - 03) has a single **AOC**, corresponding to the second image, so **CIR** = 02.

F.6.6.1 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 66**). 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.

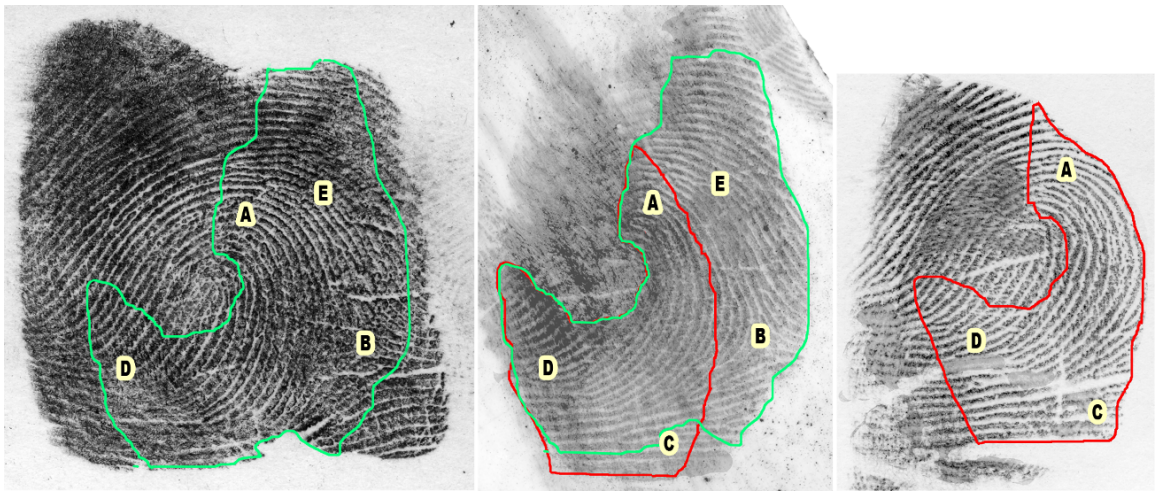


Figure 12: EFS areas and points of correspondence in rolled exemplar, latent, and plain exemplar images

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 that 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 67.**

- 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 66**. 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 mandatory if **TOC** = P or DP and is optional if **TOC** = X[144]. It is expressed in units of 10 micrometers (0.01 mm).

- The sixth information item **(corresponding 'y' coordinate / CYC)** is mandatory if **TOC** = P or DP and is optional if **TOC** = X[144]. It is expressed in units of 10 micrometers (0.01 mm).

- The seventh information item **(comment / COC)** is optional and may contain a text comment or description related to the **CPF**.

Table 66 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 67 EFS codes for types of corresponding points and features

[144] [2013n>] The conditionality is changed from the base 2011 version which stated: " conditional, used only if **TOC** = P or DP" This is to allow an examiner to demonstrate the lack of correspondence for a feature that doesn't exist. [<2013n]

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. The X,Y position may be used to optionally indicate where the absent feature would have been expected.[145]
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

[145] [2013n>] In order to allow an examiner to demonstrate the lack of correspondence for a feature that doesn't exist, the text has been changed from the 2011 version, which stated: "(X, Y, Field Number, and Field Occurrence information items are unused)" [<2013n]

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 68**. 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 print examiner.

- The fifth information item **(examiner first name / EFN**) is the given name (first name or first and middle names) of the print 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.

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.

Table 68 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)

8.9.7.51 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.6.7 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[146] 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.6.7 Ridge path: Skeletonized image and ridge path segments.**

[2013a>] In Traditional encoding, the two special characters allowed are hyphen and comma.[<2013a]

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.

8.9.7.53 Field 9.380: EFS temporary lines / TPL

[2013n>] This field is used by a latent examiner to annotate a friction ridge image with temporary lines, generally for use as reference points in making a comparison. These lines are solely for the individual examiner's use and reference – there are no implied

[146] PNG (Portable Network Graphics) is specified in ISO / IEC 15948:2004 See **Section 3 Normative references.**

semantics through the use of this field. This field has subfields, each of which describes a line segment. Each subfield is comprised of six mandatory information items.

- The first information item, **x coordinate point A / TXA,** is expressed in units of 10 micrometers (0.01 mm).
- The second information item, **y coordinate point A / TYA,** is expressed in units of 10 micrometers (0.01 mm).
- The third item, **x coordinate point B / TXB,** is expressed in units of 10 micrometers (0.01 mm).
- The fourth information item, **y coordinate point B / TYB,** is expressed in units of 10 micrometers (0.01 mm).
- The fifth information item, **line color / TLC,** is an RGB color value expressed as a hexadecimal number.[147] Some basic colors are red (FF0000), yellow (FFFF00), blue (0000FF), green (008000), black (000000) and white (FFFFFF). There shall be a total of 6 hexadecimal characters – with leading zeros where applicable.
- The sixth information item, **line thickness / TLT,** is expressed as a positive integer. Thickness is expressed in units of 0.01 mm. Any value from and including 1 through and including 99 is acceptable; suggested values are 3 (thin); 6 (medium); 9 (thick), and 15 (bold). [<2013n]

8.9.7.54 Field 9.381:EFS feature color and comment / FCC

[2013n>] This field enables a latent print examiner to annotate individual features with color for display and / or comment. It consists of multiple subfields, each containing four information items. The first two information items are mandatory. One or both of the third or fourth information items shall be present in each subfield.

- The first information item, **feature - field number / FTF,** indicates the field which is annotated with color for display and / or comment. This information item is selected from the Field number column of **Table 69 EFS codes for field numbers used for feature color.**
- The second information item, **feature – field occurrence / FTO,** indicates which repeating subfield of the specified field the label is applied to. Occurrences are numbered starting with 1 (1-based index, not a 0-based index).
- The third information item, **feature – color / FTC**, is an RGB color value expressed as a hexadecimal number.[147] Some basic colors are red (FF0000), yellow (FFFF00), blue (0000FF), green (008000), black (000000) and white (FFFFFF). There shall be a total of 6 hexadecimal characters – with leading zeros where applicable.

[147] [2013n>] See http://www.w3schools.com/tags/ref_colorpicker.asp for a tool to assist in the selection of hexadecimal values for colors. [<2013n]

- The fourth information item, **feature – comment / COM,** allows a free text comment or description to be provided by the examiner about the referenced field and subfield in this instance of a **Type-9** record.

Table 69 EFS codes for field numbers used for feature color

Field Number	Type
320	Cores
321	Deltas
323	Center Point of Reference
324	Distinctive Characteristics
331	Minutiae
340	Dots
341	Incipient Ridges
342	Creases and Linear Discontinuities
343	Ridge Edge Features
345	Pores
357	Local Quality Issues
373	Ridge Path Segment

[<2013n]

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, palm print, 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 128 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 128 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: Photographic body part imagery (including face and SMT)[148] 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.

[2013d>] The 2013 Update includes new fields **10.034,** and **10.046** through **10.050**. **Field 10.034** allows for a range of uncertainty as to when the image was captured (such as when an image of a missing person is provided by relatives from a photo album). **Field 10.046** describes the subject status – particularly useful for Disaster Victim Identification (DVI), identification of Unknown Deceased and of living persons unable to identify themselves. **Field 10.047** allows entry of the capture organization name (such as a Doctor's office). **Field 10.049** allows description of cheiloscopic images (lip prints). **Field 10.050** allows entry of dental visual image descriptive data (including intraoral images).

New Image codes are added to **Table 137: Definitions for ridge quality map values.** These are HEAD, LIP, EXTRAORAL (images of the mouth region taken from outside of the mouth – such as a cropped image of a face showing just the smile with the teeth visible) and INTRAORAL (images of the oral cavity taken from within the mouth). [<2013d]

[2013d>] **Type-10** records are restricted to 2D images created using visible light. Other types of imagery are stored in a **Type-22** record See **Record Type-22: Non-photographic imagery data record**.

Note that transilluminated images[149] can be contained in a **Type-10** record. [<2013d]

[148] [2013a>] The name of the record is changed from "facial, other body part and SMT image record" to clarify the distinction between **Type-10** records and **Type-22** records, which are added in the 2013 Update [<2013a]

[149] [2013d>] See Section 14.8 of R. Dorion, *Bitemark Evidence: A Color Atlas and Text, 2nd Edition,* CRC Press, Boca Raton, Florida, 2011 for a discussion of transillumination techniques. [<2013d]

Table 70 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 71 Type-10 image types**	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
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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
10.011	**CGA**	**COMPRESSION ALGORITHM**	M	A[150]	3	5	value from **Table 19 Compression codes** [151]	1	1
10.012	**CSP**	**COLOR SPACE**	M	A	3	4	values from **Table 28**	1	1
10.013	**SAP**	**SUBJECT ACQUISITION PROFILE**	D	N	1	2	see values in **Table 12**	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	0 ≤ LHC < HLL[152] integer	1	1
	RHC	right horizontal coordinate value	M↑	N	1	5	0 ≤ RHC < HLL integer RHC > LHC	1	1
	TVC	top vertical coordinate value	M↑	N	1	5	0 ≤ TVC < VLL integer	1	1
	BVC	bottom vertical coordinate value	M↑	N	1	5	0 ≤ BVC < VLL integer BVC > TVC	1	1
	BBC	bounding box head position code	O↑	A	1	1	value from **Table 72**	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 31**	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								

[150] [2015n> Earlier versions had AN, but since WSQ20 is not an allowed value for the compression type, it is more technically correct to specify this as A. [<2015n]

[151] [2013a>] The value WSQ20 is not allowed. Facial types have additional constraints found in **E.6.1 Compression algorithm** [<2013a]

[152] [2013e>] For the coordinate values, the proper lower bound is 0 and the upper limit is a 'less than' condition. [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	HPO	horizontal point offset	M↑	N	1	5	0 ≤ HPO < HLL[153] integer	2	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL[153] non-negative integer	2	NOP
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**	O[154]					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 73**	0	1
10.021	**POA**	**POSE OFFSET ANGLE**	D	NS	1	4	-180 ≤ POA ≤ 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↑	ANS[155]	5	14	value from **Table 74**	1	1

[153] [2013e>] HPO and VPO are 'less than' their upper limits. [<2013e]

[154] [2013n>] Changed from D to O since all types of images can now be reflected in this field, not just FACE. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 ≤ QVU ≤ 100 non-negative 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
10.025	**SPA**	**SUBJECT POSE ANGLES**	D					0	1
	YAW	yaw angle	M↑	NS	1	4	-180 ≤ YAW ≤ 180 integer allowed special character: -	1	1
	PIT	pitch angle	M↑	NS	1	3	-90 ≤ PIT ≤ 90 integer allowed special character: -	1	1
	ROL	roll angle	M↑	NS	1	4	-180 ≤ ROL≤ 180 integer allowed special character: -	1	1
	YAWU	uncertainty in degrees for yaw	O↑	N	1	2	0 ≤ YAWU ≤ 90 non-negative integer	0	1
	PITU	uncertainty in degrees for pitch	O↑	N	1	2	0 ≤ PITU ≤ 90 non-negative integer	0	1

[155] [2013a>] Changed from AN in 2011 due to the redefinition of Alphabetic (A) to not include spaces. The 'special character' is the space [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	ROLU	uncertainty in degrees for roll	O↑	N	1	2	0 ≤ ROLU ≤ 90 non-negative integer	0	1
10.026	**SXS**	**SUBJECT FACIAL DESCRIPTION**	D					0	1
		Subfields: repeating values	M↑	AS [156]	3	20	value from **Table 75**	1	50
10.027	**SEC**	**SUBJECT EYE COLOR**	D	A	3	3	value from **Table 29**	0	1
10.028	**SHC**	**SUBJECT HAIR COLOR**	D					0	1
		Subfields: Repeating values	M↑	A	3	3	value from **Table 76**	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	1	1
	HCX	X coordinate	M↑	N	1	5	0 ≤ HCX< HLL non-negative integer [157]	1	1
	HCY	Y coordinate	M↑	N	1	5	0 ≤ HCY < VLL non-negative integer [157]	1	1
10.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	entries from **Table 6**	0	1
10.031	**TMC**	**TIERED MARKUP COLLECTION**	D	N	1	3	positive integer see **Table 79**	0	1
10.032	**3DF**	**3D FACIAL FEATURE POINTS**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	88

[156] [2013a>] Changed from A in the 2011 version, due to the redefinition of code A (alphabetic) to not include spaces. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FPT	feature point type	M↑	N	1	1	FPT = 1 or 2	1	1
	FPC	feature point code	M↑	ANS	1	5	Format: N.N, N.NN, NN.N, NN.NN, a, aa, aaa or aaaa	1	1
	HCX	x coordinate	M↑	N	1	5	0 ≤ HCX < HLL non-negative integer [157]	1	1
	HCY	y coordinate	M↑	N	1	5	0 ≤ HCY < VLL non-negative integer [157]	1	1
	HCZ	z coordinate	M↑	N	1	5	0 ≤ HCZ ≤ 99999 non-negative integer [157] [158]	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 30**	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; non-negative integer [157]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL non-negative integer	3	NOP

[157] [2013n>] Lower range boundary extended from 1 to zero to allow markups on the edge. Upper bound is < not ≤ [<2013n]

[158] [2013n>] The upper bound is changed from 65,535 to correspond to the upper bounds for x and y coordinates See **Section 7.7.8.1** and **Section 7.7.8.2** [<2013]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
10.034 [159]	**ICDR**	**IMAGE CAPTURE DATE RANGE ESTIMATE**	O	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M months, D days	0	1
10.035-10.037		**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	$1 \leq T10 \leq 255$ positive integer	0	1
10.040	**SMT**	**NCIC SMT CODE**	D					0	1
		Subfields: Repeating values	M↑	AS [156]	3	10	values from **Annex D: NCIC code table**	1	3
10.041	**SMS**	**SMT SIZE OR SIZE OF INJURY OR IDENTIFYING CHARACTERISTIC**	D					0	1
	HGT	height	M↑	N	1	3	positive integer	1	1
	WID	width	M↑	N	1	3	positive 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 "Field 10.042 SMT Code" column of **Table 71**	1	1
	TAC	tattoo class	D	A	4	8	value from **Table 80**	0	1
	TSC	tattoo subclass	D	A	3	11 [160]	value from **Table 80**	0	1
	TDS	tattoo description	D	U	1	256	none	0	1

[159] [2013d>] New field in the 2013 Update. [<2013d]

[160] [2013e>] Typographical correction [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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 81**	1	1
	TC2	tattoo color code 2	O↑	A	3	7	values from **Table 81**	0	1
	TC3	tattoo color code 3	O↑	A	3	7	values from **Table 81**	0	1
	TC4	tattoo color code 4	O↑	A	3	7	values from **Table 81**	0	1
	TC5	tattoo color code 5	O↑	A	3	7	values from **Table 81**	0	1
	TC6	tattoo color code 6	O↑	A	3	7	values from **Table 81**	0	1
10.044	**ITX**	**IMAGE TRANSFORM**	O					0	1
		Subfields: Repeating values	M↑	A	3	11	values from **Table 82**	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 32**	1	1
	OCT	occlusion type	M↑	A	1	1	OCT = H, S, C, R, or O **Table 33**	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 <u>as pairs</u>, in order by point following the path, up to the final point - for a total of **NOP** pairs								

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	HPO	horizontal point offset	M↑	N	1	5	0 ≤ HPO < HLL non-negative integer [157]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL non-negative integer [157]	3	NOP
10.046 [161]	**SUB**	**IMAGE SUBJECT CONDITION**	O					0	1
	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2 positive integer	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1, 2, or 3 positive integer	0	1
10.047 [161]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
10.048 [161]	**PID**	**SUSPECTED PATTERNED INJURY DETAIL**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	PARC	patterned injury -reference code list [162]	O↑	U	1	30	none	0	1
	PADT	patterned injury - additional descriptive text	D	U	1	*	none	0	1
10.049 [161]	**CID**	**CHEILOSCOPIC IMAGE DESCRIPTION**	D					0	1
	LPW	lip print width	O↑	N	1	4	positive integer	0	1
	LPH	lip print height	O↑	N	1	4	positive integer	0	1

[161] [2013d>] New field for the 2013 Update [<2013]

[162] [2015n>] Specifications and the name for this information item have been modified to allow more flexibility in the use of additional codes. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	PHW	philtrum width	O↑	N	1	4	positive integer	0	1
	PHH	philtrum height	O↑	N	1	4	positive integer	0	1
	ULCL	upper lip characterization list	O↑	AS	1	3[163]	**list** of values from Type-code column of **Table 83 Cheiloscopic characterization codes.**	0	LIST of up to 5 values [163]
	LLCL	lower lip characterization list	O↑	AS	1	3[163]	**list** of values from Type-code column of **Table 83 Cheiloscopic characterization codes.**	0	LIST of up to 5 values [163]
	LCLD	lip contact line descriptor	O↑	A	1	1	LCLD = L, C or M	0	1
	LPCT	lip print characterization text	D [164]	U	1	*	none	0	1
	LPPL	lip print pathologies and peculiarities list	D [164]	NS	1	2[163]	**list** of values from Type-code column of **Table 84 Lip Pathologies and peculiarities codes**	0	LIST of up to 13 values. Only one of the values 8, 9, 10, 11 or 12 may appear in the list. [163]
	LPPT	lip print pathologies and peculiarities descriptive text	D 164	U	1	*	none	0	1

[163] [2015a>] Character Min# and Max# refers to each element in the list. The number of elements in the list is mentioned in Occurrence Max#.There is a maximum of one list.[<2015a]

[164] [2015e>] Typographical correction [<2015e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	LPSL	lip print surface list	O↑	NS	1	1[163]	list of values from Type-code column of **Table 85 Lip print surface codes**	0	LIST of up to 3 values. If Type-code 1 is chosen, no other values are allow-ed.[163]
	LPST	lip print surface descriptive text	D[164]	U	1	*	none	0	1
	LPMC	lip print medium code	O↑	N	1	1	integer from Type-code column of **Table 86 Lip print medium codes**	0	1
	LPMT	lip print medium descriptive text	D[164]	U	1	*	none	0	1
	FHDT	facial hair descriptive text	O↑	U	1	*	none	0	1
	LPDT	lip print position and tension text	O↑	U	1	*	none	0	1
	LPAT	lip print additional descriptive text	O↑	U	1	*	none	0	1
	LPCT	lip print comparison descriptive text	O↑	U	1	*	none	0	1
10.050 161	**VID**	**DENTAL VISUAL IMAGE DATA INFORMATION**	D[164]					0	1
	VIVC	visual image view code	M↑	A	3	4	valid code from **Table 87 Dental image codes**	1	1
	VIDT	visual image additional descriptive text	O[164]	U	1	*	none	0	1
	VICD	visual image comparison descriptive text	O[164]	U	1	*	none	0	1
10.051 165	**RSP**	**RULER OR SCALE PRESENCE**	O					0	1

[165] [2013n>] New field in the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	RSU	ruler or scale units	M↑ [164]	A	2	4	RSU = IN, MM, or BOTH	1	1
	RSM	ruler or scale make	O [164]	U	1	50	none	0	1
	RSO	ruler or scale model	O [164]	U	1	50	none	0	1
10.052 – 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	*
	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
10.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SER	serial number	M↑	U	1	50	none	1	1
10.905-10.991		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
10.992 [166]	**T2C**	**TYPE-2 RECORD CROSS REFERENCE**	O	N	1	2	0 ≤ T2C ≤ 99 non-negative integer	0	1
10.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
10.994 [167]	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
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
	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

[166] [2013n>] New field for the 2013 Update [<2013]

[167] [2015n>] New field for the 2015 Update. Either **Field 10.994** or **Field 10.999** shall appear in the record, but not both. <2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 [168]	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 [168]	0	1
	ELE	elevation	O	NS	1	8	422.000≤ ELE ≤ 8848.000 real number [168]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [169]	AN	2	3	one or two digits 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

[168] [2013e>] corrected typographical error: < → ≤ [<2013e]

[169] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also show GCM as D. [<2013a]

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**	D[170]	B	1	*	none	1	1

8.10.1 Field 10.001: Record header

The content of this mandatory field is dependent upon the encoding. 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.**

[2015n>] Fields **10.003** through **10.012** are mandatory. This applies whether Field **10.994** (for an externally stored image) or **10.999** (for an image transmitted in this record) is used. [<2015n]

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 71 Type-10 image types** 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**) was new for the 2011 version of the standard.

[2015n>] In **Field 10.003: Image type / IMT,** **SCAR** indicates a visible difference from standard tissue appearance on a body surface that is non-intentional or (quasi)medically induced. It is broken down in **Field 10.042: SMT descriptors / SMD** to SCAR, BIRTHMARK, PIERCING, ZABIBA, and IMPLANTS. The definitions of each are shown in **Table 71 Type-10 image types**. **MARK** refers solely to visible patterns of needle marks on the skin. **TATTOO** in **Field 10.003: Image type / IMT** is used for (intentional) placing of patterns on the skin. It is broken down in **Field 10.042: SMT descriptors / SMD** to TATTOO, CHEMICAL, BRANDED, and CUT. The definitions of each are shown in **Table 71 Type-10 image types**. Note that physical abnormalities are covered by entering the Image Code CONDITION and then using the appropriate NCIC code in **Field 10.040: NCIC code / SMT.** The relevant

[170] [2015n>] **Field 10.994** was added. Only one of either **10.994** or **10.999** shall be in a Type-10 record. [<2015n]

NCIC codes are listed in **Footnote 177.** Image Code OTHER is used for the NCIC codes shown in **Footnote 179**. Image Code MISSING corresponds to the NCIC code MISS. [<2015n]

[2013n>] Note that patterned injuries may be on any part of the body. Patterned injuries are not treated as a separate image type. Appropriate codes for the affected part of the body shown in the image shall be used for patterned injuries. SCAR, MARK, TATTOO, MISSING, OTHER and CONDITION shall not be used for patterned injuries. [<2013n]

Table 71 Type-10 image types

Field 10.003 Image Type	Field 10.042 SMT Code	Description
SCAR	SCAR[171]	Healed tissue that was the result of an accident or medical procedure
	BIRTHMARK[172]	Tissue that is differentiated from normal tissue but is not the result of an accident or medical procedure, such as a 'blood stain' birthmark on part of the face.
	PIERCING[173]	A medical or quasi-medically induced hole in or through the skin – often to allow the insertion of jewelry.
	ZABIBA[172]	Commonly referred to as a 'prayer bump' on the forehead.
	IMPLANT[172]	Sub-dermal implants that are visible as distinct shapes in the skin. This category may also be used to indicate jewelry that has been (semi-)permanently affixed to the body – such as plugs in the earlobes or a microdermal implant that has a jewel above the skin.
TATTOO	TATTOO	An image on the skin resulting from pricking of the skin with a coloring material. This also includes tattoos that have been removed but still leave a pattern on the skin. Note that some tattoos may be visible only in ultra-violet light.
	CHEMICAL	Creation of an image on the skin by using chemicals.
	BRANDED	Creation of an image on the skin by using a branding iron or other form of heat.
	CUT	Creation of an image resulting from patterned cutting of the skin and resultant healing.
MARK	MARK	Patterns of needle marks on the skin.

[171] NCIC code header SC

[172] [2015n>] New for the 2015 Update. [<2015n]

[173] NCIC code header PRCD

Field 10.003 Image Type	Field 10.042 SMT Code	Description
FACE	Not applicable	A mugshot. This may be used for facial recognition algorithms.[174]
FRONTAL-C [175]	Not applicable	These Image Types are used for transmittal of images, such as patterned injuries on various parts of the body. They may also be used for general images of a body, such as with an unknown deceased.
REAR-C[175]		
HEAD[176]		
FRONTAL-N[175]		
REAR-N[175]		
TORSO-BACK		
TORSO-FRONT	Not applicable	These Image Types are used for transmittal of images, such as patterned injuries on various parts of the body. They may also be used for general images of a body, such as with an unknown deceased.
CONDITION[177]		
MISSING[178]		
OTHER[179]		
CHEST		
FEET		
EXTRAORAL[176]		
INTRAORAL[176]		
LIP[176]		
HANDS-PALM		
HANDS-BACK		
GENITALS		
BUTTOCKS		
RIGHT LEG		

[174] [2015a>] Designation of FACE excludes the image from possibly being entered into systems for tattoo recognition. If a face has a tattoo on it, enter one image as a mugshot, indicated by FACE, and another marked TATTOO. [<2015a]

[175] 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.

[176] [2013n>] New codes added are HEAD, INTRAORAL, EXTRAORAL and LIP. [<2013n]

[177] This covers NCIC code headers BALD, BLIND, BLND, CATA, CATARACT, CAUL, CL, CLEFT, CRIP, CROSSEYED, DEV, DIMP, DISC, EXTR, FRECKLES, FRC, HERMAPHR, HFR, HUMPBACKED, MC, MOLE, POCKMARKS, PROT, SHRT.

[178] This covers NCIC code header MISS (Showing the location on the body where the part would normally be).

[179] This covers NCIC code headers ART, BRA, BRAC, BRACE, CANE, CARD, COLOST, CON, DENT, EAR, GLASSES, GOLD, HAIR, HEAR, IMPL, INTRA, ORTH, PACE, SHUNT, SKL, SLVR, STAPLES, SUTUR, TUBE, VASC PROT, TRANSSXL, TRANSCST, TUBE, VASC, WHEELCHAIR, WIRE, .

Field 10.003 Image Type	Field 10.042 SMT Code	Description
LEFT LEG		
LEFT ARM		
CHEST		

[2013a>] The following NCIC code headers are not applicable to **Type-10** images: DA, DEAF, IUD, GLAUCOMA, MUTE, STUTTERS and TD. [<2013a]

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.

[2013n>] It may not be possible to know the exact date of imagery capture. [2015e>]. In such a case, specify the date to the level known. For traditional encoding, fill the unknown portions of the date with zeros. For XML, use a date element with the correct level of precision.[180] [<2015e] In such cases, it is highly recommended that **Field 10.034: Image capture date range estimate / ICDR** be used in conjunction with this field. [<2013n]

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.

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.

[180][2015e>] Fixed and harmonized encoding guidance in accordance with section 7.7.2.3. [<2015e]

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 19 Compression codes** for the labels and **Sections 7.7.9.4** and **7.7.9.5** for a detailed description of this field. Annex E: **E.6.1 Compression algorithm** lists conditions for facial images by **SAP** level. [2013a>] Note that WSQ20 is inapplicable to **Type-10** imagery. [<2013a]

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[181] 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 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.
- The second information item **(right horizontal coordinate value / RHC)** is the right 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.
- 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

[181] New for the 2011 version of the standard.

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 72.**

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[182] 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 Scanned horizontal pixel scale / SHPS** for details.

8.10.17 Field 10.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS** for details.

Table 72 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

[182] New for the 2011 version of the standard.

This optional field contains the type of distortion[183], 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 73** 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.

[2013n>] A value of **POS** = D does not imply that the image itself is a 3D image, such as a point cloud. 3D imagery shall be transmitted in a **Type-22** record. [<2013n]

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 73 Subject pose

Pose description	Pose code	Pose description	Pose code

[183] [2013n>] In 2011, this field was restricted to IMT= FACE. That restriction is removed. It may be utilized for all image types. [<2013n]

Full Face Frontal	F
Right Profile (90 degree)	R
Left Profile (-90 degree)	L

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 74** 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.

[2013n>] Note that all of the acquisition sources in **Table 74 Acquisition source type codes** result in a 2D image in visible light. To transmit other types of imagery, use the **Record Type-22: Non-photographic imagery data record**. [<2013n]

Table 74 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 121 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 121** 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 [2013a>] if and only if [<2013a][184] **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'). 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**.

[184] [2013a>] This is not a technical change – words revised for clarity. [<2013a]

- 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 [2013e>]"30" or greater [<2013e][185]. (**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 75**. 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 75 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
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

[185] [2013e>] **Annex E, Section E.4.9** applies to all SAPs 30 and above but in 2011 this was restricted to 40,50 or 51. [<2013e]

Facial description attribute	Attribute code
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: NCIC code table**
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 [2013n>]"30" or greater [<2013n][186]. 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 29**. 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 [2013n>]"30" or greater [<2013n][187]. For other facial images (**IMT** = 'FACE'), it is optional. When present, it shall contain one or two entries from **Table 76** 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.

[186] [2013e>] The text here is restated to be consistent with **Annex E, Section E.4.11** [<2013e]

[187] [2013e>] The text here is restated to be consistent with **Annex E, Section E.4.10**[<2013e]

Table 76 Hair color codes

Hair color attribute	Attribute code	Hair color attribute	Attribute code
Unspecified or unknown	XXX	White	WHI
Bald	BAL	Blue	BLU
Black	BLK	Green	GRN
Blonde or Strawberry	BLN	Orange	ONG
Brown	BRO	Pink	PNK
Gray or Partially Gray	GRY	Purple	PLE
Red or Auburn	RED	Streaked	STR
Sandy	SDY		

8.10.28 Field 10.029: 2D facial feature points / FFP

The optional field shall be used for the exchange of facial [2013n>] (**IMT** = 'FACE', 'HEAD', 'LIP', 'EXTRAORAL' and 'CONDITION') [<2013n][188] 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. [189] It shall be either:

  1 = Denoting an MPEG4 Feature point; or,
  2 = Denoting an anthropometric landmark.

- The second information item, **feature point code / FPC** is 3 to 5 characters. If

[188] [2013n>] Valid values for IMT are expanded from being restricted to only FACE in 2011 [<2013n]

[189] [2013e>] In the 2011 base version, there was a sentence that incorrectly indicated that a period could be present in this one digit numerical field. [<2013e]

FPT is 1, this information item shall be "A.B" with A and B defined in **Section 8.10.28.1 MPEG4 feature points** and illustrated in **Figure 14.** If FPT is 2, the codes are entered as shown in the "Feature Point ID" column of **Table 78.** 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 77**.

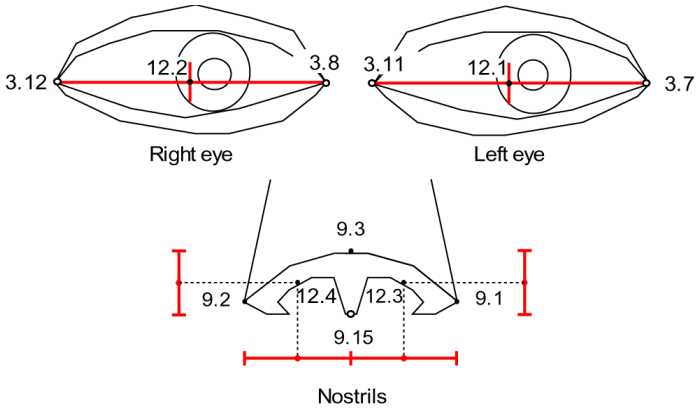


Figure 13: Eye and nostril center feature points

Table 77 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	

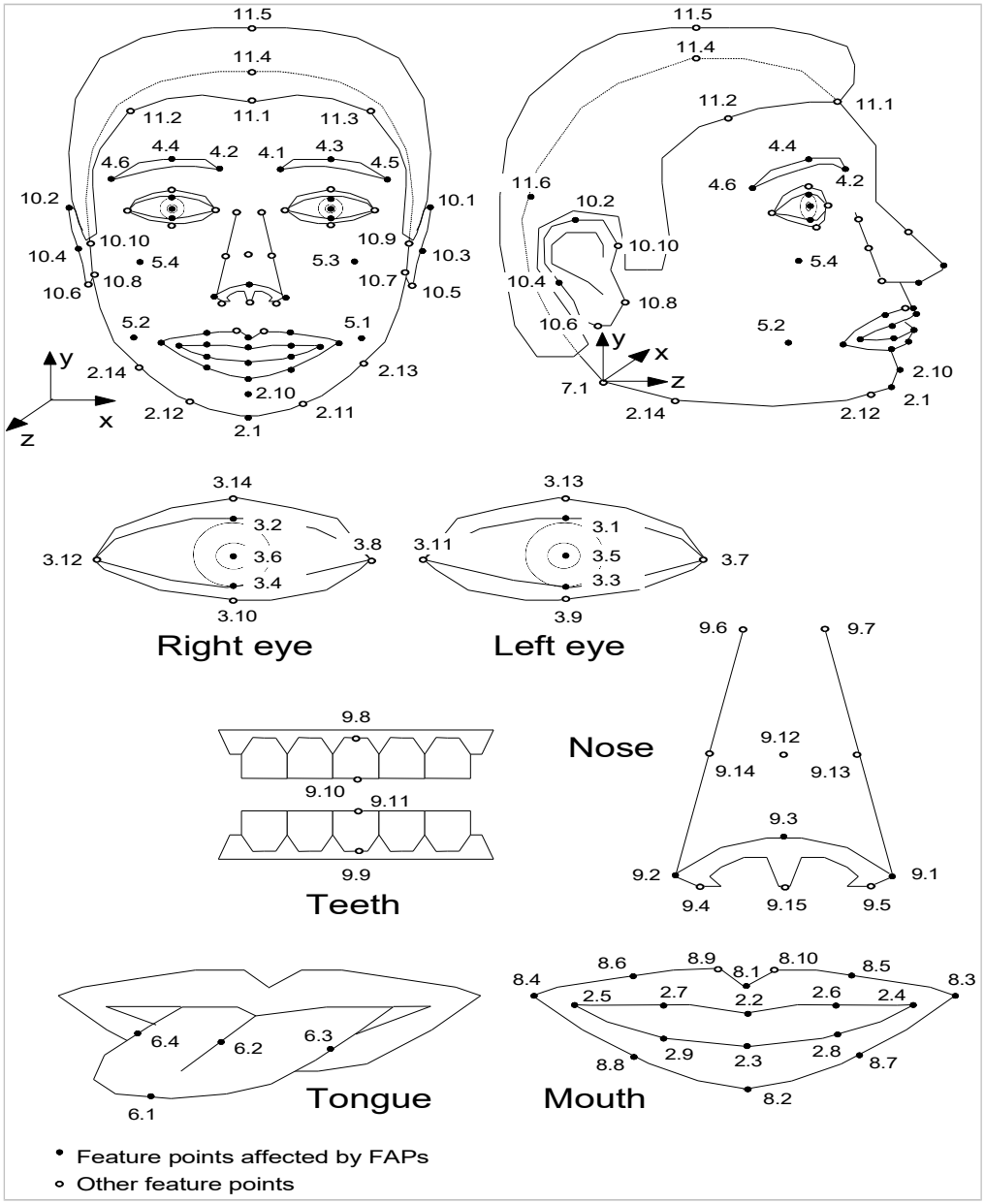


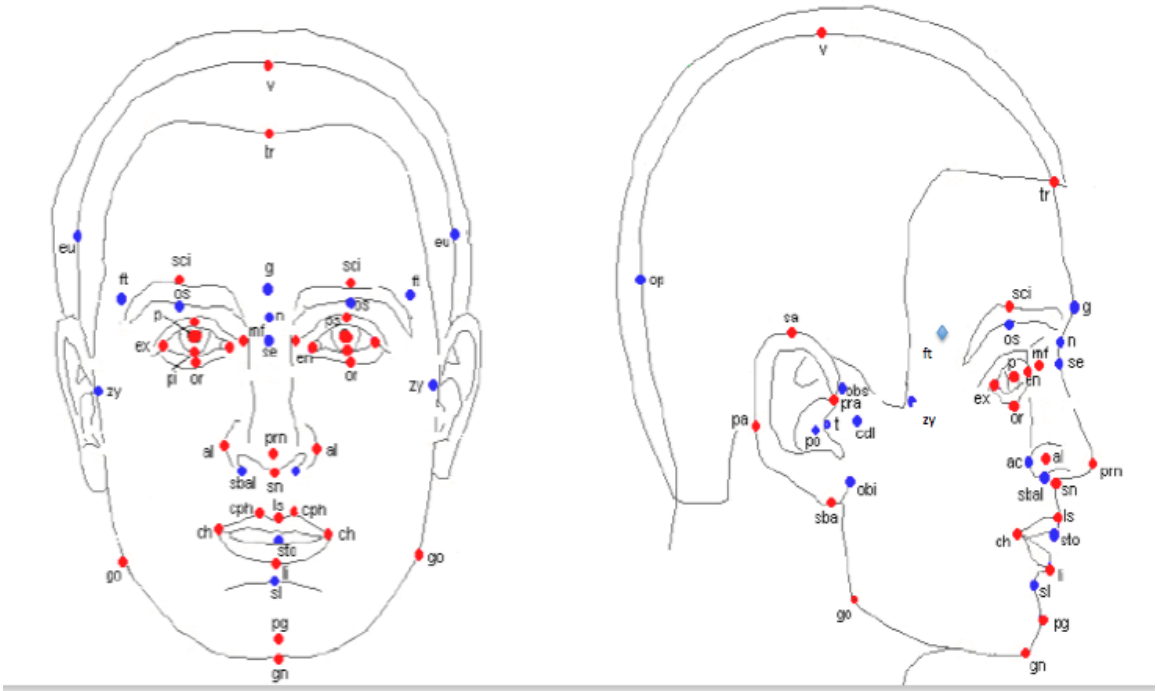
Figure 14: Feature point codes defined in ISO/IEC 14496-2

8.10.28.3 Anthropometric landmarks with and without MPEG4 counterparts

This Section[190] references the definitions specified by ISO[191]. 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**[192] and **Table 78** 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 3 mm. The point on the surface is a vertex, or a point on an edge, or a point on a face of the surface.

[2013e] The locations of points ZY and FT have been corrected in the profile view in **Figure 15: Anthropometric facial landmarks defined in ISO/IEC 19794-5** [<2013e]

Figure 15: Anthropometric facial landmarks defined in ISO/IEC 19794-5



[190] New for the 2011 version of the standard.

[191] See ISO/IEC 19794-5 *Information technology – Biometric data interchange formats – Part 5: Face image data*, Section 5.5.6 Anthropometric Landmarks.

[192] Red landmarks denote with MPEG4 counterparts and blue without MPEG4 counterparts.

Table 78 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 vermilion line
li	8.2	labiale (or labrale) inferius	The midpoint of the lower vermilion line
ch	8.3 8.4	cheilion	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

Feature Point ID	MPEG4 Feature Point	Anthropometric Point Name	Description
sba	10.5 10.6	subaurale	The lowest point of the free margin of the ear lobe
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[193] [2013a>] is defined only if **IMT** = 'FACE'. It specifies feature points that shall [<2013a] be contained in **Field 10.029: 2D facial feature points / FFP** and if the value of **TMC** is 5, these contours shall be contained in **Field 10.033: Feature contours / FEC**. It is selected from the "Value" column of **Table 79.**

[193] New for the 2011 version of the standard.

Table 79 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 [2013n>] (**IMT** = 'FACE', 'HEAD', 'LIP', 'EXTRAORAL' and 'CONDITION') [<2013n][188]. 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.

[2013a>] The 3D facial feature points are noted on a 2D image, since **Type-10** records only convey 2D visible light photographic images. [<2013a]

- 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 MPEG4 feature points** 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 78.** 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 [2013n>] image [<2013n][194] and contains a minimum of three points. [2013a>] This field shall appear if **TMC** = 5. It is optional otherwise. [<2013a]

8.10.33 Field 10.034: Image capture date range estimate / ICDR

[2013n> This is the amount of time (plus and minus) of which **PHD** is the center point during which the image data could have been originally collected. In Traditional format, it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month

[194] [2013n>] In 2011, this field was restricted to use when **IMT** = FACE. That restriction has been removed in the 2013 Update. [<2013n]

and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **PHD.** Leading zeros need not be entered.

[2015a>]For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

8.10.34 Field 10.038: Comment / COM

This is an optional field. See **Section 7.4.4.**

8.10.35 Field 10.039: Type-10 reference number / T10

This is an optional field. It [2015 a>] may be [<2015a] used when several images cover either the entire scar, (needle) mark, tattoo (SMT) or portions of it.

[2013d>] This field shall be present if **lip print comparison descriptive text / LPCD** is present in **Field 10.049: Cheiloscopic image data / CID** or **dental visual image comparison descriptive text / VICD** is present in **Field 10.050: Dental visual image data information / VID**. [<2013d]

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 **T10.** No other **Type-10** records (in this example) would have a value of 1 for **T10.**

8.10.36 Field 10.040: NCIC code / SMT

This field shall be used only when **Field 10.003: Image type / IMT** = "SCAR", "MARK", "TATTOO", [2015n>] "CONDITION", "MISSING" or "OTHER". [<2015n]

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: NCIC code table**). 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.

8.10.37 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. [195]

8.10.38 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 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. The value for this information item is selected from the "Image sub-code" column of **Table 71.** It shall contain *"SCAR"* to indicate healed scar tissue that was the result of 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.

  [2015a>] Published best practice guidelines on the collection of tattoo images to support image-based tattoo recognition are available at http://www.nist.gov/itl/iad/ig/tattoo.cfm [<2015a]

- The second information item **(tattoo class / TAC)** shall be the general class code of tattoo chosen from the "Class Code" column of **Table 80**. 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 80.** For each general class of tattoo, there

[195] [2013n>] The restriction against using this field if **Field 10.003** is set to FACE is lifted in this update. [<2013n]

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 80 Tattoo classes and subclasses

Class Code	Subclass Description	Subclass Code
HUMAN	Male Face	MFACE
	Female Face	FFACE
	Abstract Face	ABFACE
	Male Body	MBODY
	Female Body	FBODY
	Abstract Body	ABBODY
	Roles (Knight, Witch, man, etc.)	ROLES
	Sports Figures (Football Player, Skier, etc.)	SPORT
	Male Body Parts	MBPART
	Female Body Parts	FBPART
	Abstract Body Parts	ABBPART
	Miscellaneous Human Forms	MHUMAN
	Skulls	SKULL

Class Code	Subclass Description	Subclass Code
ANIMAL	Cats & Cat Heads	CAT
	Dogs & Dog Heads	DOG
	Other Domestic Animals	DOMESTIC
	Vicious Animals (Lions, etc.)	VICIOUS
	Horses (Donkeys, Mules, etc.)	HORSE
	Other Wild Animals	WILD
	Snakes	SNAKE
	Dragons	DRAGON
	Birds (Cardinal, Hawk, etc.)	BIRD
	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

8.10.39 Field 10.043: Tattoo color / COL

This field is optional, but it can only be 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 state 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 81**. Additional colors may be entered as optional subsequent information items of the form **tattoo color code 1** through **tattoo color code 6**. There need not be more than one information item.

Table 81 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

8.10.40 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 82 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

Value	Description
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

8.10.41 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 32.**
- The second information item contains the alphabetic code from **Table 33**.

8.10.42 Field 10.046: Image subject condition / SUB

[2013n>] This field is optional. This field is particularly useful if the image contained in this record is of an injury. However, its use is not limited to such circumstances.

SUB reflects the status of the subject when the image was taken, not necessarily the current status of the individual. For instance, if a photograph is furnished by a family to assist in Disaster Victim Identification, the subject would be listed as alive at the time of the image capture. A different instance of Record **Type-10** may contain a postmortem image, with **SSC** recorded as deceased. Use of X for **SSC** would be for instances such as an image of a person who died of injuries but the status of the individual at the time of imagery was not recorded – or for a detached body part (such as an arm) imaged at a disaster scene.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or persons unable to identify themselves

  D = Data obtained from a non-living person (deceased)

- The second information item is mandatory if **SSC** is D. It is optional for codes X or A. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire body or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

SBSC may occur with a value of **SSC** equal to X, A or D when a detached body part is imaged. **IMT** would be set to the appropriate code for the body part and **SBSC** would be set to 2**.**

IMT = MISSING shall be used to image the area of the body from which a body part was separated and **SBSC** would be set to a value of 1 in that case**.**

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code / SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

  3 = Skeletal

8.10.43 Field 10.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 10.004: Source agency/ SRC** and **Field 10.993: Source agency name / SAN**. **SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example,

- The photograph of a subject's mouth (intraoral) was taken at a dentist's office two years ago – and now could be used for possible identification of a body following a disaster. That Dentist office is entered as the **CON.**
- The local police department that would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 10.004: Source agency/ SRC** (for example *NA54-X*) and its name in **Field 10.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**.

8.10.44 Field 10.048: Suspected patterned injury detail / PID

This optional field allows the entry of information concerning suspected patterned injuries. Values for **Field 10.003: Image type / IMT** of SCAR, MARK, TATTOO, MISSING, OTHER and CONDITION shall not be used for patterned injuries, and thus this field shall not appear if **IMT** is set to any of those values. **Field 10.041: SMT size or size of injury or identifying characteristic / SMS** should be included in the record if this field is present. This field contains an unlimited number of subfields with the following information items:

- [2015n>] The first information item is the **patterned injury - reference code list / PARC**. If there is a definitive code list for patterned injuries agreed upon for use by the sending and receiving organizations, this information item may contain that code. (This expands the possibilities from the 2013 version.) [<2015n]
- The second information item is the **patterned injury - additional descriptive text / PADT**. It is a Unicode free text information item. It shall appear in a subfield if **PARC** is not present in the subfield. It is optional if **PARC** is present in the subfield. [<2013n]

8.10.45 Field 10.049: Cheiloscopic image data / CID

[2013d>] This is an optional field. If this field is encoded in Traditional format, each of the values in information items designated as a 'list' shall be separated by '|' (vertical bar). For XML each value in a list should be entered as a separate element. This field may be used only if **Field 10.003: Image type / IMT** is LIP.

For cheiloscopic analysis, it may be useful to include information in **Field 10.029: 2D facial feature points / FFP** indicating the position of certain features of the lips on the image, using the points shown in **Figure 14: Feature point codes defined in ISO/IEC 14496-2**. Note that **Field 10.032: 3D facial feature points/ 3DF** may also be used, with the feature points selected from **Figure 15: Anthropometric facial landmarks defined in ISO/IEC 19794-5**. **Field 10.033: Feature contours / FEC** may be used to outline distinctive features in a lip print. When distinct features are outlined for comparison on an exemplar and a latent image, then **Field 10.039: Type-10 reference number / T10** should be used to link the two **Type-10** records. Measurements are millimeters.

- The first information item, **lip print width / LPW**, is optional. It corresponds to the distance from feature point code 8.4 to feature point code 8.3 on the MOUTH in **Figure 14: Feature point codes defined in ISO/IEC 14496-2**. It is measured in millimeters.
- The second information item, **lip print height / LPH**, is optional. It contains the distance from feature points 8.2 to feature point 2.3 PLUS the distance from feature point 2.2 to feature 8.1 on the MOUTH in **Figure 14: Feature point codes defined in ISO/IEC 14496-2**. It is measured in millimeters.
- The third information item, **philtrum width / PHW** is optional[197]. It is the distance from feature point 8.9 to 8.10 as shown in **Figure 14: Feature**

point codes defined in ISO/IEC 14496-2. It is measured in millimeters.

- The fourth information item, **philtrum height / PHH** is optional[197]. It is the distance in millimeters from feature point 8.1 to 9.15 (on the nose) as shown in **Figure 14: Feature point codes defined in ISO/IEC 14496-2.**

- The fifth information item, **upper lip print characterization list/ ULCL,** is optional. [2015a>]It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a] The characterizations are those developed by Suzuki and Tsuchihashi[196] The Type-code from **Table 83 Cheiloscopic characterization codes** is entered in this information item. It is highly recommended that any distinctive patterns be outlined using **Field 10.033: Feature contours / FEC**.

- The sixth information item, **lower lip print characterization list/ LLCL,** is optional. [2015a>] It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a] The characterizations are those developed by Suzuki and Tsuchihashi[196]. The Type-code from **Table 83 Cheiloscopic characterization codes** is entered in this information item. It is highly recommended that any distinctive patterns be outlined using **Field 10.033: Feature contours / FEC**.

An example, coded as lists is: **ULCL** = II | I | <> | I | II

and **LLCL** = III| I | <> | I | II

The vertical bar "|" is used in Traditional format in a list as a separating character. In XML encoding, each value (including <>) is a separate element and the vertical bar does not appear.

Table 83 Cheiloscopic characterization codes

Type-code	Description
Suzuki and Tsuchihashi descriptors	
I	A clear cut groove running vertically across the lip
IP	Partial-length groove of Type I (IP is used in lieu of I' in coding)
II	Branched groove (fork-like; fork in their transit of the lip)
III	An intersected groove
IV	A reticular groove (cross-hatch or a net-like pattern)
<>	Indicator for center of the lip (left < followed by right >)
O	Other pattern(s) – Describe in **LPCT** **(Also called Type V by Suzuki and Tsuchihashi)**

- The seventh information item is the **lip contact line descriptor / [2015e>] LPCT [<2015e].** It is

[196] [2013d>] Suzuki K, Tsuchihashi Y., *Personal identification by means of lip prints,* Journal of Forensic Medicine 1970, 17-52-7 and *New attempt of personal identification by means of lip prints*, Canadian Society of Forensic Science Journal, 1971; 4:154-58 [<2013d]

optional[197]. Its values are:

L = Linear contact line of the two lips

C = Curved contact line of the two lips

M = Mixed shape contact line

- The eighth information item **lip print characterization descriptive text/ LPCT.** It is optional; however,

[2015e>]it is mandatory if **ULCL or LLCL** contains the value O. [<2015e]

It is UNICODE free text.

- The ninth information item is the **lip pathologies and peculiarities list / LPPL.**[197] It is optional. It is chosen from the Type-codes in **Table 84 Lip Pathologies and peculiarities codes**. If Type-code 99 is selected, then **LPPT** shall be used to describe the condition. Only one of the values 8, 9, 10, 11 or 12 may appear in the list. [2015a>] It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a]

Table 84 Lip Pathologies and peculiarities codes

Type-code	Description
1	Herpetic lesions
2	Scar(s)
3	Severe cracking
4	Blood varicosities
5	Intense 'whirls'
6	Mole
7	Cuts and scabs
8	Cleft lip (cheiloschisis) – unilateral incomplete - left
9	Cleft lip (cheiloschisis) – unilateral incomplete - right
10	Cleft lip (cheiloschisis) – unilateral complete - left
11	Cleft lip (cheiloschisis) – unilateral complete - right
12	Cleft lip (cheiloschisis) – bilateral incomplete
13	Cleft lip (cheiloschisis) – bilateral complete
14	Piercing – upper lip
15	Piercing – lower lip
16	Tattoo – upper lip
17	Tattoo – lower lip
99	Other (describe in **LPPT**)

- The tenth item is optional; however, it shall appear if **LPPL** has a value of

[197] [2013d>] See R.C. Coward, *The Stability of Lip Pattern Characteristics Over Time,* The Journal of Forensic Odonto-Stomatology, Vol. 25 No. 2, December 2007. [<2013d]

99. It is **lip print pathologies and peculiarities descriptive text / LPPT.** It is UNICODE free text. [2015a>] It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a]

- The eleventh information item is **lip print surface list / LPSL.** It is optional. Multiple codes may be selected from **Table 85 Lip print surface codes**, since a lip print may be on multiple surfaces. An exemplar of a lip print may be made on a standard surface, such as a glass photographic slide mount. If a Type-code other than 1 is selected, then **lip print surface descriptive text / LPST** shall be entered. If Type-code 1 is chosen, then no other values shall be entered in the list. Thus, there is a maximum of 3 items in the list. [2015a>] It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a]

Table 85 Lip print surface codes

Type-code	Description
1	Glass photographic mount or other surface used for exemplars
2	Human skin (describe in **LPST)**
3	Clothing - such as a shirt collar (describe in **LPST)**
9	Other - such as a drinking glass (describe in **LPST)**

- The twelfth information item is **lip print surface descriptive text / LPST.** It is optional; however, it shall appear if **LPSL** has a value other than 1. It is UNICODE free text. [2015a>] It is a list of codes that may be used to describe the print. Lists are described in Section 7.7.13. [<2015a]

- The thirteenth information item is **lip print medium code / LPMC.** It is optional. It shall be selected from **Table 86 Lip print medium codes**. If Type-code 9 is selected, then **lip print medium descriptive text / LPMT** shall be entered.

Table 86 Lip print medium codes

Type-code	Description
1	Lipstick / lip balm
2	Water / sweat / natural moisture / other liquid
3	Food residue (such as cream cheese)
9	Other (describe in **LPMT)**

- The fourteenth information item is optional; however, if **LPMC** has a value of 9, then it shall be entered. It is the **lip print medium descriptive text / LPMT.** It is UNICODE free text.

- The fifteenth information item is optional. It is the **facial hair descriptive text / FHDT**[197]**.** It should be used to describe the presence, pattern,

distribution and density of the follicles – if they are visible in the image. This may be useful in establishing the sex of the individual based upon the cheiloscopic image.

- The sixteenth information item is optional. It is the **lip position and tension descriptive text / LPDT.** There may be considerable variation in lip prints if the lips were pursed or open or if a print is taken post-mortem. This information item should describe in general terms the probable, possible or verified relative position of the lips to each other and the muscle tension and shape of the lip print. It is UNICODE free text.
- The seventeenth information item is optional. It is the **lip print additional descriptive text/ LPAT**. It is UNICODE free text. This information item should be used to describe any relevant information that may assist in the analysis of the cheiloscopic image.
- The eighteenth information item is optional, [2015a>] but shall be present if ULCL or LLCL contains the value O (See **Table 83 Cheiloscopic characterization codes)** [<2015a]. It is the **lip print comparison descriptive text / LPCT.** It may be used by an analyst to note the results of a comparison against another image. If this information item is present, then **Field 10.039: Type-10 reference number / T10** shall be present in the record to indicate the image against which the image in this instance of the Record **Type-10** is compared. It is UNICODE free text.

One approach for comparing lip prints is based upon identifying and counting the number of superimposed vermillion patterns (stars, Ys, and notches) and rating the quality of the contact line and the general appearance of the images[197]. If this approach is followed, use **LPCD** to describe the results.

8.10.46 Field 10.050: Dental visual image data information / VID

This field shall only be used if **Field 10.003: Image type / IMT** has a value of EXTRAORAL or INTRAORAL.

Field 10.033: Feature contours / FEC may be used to highlight distinctive features in an image.

When distinct features are outlined for comparison on an exemplar and a latent image, then **Field 10.039: Type-10 reference number / T10** should be used to link the two **Type-10** records.

- The first information item is the **visual image view code / VIVC**. It is an entry selected from the "View Code" column of **Table 87 Dental image codes.**

Table 87 Dental image codes

View Type	View Position / Type	View Code	Description
IMT = EXTRAORAL			Image is taken from outside of the oral cavity. **IMT** = EXTRAORAL is not intended for use on living individuals. **IMT** = FACE should be used for living individuals and those images shall adhere to the photographic guidelines in **Annex E: Facial Capture – SAPs 30 and above.**
	Frontal		Image should fill at least 90% of the image and extend from above the top of the head to the inferior border of the hyoid bone. Both the Frankfort horizon line and the interpupillary line should be at right angles to the image with no rotation of the head. The image should be centered on the midline of the face both vertically and horizontally.
	Natural state	EFNS	The subject's face without any incisions performed by the medical examiner or coroner.
	With incisions present	EFWI	Image taken after incisions made that were part of the examination of the subject
	Lips retracted	EFLR	Image with device present that retracts the lips
	Oblique (45º) LEFT RIGHT	 EFOL EFOR	Image should fill at least 90% of the image and extend from above the top of the head to the inferior border of the hyoid bone. The subject's head is rotated 45º. This position is independent of the size of the nose in contrast to the alignment of the nose with the cheek. Focus point and center of the picture is on the Frankfort horizontal line at the junction with the lateral acanthus. The lower margin is the steno-clavicular joint.
	Profile (90º) LEFT RIGHT	 EFPL EFPR	Image should fill at least 90% of the image and extend from above the top of the head to the inferior border of the hyoid bone. The head should be positioned so that the ala-tragus line is parallel to the floor of the jaw in the rest position. The head should be turned so that the contralateral eyebrow is barely visible. The image should be centered midline of the face both horizontally and vertically.
IMT = INTRAORAL			These are images focused upon the interior of the oral cavity. They need not be captured with the imager actually inserted into the oral cavity.

View Type	View Position / Type	View Code	Description
	Frontal		The lips should be retracted and the image should be parallel to the occlusal plane. The image should be center between the occlusal plane and the midline of the maxillary central incisors.
	Jaws open – upper (maxillary) teeth	IFJU	The image is taken from the front of the mouth and shows a view of the upper (maxillary) teeth. This code should be selected when the lower jaw is not present on the subject or there are no upper teeth present on the subject.
	Jaws open – lower (mandibular) teeth	IFJL	The image is taken from the front of the mouth and shows a view of the upper (maxillary) teeth. This code should be selected when there are no lower teeth present on the subject.
	Jaws open – both sets of teeth	IFJB	The image shows the full set of teeth, including anterior teeth as well as a partial view of the premolar and possibly the first molar region. This is the most common code associated with an intraoral frontal view.
	Facial (cheek side)		The tongue should be placed so that it is not in the image.
	Subject's upper right (maxillary) teeth	IBUR	The image should extend from the right maxillary canine to as far distally as possible. Ideally the right maxillary second molar should be included.
	Subject's upper left (maxillary) teeth	IBUL	The image should extend from the left maxillary canine to as far distally as possible. Ideally the left maxillary second molar should be included.
	Subject's lower right (mandibular) teeth	IBLR	The image should extend from the right mandibular canine to as far distally as possible. Ideally the right mandibular second molar should be included.
	Subject's lower left (mandibular) teeth	IBLL	The image should extend from the left mandibular canine to as far distally as possible. Ideally the left mandibular second molar should be included.
	Subject's right teeth – both sets	IBRB	The image should extend from the right canines to as far distally as possible. Ideally the right second molars should be included.
	Subject's left teeth – both sets	IBLB	The image should extend from the left canines to as far distally as possible. Ideally the left second molars should be included.
	Lingual (from the tongue / palatal side of the teeth)		The tongue should be placed so that it is not in the image.

View Type	View Position / Type	View Code	Description
	Subject's upper right (maxillary) teeth	ILUR	The image should extend from the right maxillary canine to as far distally as possible. Ideally the right maxillary second molar should be included.
	Subject's upper left (maxillary) teeth	ILUL	The image should extend from the left maxillary canine to as far distally as possible. Ideally the left maxillary second molar should be included.
	Subject's lower right (mandibular) teeth	ILLR	The image should extend from the right mandibular canine to as far distally as possible. Ideally the right mandibular second molar should be included.
	Subject's lower left (mandibular) teeth	ILLL	The image should extend from the left mandibular canine to as far distally as possible. Ideally the left mandibular second molar should be included.
	Subject's right teeth – both sets	ILRB	The image should extend from the right canines to as far distally as possible. Ideally the right second molars should be included.
	Subject's left teeth – both sets	ILLB	The image should extend from the left canines to as far distally as possible. Ideally the left second molars should be included.
	Subject's upper front teeth	ILUF	The image should include left maxillary canine to right maxillary canine.
	Subject's lower front teeth	ILLF	The image should include left mandibular canine to right mandibular canine.
	Occlusal (biting edge)		These images are of the occlusal surfaces of the teeth. The images should be taken perpendicular to the plane of the teeth surface.
	Subject's full upper (maxillary) teeth	IOUA	This view should include all anterior teeth, all premolars and at least the maxillary first molar.
	Subject's full lower (mandibular) teeth	IOLA	This view should include all anterior teeth, all premolars and at least the mandibular first molar.
	Subject's upper right (maxillary) teeth	IOUR	This view should include all anterior teeth, all premolars and at least the maxillary first molar.
	Subject's upper left (maxillary) teeth	IOUL	This view should include all anterior teeth, all premolars and at least the maxillary first molar.
	Subject's lower right (mandibular) teeth	IOLR	This view should include all anterior teeth, all premolars and at least the mandibular first molar.
	Subject's lower left (mandibular) teeth	IOLL	This view should include all anterior teeth, all premolars and at least the mandibular first molar.

View Type	View Position / Type	View Code	Description
	Subject's upper front teeth	IOUF	This image should contain the occlusal surface of the teeth from left maxillary canine to right maxillary canine.
	Subject's lower front teeth	IOLF	This image should contain the occlusal surface of the teeth from left mandibular canine to right mandibular canine.
	Palatal		This is a view of the 'roof' of the mouth. The rugae should be in focus with an adequate depth of field, since they may be useful in subject identification. This image should be taken if the subject has a cleft palate or other abnormality. It should also be taken when the palate is tattooed.
	Subject's palate (including rugae)[198]	IPC	This should be a centered view of the palate.
	Tongue		This view should be used if there is any jewelery, piercing abnormalities of the tongue (including 'ornamental disfiguration') and tattoos.
	Upper tongue surface	ITU	This view should be taken with the tongue as flat as possible.
	Lower tongue area	ITL	This view should be taken with the tongue raised or in retroflex position, centered on the frenulum.
	Cheeks		This view should be used if there is any jewelery piercing, abnormalities of the cheek (including 'ornamental disfiguration') and tattoos.
	Subject's right interior cheek	ICR	This view should be centered on the right oral linea alba and should include the right parotid papilla.
	Subject's left interior cheek	ICL	This view should be centered on the left oral linea alba and should include the left parotid papilla.
	Pharynx back of mouth	IPB	This view is focused upon the soft tissue at the back of the mouth. It should include the uvula and oropharynx regions.
	Inside of lips [199]		This view should be used if there is any jewelery piercing, abnormalities of the lip, (including 'ornamental disfiguration') and tattoos.

[198] [2013d>] For a discussion of the use of rugae in DVI, see Muthusubramanian M., Limson, K.S., Julian R., *Analysis of rugae in burn victims and cadavers to simulate rugae identification in cases of incineration and decomposition*, The Journal of Forensic Odonto-Stomatology, Vol. 23, No. 1, June 2005

Human remains were successfully identified by comparing the rugae to those imprinted in a spare upper denture, as described in Thomas C.J., van Wyk C.W., *The palatal rugae in an identification,* Journal of Forensic Odonto-Stomatology, Volume 6, June 1988. [<2013d]

[199] [2013d>] Note that this is considered intraoral and does not have **IMT = LIP** (which is intended for

View Type	View Position / Type	View Code	Description
	Upper inside lip	ILU	This image should be captured of the maxillary vestibule if there is a significant finding (i.e., tattoo or oral lesion) or an abnormailty of the superior labial frenulum such as connecting to the palate between the front teeth.
	Lower inside lip	ILL	This image should be captured of the mandibular vestibule if there is a significant finding (i.e., tattoo or oral lesion) or an abnormailty of the inferior labial frenulum such as connecting to the palate between the front teeth.

- The second information item is the **visual image additional descriptive text / VIDT**. It is a Unicode free text information item.
- The third information item is the **visual image comparison descriptive text / VICD.** It may be used by an analyst to note the results of a comparison against another image. If this information item is present, then **Field 10.039: Type-10 reference number / T10** shall be present in the record to indicate the image against which the image in this instance of the Record **Type-10** is compared. It is UNICODE free text.

  [<2013d] [2013n>]

8.10.47 Field 10.051: Ruler or scale presence / RSP

This optional field allows the user to state whether a ruler or other known scale is present in the image. The field consists of four information items.

- The first information item, **ruler or scale units / RSU,** indicates the units of measurement visible on the ruler or measurement scale:

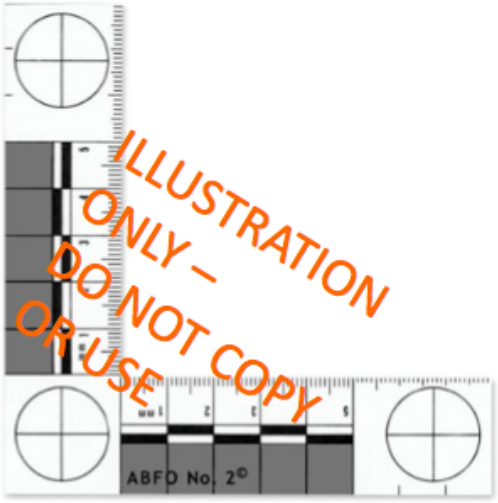
  IN = inches; MM = millimeters; BOTH = both inches and millimeters

- The second information item, **ruler or scale make / RSM,** lists the maker of the ruler or scale (if known).
- The third information item, **ruler or scale model / RSO,** lists the model of the ruler or scale (if known). For patterned injuries, the ABFO # 2 Reference Scale (commonly called the ABFO # 2 ruler) shall be used.[200]

cheiloscopic analysis) [<2013d]

[200] [2013d>] The guidelines of the American Board of Forensic Odontology (ABFO) shall be followed for patterned injuries of possible oral origin. The ABFO Guidelines are available at http://www.abfo.org/resources/abfo-manual/ [<2013d]

Figure 16: ABFO # 2 Reference Scale



[<2013n]

8.10.48 Fields 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.

8.10.49 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.**

8.10.50 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 128 Character encoding set values** are allowed.

8.10.51 Field 10.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.10.52 Field 10.992: Type-2 Record cross reference / T2C

[2013n>] This is an optional field. When used, it contains the **IDC** value of the **Type-2** record that contains relevant biographic information and other data concerning the subject of this instance of the record, who may be different from the subject of the transaction. See **Section 7.3.1.1 Type-2 Record cross reference / T2C.** [<2013n]

8.10.53 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**.

[2015n>]

8.10.54 Field 10.994: External file reference / EFR

This conditional field may be used to enter the URL/URI or other unique reference to a storage location for the image, if the data is not contained in **Field 10.999: Body part image / DATA.** If this field is used, **Field 10.999** shall not be used. However, one of the two fields shall be present in all instances of this record type. It is highly recommended that the user state the format of the external file in **Field 10.038: Comment / COM.** [<2015n]

8.10.55 Field 10.995: Associated context / ASC

This optional field refers to one or more Records **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.

8.10.56 Field 10.996: Hash/ HAS

This optional field shall contain the hash value of data in **Field 10.999: Body part image / DATA.**

8.10.57 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.**

8.10.58 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**.

8.10.59 Field 10.999: Body part image / DATA

[2015n>] This field may contain the image. See **Section 7.2** for details on the Data field entry. If **Field 10.994: External file reference / EFR** is present in this record, then this field shall not be present. However, one of the two fields shall be present in the record. [<2015n]

[2013v>]

8.11 Record Type-11: Forensic and investigatory voice record

The **Type-11** is focused upon the analysis of voice signals for forensic and investigatory purposes. Voice analysis is often divided into two general areas:

Speech Recognition

Speaker Recognition

Both of these areas may play a part in forensic and investigatory analyses.

Speech recognition involves the interpretation of vocalizations for their linguistic content. Automatic speech recognition may be speaker dependent (based upon enrollment data from the individual speaker) or speaker independent[201]. Speech recognition can also be performed manually, such as when a phonetic transcript or a translation is generated. This content is contained in **Field 11.026: Vocal content diary / VCD**.

Speaker recognition involves determining who is performing the vocalizations. The human voice - generally carrying both speech and non-speech sounds - propagates varying distances through air (principally) or another medium to reach acoustic transducers (usually microphones, when recorded) of varying amplitude and phase response. For purposes of the **Type-11** record, a "speaker" is any person producing "vocalizations" from the throat or oral cavity, which may be voiced (activating the vocal cords) or unvoiced (such as aspirations, whispers, tongue clicks and other similar sounds). An automated interlocutor is considered to be a "speaker" for the purposes of this record type, since the intent is to directly mimic human speech, although such a speaker will not be the primary subject of an *ANSI/NIST-ITL* transaction.

When voice sounds carry speech, that speech usually occurs within a social context involving more than one speaker. Consequently, a recorded speech signal may contain the voices of multiple speakers. Thus, the **Type-11** record accommodates recordings with multiple speakers; can designate whether any of the speakers are already identified; can convey the count of the number of individual speakers; and can convey when the same person is speaking at multiple points during the recording. It can also convey the transcribed linguistic content of each speaker.

An *ANSI/NIST-ITL* transaction is typically focused upon the identification of one individual. However, in order to effectively perform that identification (or verification of identity), it may be necessary to include information about other persons in the transaction. With voice recordings, it may be necessary to contain in a transaction 'known' clips of certain persons who are possibly speaking in the recording under investigation, in order to separate out the speech of the known individuals and concentrate on the identification of the remaining speakers. Thus, there may be a difference between the 'subject of the transaction' and the 'subject of the record.'

Multiple **Type-11** records may be contained in a single transaction. The type of action desired by the submitter of the transaction (to be performed by the receiver of the transaction) is specified in a **Type-1** record in the **TOT** field.

There are factors that had to be considered in developing this record type. Some of the most significant ones include:

[201] See David S. Pallett, *Performance Assessment of Automatic Speech Recognizers,* Journal of the National Bureau of Standards, Volume 90, Number 5, September-October 1985 for a set of terms used by the IEEE Acoustics, Speech and Signal Processing Society Working Group on Speech I/O Systems Performance Assessment.

· Voice signals generally contain both speech and non-speech elements, either of which might be useful in speaker recognition applications.

· Unlike other modalities, voice signals are collected in time - not spatial - dimensions and will not have a single "time of collection".

· In mobile applications, even a single segment of a voice signal may not be linkable to a single geographic location or to a specific speaker.

· Voice signals containing speech have direct informational content. Unlike other forms of biometric recognition, the speech itself means something and, even if stripped of all personally identifiable information including the acoustic content itself, may require protection for privacy or security reasons.

· Unlike other modalities, voice signals may reflect and depend upon the social and behavioral conditions – as well as the environmental conditions -- of the collection environment, including the relationship between the data subject and any interlocutors.

Application profiles of this standard shall specify the applicable upper limit for all elements with a maximum occurrence of * (unlimited).

Table 88 Type-11 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
11.001		**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
11.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
11.003	**AOD**	**AUDIO OBJECT DESCRIPTOR CODE**	M	N	1	1	0 ≤ AOD ≤ 5 integer	1	1
11.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
11.005	**VRSO**	**VOICE RECORDING SOURCE ORGANIZATION**	O					0	1
	STC	source organization type code	M↑	A	1	1	STC = U, P, I, G or O	1	1
	SON	source organization name	O↑	U	1	400	none	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	POC	point of contact	O↑	U	1	200	none	0	1
	CSC	source organization country code	O↑	AN	2	3	values from *ISO-3166-1* or GENC	0	1
11.006	**VRC**	**VOICE RECORDING CONTENT DESCRIPTOR**	O					0	1
	AVI	assigned voice indicator	M↑	A	1	1	AVI = A, N or Q	1	1
	SPC	speaker plurality code	O↑	A	1	1	SPC = M or S	0	1
	COM	comment	O↑	U	1	*	none	0	1
11.007	**AREC**	**AUDIO RECORDING DEVICE**	O					0	1
	RDD	recording device descriptive text	O↑	U	1	*	none	0	1
	MAK	recording device make	O↑	U	1	50	none	0	1
	MOD	recording device model	O↑	U	1	50	none	0	1
	SER	recording device serial number	O↑	U	1	50	none	0	1
11.008	**AQS**	**ACQUISITION SOURCE**	D					0	1
	AQC	acquisition source code	M↑	N	1	2	value from **Table 121 Acquisition source**	1	1
	A2D	analog to digital conversion description	D	U	1	*	none	0	1
	FDN	radio transmission format description	D	U	1	*	none	0	1
	AQSC	acquisition special characteristics	O↑	U	1	*	none	0	1
11.009	**RCD**	**RECORD CREATION DATE**	**M**	See Section 7.7.2.4 Local date & time			See Section 7.7.2.4 Local date & time	1	1
11.010	**VRD**	**VOICE RECORDING CREATION DATE**	O	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
11.011	**TRD**	**TOTAL RECORDING DURATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	TIM	voice recording time	O↑	N	1	11	1 ≤ TIM ≤ 99999999999 integers, no commas or periods	0	1
	CBY	compressed bytes	O↑	N	1	14	1 ≤ CBY ≤ 99999999999999 integers, no commas or periods	0	1
	TSM	total digital samples	O↑	N	1	14	1 ≤ TSM ≤ 99999999999999 integers, no commas or periods	0	1
11.012	**PMO**	**PHYSICAL MEDIA OBJECT**	D					0	1
	MTD	media type description	M↑	U	1	300	none	1	1
	RSP	recording speed	O↑	NS	1	9	numbers, with decimals allowed	0	1
	RSU	recording speed measurement units description text	D	U	1	*	none	0	1
	EQD	equalization description	O↑	U	1	*	none	0	1
	TRC	track count	O↑	N	1	4	1 ≤ TRC ≤ 9999 integer	0	1
	STK	speaker track number	O↑	NS	1	4	List	0	LIST[203] of up to TRC elements
	COM	comment	O↑	U	1	*	none	0	1
11.013	**CONT**	**CONTAINER**	D[202]					0	1
	CONC	container code	M↑[160]	N	1	2	code specified in **Table 90 Audio Visual Container Codes**	1	1
	ECON	external container reference code	D	U	1	80	reference code from external container table	0	1
	COM	comment	D	U	1	*	none	0	1
11.014	**CDC**	**CODEC**	D					0	1

[202] [2015a>] This was listed as O since the field itself is optional. However, it can only appear if AOD is set to 0, 1 or 2. Some commenters felt that it was more accurate to describe it as D. [<2015a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	CODC	codec code	M↑[160]	N	1	2	code specified in **Table 91 Codec Type Codes**	1	1
	SRTN	sampling rate number	O↑	N	1	9	0 ≤ SRTN ≤ 100000000 positive integer, no commas	0	1
	BITD	bit depth count	O↑	N	1	4	0 ≤ BITD ≤ 1024 positive integer	0	1
	ENDC	endian code	O↑	N	1	1	ENDC = 0 or 1	0	1
	NFMT	numeric format	O↑	AN	1	5	NFMT = positive integer with an optional letters s, b, or d following it	0	1
	CHC	channel count	O↑	N	1	4	1 ≤ CHC ≤ 9999 positive integer	0	1
	ECOD	external codec reference code	D	U	1	80	reference code from external codec table	0	1
	COM	comment	D	U	1	*	none	0	1
11.015 – 11.020		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
11.021	**RED**	**REDACTION**	O					0	1
	RDI	redaction indicator	M↑	N	1	1	RDI = 0, 1 or 2	1	1
	RDA	redaction authority organization name	D	U	1	300	none	0	1
	COM	comment	O↑	U	1	*	none	0	1
11.022	**RDD**	**REDACTION DIARY**	D					0	1
		Subfields: ***Repeating sets of information items***	M↑					1	600000
	SID	segment identifier	M↑	N	1	6	1 ≤ SID ≤ 600000 positive integer, no commas	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	TRK	track and channel number list	D	NS	1	4	list of non-negative integers	0	LIST [203] of up to 9999 tracks and channels.
	RST	relative start time	M↑	N	1	*	1 ≤ RST positive integer	1	1
	RET	relative end time	M↑	N	1	*	RET > RST positive integer	1	1
	COM	comment	O↑	U	1	*	none	0	1
11.023	**DIS**	**DISCONTINUITIES**	O					0	1
	DCI	discontinuity indicator	M↑	N	1	1	SGI = 0 , 1 or 2 non-negative integer	1	1
	CTA	cutting authority organization name	D	U	1	300	none	0	1
	COM	comments	O↑	U	1	*	none	0	1
11.024	DCD	**DISCONTINUITIES DIARY**	D					0	1
		Subfields: ***Repeating sets of information items***	M↑					1	600000
	SID	segment identifier	M↑	N	1	6	1 ≤ SID ≤ 600000 positive integer, no commas	1	1
	TRK	track and channel number list	D	NS	1	4	list of non-negative integers	0	LIST [203] of up to 9999 tracks and channels
	RST	relative start time	M↑	N	1	*	1 ≤ RST integer	1	1
	RET	relative end time	M↑	N	1	*	RET ≥ RST [204] integer	1	1
	COM	comment	O↑	U	1	*	none	0	1
11.025	**VOC**	**VOCAL CONTENT**	O					0	1
	DII	diarization indicator	M↑	N	1	1	DII = 0 or 1	1	1

[203] [2015a>] Lists are handled differently in traditional and XML encodings. See **Annex B: Traditional encoding** and **Annex C: NIEM-conformant encoding rules**. Character Min# and Max# refers to each element in the list. The number of elements in the list is mentioned in Occurrence Max#. There is a maximum of one list.[<2015a]

[204] Note that this allows RET to equal RST, unlike the redaction and vocal content diaries.

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	DAU	diarization authority organization name	D	U	1	300	none	0	1
	COM	comments	O↑	U	1	*	none	0	1
	VCD	**VOCAL CONTENT DIARY**	D					0	1
		Subfields: ***Repeating sets of information items***	M↑					1	600000
	SID	segment identifier	M↑	N	1	6	1 ≤ SID ≤ 600000 integer, no commas	1	1
	TRK	track and channel number list	D	NS	1	4	list of non-negative integers	0	LIST [203] of up to 9999 tracks and channels
	RST	relative start time	M↑	N	1	11	1 ≤ RST integer	1	1
	RET	relative end time	M↑	N	1	*	RET > RST integer	1	1
11.026	COM	comment	O↑	U	1	*	none	0	1
	TDT	tagged date	O↑	See **Section 7.7.2.3 Local date**			See **Section 7.7.2.3 Local date**	0	1
	TST	tagged start time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	TET	tagged end time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	ORD	original recording date	O↑	See **Section 7.7.2.3 Local date**			See **Section 7.7.2.3 Local date**	0	1
	SRT	segment recording start time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	END	segment recording end time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	TMD	time source description text	O↑	U	1	300	none	0	1
	TCOM	timing comments	O↑	U	1	*	none	0	1
	OCON	**OTHER CONTENT**	O					0	1
	DII	diarization indicator	M↑	N	1	1	DII = 0 or 1	1	1
11.027	DAU	diarization authority	D	U	1	300	none	0	1
	COM	comments	O↑	U	1	*	none	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
11.028	**OCD**	**OTHER CONTENT DIARY**	O					0	1
		Subfields: ***Repeating sets of information items***	M↑					1	600000
	SID	segment identifier	M↑	N	1	6	1 ≤ SID ≤ 600000 positive integer, no commas	1	1
	TRK	track and channel number list	D	NS	1	4	list of non-negative integers	0	LIST [203] of up to 9999 tracks and channels
	RST	relative start time	M↑	N	1	11	1 ≤ RST positive integer	1	1
	RET	relative end time	M↑	N	1	*	RET > RST positive integer	1	1
	COM	comment	O↑	U	1	*	none	0	1
	TDT	tagged date	O↑	See **Section 7.7.2.3 Local date**			See **Section 7.7.2.3 Local date**	0	1
	TST	tagged start time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	TET	tagged end time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	ORD	original recording date	O↑	See **Section 7.7.2.3 Local date**			See **Section 7.7.2.3 Local date**	0	1
	SRT	segment recording start time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	END	segment recording end time	O↑	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	TMD	time source description text	O↑	U	1	300	none	0	1
	TCOM	timing comments	O↑	U	1	*	none	0	1
11.029 – 11.031		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
11.032	**SGEO**	**VOCAL SEGMENT GEOGRAPHICAL INFORMATION**	D					0	1
		Subfield: repeating sets of information items	M↑					1	600000

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST [203] of up to 600000 values
	SCT	segment cell phone tower code	O↑	U	1	100	none	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	-442.000 ≤ ELE ≤ 8848.000 Decimal point is the allowed special character.	0	1
	GDC	geodetic datum code	O↑	AN	3	6	value from **Table 7 Geographic coordinate datum code values**	0	1
	GCM	geographic coordinate universal transverse mercator zone	D	AN	2	3	one or two digits 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 (or landmark)	O↑	U	1	10	none	0	1
	OCV	geographic coordinate other system value	D	U	1	126	none	0	1
11.033	**SQV**	**VOCAL SEGMENT QUALITY VALUES**	D					0	1
		Subfield: repeating sets of information items	M↑					1	9
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST[203] of up to 600000 values
	QVU	quality value	M↑	N	1	3	integer, 0 ≤ QVU ≤ 100 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	integer, 0 ≤ QAP ≤ 65534	1	1
	COM	comments	D	U	1	*	none	0	1
11.034	**VCI**	**VOCAL SEGMENT COLLISION IDENTIFIER**	D					0	1
		Subfields: Repeating values	M↑	N	1	6	non-negative integer	1	600,000
11.035	**PPY**	**VOCAL SEGMENT PROCESSING PRIORITY**	D					0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
		Subfield: repeating sets of information items	M↑					1	9
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST [203] of up to 600000 values
	PTY	priority	M↑	N	1	1	positive integer, 1 ≤ PTY ≤ 9	1	1
11.036	**VSCD**	**VOCAL SEGMENT CONTENT DESCRIPTION**	D					0	1
		Subfield: repeating sets of information items	M↑					1	600000
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST [203] of up to 600000 values
	TRN	transcript text	D	U	1	*	none	0	1
	LNG	transcript language	D	A	3	3	Value from *ISO 639-3*	0	1
	PTT	phonetic transcript text	D	U	1	*	none	0	1
	PTC	phonetic transcript convention	D	U	1	100	none	0	1
	TLT	translation text	D	U	1	*	none	0	1
	TLG	translation language	D	A	3	3	Value from *ISO 639-3*	0	1
	COM	segment content comments	D	U	1	*	none	0	1
	TAC	transcript authority comment text	D	U	1	*	none	0	1
11.037	**SCC**	**VOCAL SEGMENT SPEAKER CHARACTERISTICS**	D					0	1
		Subfield: repeating sets of information items	M↑					1	600000
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST [203] of up to 600000 values
	SPL	speaker list	D	U	1	4	list of non-negative integers	0	LIST [203] of up to 9999 speakers
	T2C	**type-2** record cross reference	D	NS	1	2	list of non-negative integers 1 ≤ T2C value ≤ 99	0	LIST [203] of up to 98 references
	IMP	impairment level number	D	N	1	1	integer, 0 ≤ IMP ≤ 5	0	1
	DSL	dominant spoken language code	D	A	3	3	value from *ISO 639-3*	0	1
	LPS	language proficiency scale number	D	N	1	1	integer, 0 ≤ LPS ≤ 9	0	1
	STY	speech style code	D	N	1	2	See **Table 92 Speech Style Codes**	0	1
	INT	intelligibility scale code	D	N	1	1	integer, 0 ≤ INT ≤ 9	0	1
	FDC	familiarity degree code	D	N	1	1	integer, 0 ≤ FDC ≤ 5	0	1
	HCM	health comment	D	U	1	*	none	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	EMC	emotional state code	D	N	1	2	See **Table 93 Emotional State Codes**	0	1
	VES	vocal effort scale number	D	N	1	1	integer 0 ≤ VES ≤ 5	0	1
	VSC	vocal style code	D	N	1	2	See **Table 94 Vocal Style Codes**	0	1
	RAI	recording awareness indicator	D	N	1	1	RAI = 0, 1 or 2	0	1
	SCR	script text	D	U	1	*	none	0	1
	COM	comments	D	U	1	*	none	0	1
11.038	**SCH**	**VOCAL SEGMENT CHANNEL**	D					0	1
		Subfield: repeating sets of information items	M↑					1	600000
	SIL	segment identifier list	M↑	NS	1	6	list of non-negative integers	1	LIST [203] of up to 600000 values
	ACD	audio capture device code	O↑	N	1	2	See **Table 95 Audio Capture Device Type Codes**	0	1
	MTC	microphone type code	O↑	N	1	1	MTC = 0 , 1, 2, 3 or 4	0	1
	ENV	capture environment description text	O↑	U	1	*	none	0	1
	DST	transducer distance	O↑	N	1	5	integer, 0 ≤ DST ≤ 99999	0	1
	AQC	acquisition source code	O↑	N	1	2	See **Table 121 Acquisition source**	0	1
	VMT	voice modification description text	O↑	U	1	*	none	0	1
	COM	comments	O↑	U	1	*	none	0	1
11.039 – 11.050		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
11.051	**COM**	**COMMENTS**	O↑	U	1	*	none	0	1
11.052 – 11.099		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
11.100 – 11.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
11.901		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
11.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	GMT	Greenwich Mean Time	M↑	See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT** encoding specific			See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT** encoding specific	1	1
	NAV	processing algorithm name / version	M↑	U	1	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
11.903 - 11.992		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
11.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
11.994	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
11.995	**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
11.996	**HAS**	**HASH**	O	H	64	64	none	0	1
11.997 [205]	**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
11.998		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
11.999	**DATA**	**VOICE DATA**	D	Base64	1	*	none	0	1

[205] Atypically, this instance of SOR does not include a second information item RSP (reference segement position) since this record type does not deal with images.

8.11.1 Field 11.001: Record header

This field is mandatory. See **Section 7.1 Record header.**

8.11.2 Field 11.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this **Type-11** record as listed in the information item **IDC** for this record in **Field 1.003: Transaction content / CNT.** See **Section 7.3.1 Information designation character / IDC.**

8.11.3 Field 11.003: Audio object descriptor code /AOD

This mandatory field shall be a numeric entry selected from the attribute code column of **Table 89 Audio Object Descriptor**. Only one value is allowed and indicates the type of audio object containing the voice recording which is the focus of this **Type-11** record. Attribute code 0 indicates that the audio object of this record is a digital voice data file in the **Field 11.999: Voice record data / DATA.** Attribute code 1 indicates that the audio object is a digital voice data file at the location specified in **Field 11.994: External file reference / EFR**. Attribute codes 2-4 indicate that the audio object is a physical media object at a location described in **Field 11.994**.

If the **Type-11** record contains only metadata (such as in a response to a voice recording submission), attribute code 5 shall be selected.

Note that the difference between Attribute code 1 and Attribute code 2 is that 1 indicates a file that is accessible without the physical media object itself – such as being stored at a URL. Code 2 indicates that something that is a physical object like a digital telephone answering machine contains the digital file. Therefore, the physical media object is required to retrieve and analyze the data.

Table 89 Audio Object Descriptor

Audio Object	Attribute Code
Internal digital voice data file	0
External digital voice data file	1
Physical Media Object containing digital data	2
Physical Media Object containing analog signals	3
Physical Media Object containing unknown data or signals	4
No audio object associated with this record	5

8.11.4 Field 11.004: Source agency / SRC

This is a mandatory field. See Section 7.6 for details. The **SRC** is a code for a particular agency that is assigned by the implementation domain (such as

NORAM, which is maintained by the FBI). It is often not the common name of the organization. The source agency name may be entered in **Field 11.993: Source agency name / SAN.**

This field denotes the agency that prepared this record. It is not necessarily the agency that is transmitting this transaction (which is designated in **Field 1.008: Originating agency identifier / ORI**). It also need not be the agency that gathered the biometric samples and/or metadata. That organization (if different) is specified in **Field 11.993: Source agency name / SAN.**

Note that changes and additions or subtractions to/from the original **Type-11** record may be made. Thus, when an agency updates a **Type-11** record, **Field 11.004** is updated to reflect this new agency name and the previous value for **Field 11.004** can be recorded in **Field 98.900: Audit log / ALF**.

8.11.5 Field 11.005: Voice recording source organization / VRSO

This is an optional field and shall contain information about the person, group, site or agency that created the voice recording pointed to or included in this record. In the case of files created from previous recordings, this is not necessarily the source of the original transduction of the acoustic vocalizations from the person to whom the **Type-11** record pertains. This need not be the same as the **Field 11.004: Source agency / SRC** (which created the record) or **Field 1.008: Originating agency identifier / ORI** (which sent the transaction to the receiving agency).

- The first information item is the **source organization type code / STC.** It is mandatory if this field is used. There may be no more than one occurrence of this item. This information item contains a single character describing the site or agency that created the voice recording:

  U = Unknown

  P = Private individual

  I = Industry/Commercial

  G = Government

  O = Other

- The second information item is the **source organization name / SON.** It is optional and shall be the name of the group, organization or agency that created the voice recording. There may be no more than one occurrence for this item. This is an optional information item in Unicode characters and is limited to 400 characters in length.
- The third information item is the **point of contact / POC.** It states who composed the voice recording. This is an optional information item that could include the name, telephone number and e-mail address of the person or persons responsible for the creation of the voice recording. This information item may be up to 200 Unicode characters.

- The fourth information item the **country code of the sending country / CSC.** It is optional. This is the code of where the voice recording was created – not necessarily the nation of the agency entered in **Field 11.993: Source agency name / SAN**. All three formats specified in *ISO-3166-1* are allowed (Alpha2, Alpha3 and Numeric). A country code is either 2 or 3 characters long. Note that if **Field 1.018: Geographic name set / GNS** is set to GENC, the entry in this information item is from GENC.

8.11.6 Field 11.006: Voice recording content descriptor / VRC

This field is optional and shall describe the content of the voice recording. It consists of four information items.

- The first information item is the **assigned voice indicator / AVI.** It is mandatory if this field is used. It indicates if the voice recording sample was obtained from a known subject.

  A = the subject of this record is 'assigned' an identity (whether or not there is biographical information associated with the individual.

  Q = this record contains a voice sample of a 'questioned' identity (such as a sample to be compared against a database for identification)
- The second information item is the **speaker plurality code / SPC.** It is optional and indicates plurality of speakers represented on voice recording:

  M = multiple speakers

  S = single speaker
- The third information item is a **comment / COM.** It is optional and describes methods by which the plurality and nationality of the speakers was determined, along with any supporting text.

8.11.7 Field 11.007: Audio recording device / AREC

This field is optional and shall indicate information about the recording equipment that created the voice recording contained in or pointed to by this record. There may be no more than one occurrence of this field.

As recordings or data files may be transcoded from previously recorded or broadcast content, this equipment may or may not be the equipment used to record the original acoustic vocalization of the person to whom the **Type-11** record pertains.

- The first information item is the **recording device descriptive text / RDD.** It is an optional text field describing the recording device that created the voice recording. An example would be “Home telephone answering device”.
- The second, third and fourth information items (**recording device make / MAK, recording device model / MOD, recording device serial number/SER**) are optional items of up to 50 characters each and shall

contain the make, model and serial number, respectively, for the recording device. There may be no more than one entry for each of these information items.

8.11.8 Field 11.008: Acquisition source / AQS

This is a mandatory field if **AOD** does not equal 5. It shall not appear if **AOD** = 5. It shall specify and describe the acquisition source.

- The first information item is the **acquisition source code / AQC.** It is mandatory and it shall be a numeric entry selected from the 'attribute code' column of **Table 121 Acquisition source**.
- The second information item is **analog to digital conversion description / A2D.** It is optional if an analog to digital conversion occurred. It shall not be present if no such operation occurred. If the original acquisition source is analog, and the data is stored in digital format, it should be entered if the conversion is an explicit separate step in preparation of the data and the process is known. It is a text field that describes the analog to digital equipment used to transform the source (which may be embedded in a general processing program and the analog to digital process is unknown to the user; in such a case this information item would not be used). This field should be used to enter the make, model and serial number of the analog to digital conversion equipment used, if known. This field should also address parameters used, such as the sampling rate, if known. Additional information about the digital conversion process can be contained in **Field 11.902: Annotation information / ANN**.
- The third information item, the **radio transmission format description / FDN** is a text field. It is mandatory if the **AQC** is 23 or 24. It is optional for other radio transmission codes.
- The fourth information item is the **acquisition special characteristics / AQSC.** It is an optional free text field, that is used to describe any specific conditions not mentioned in **Table 121 Acquisition source**.

8.11.9 Field 11.009: Record creation date / RCD

This mandatory field shall contain the date and time of creation of this **Type-11** record (not the original source recording contained in Record **Type-20**, if it is different from that). This date will generally be different from the voice recording creation date and may be different from the date at which the acoustic vocalization originally occurred. See **Section 7.7.2.4 Local date & time** for details.

8.11.10 Field 11.010: Voice recording creation date / VRD

This optional field shall contain the date and time of creation of the voice recording contained in this **Type-11** record (not the original source recording contained in Record **Type-20**, if it is different from that). If pre-recorded or transcoded materials were used,

this date may be different from the date at which the acoustic vocalization originally occurred. See **Section 7.7.2.4 Local date & time** for details.

8.11.11 Field 11.011: Total recording duration / TRD

This field is optional and gives the total length of the voice recording time for this **Type-11** record (not the original source recording contained in Record **Type-20**, if it is different from that). At least one of the three information items must be entered if this field is used. The second and third items of this field only apply to digital audio objects, as indicated by a value of 0, 1 or 2 in **Field 11.003: Audio object descriptor code /AOD**.

- The first information item is the **voice recording time / TIM.** It is optional and gives the total time of the voice recording in microseconds. The size of this item is limited to 11 digits, limiting the total time duration of the signal to 99,999 seconds, which is approximately 28 hours. See **Section 7.7.2.6.**
- The second information item is the **compressed bytes / CBY.** It is optional and gives the total number of compressed bytes in the digital voice data file. Consequently, this information item applies only to digital voice recordings stored as voice data files. The size of this item is limited to 14 digits, limiting the total size of the voice data file to 99 terabytes.
- The third information item is the **total digital samples / TSM.** It is optional. It gives the number of digital samples in the voice data file after any decompression of the compressed signal. This information item applies only to digital voice recordings stored as voice data files. The size of this item is limited to 14 digits.

8.11.12 Field 11.012: Physical media object / PMO

This field is optional and identifies the characteristics of the physical media containing the voice recording. There can be only one physical media object per **Type-11** record, but multiple **Type-11** records can point to the same physical media object. This field only applies if **Field 11.003: Audio object descriptor code /AOD** has an attribute code of 2, 3 or 4. The location of the physical media object is given in **Field 11.994: External file reference / EFR.**

- The first information item is the **media type description / MTD.** It is mandatory if this field is used and contains text describing the general type of media (e.g., analog cassette tape, reel-to-reel tape, CD, DVD, phonograph record) upon which the voice recording is stored. If an analog media is used for storage, and **AQC** of **Field 11.008: Acquisition source / AQS** is 14, then a description of the digital to analog procedure should be noted in **Field 11.902: Annotation information / ANN** and the reasons for such a conversion noted in **COM** of this field.
- The second information item is **recording speed / RSP.** It is optional and gives a numerical value to the speed at which the physical media object must be played to reproduce the voice signal content. This value may be integer

or floating point and shall not exceed 9 characters (such as 33.33 or 78).

- The third information item is **recording speed measurement units description text / RSU.** It is mandatory if the second information item, **RSP**, is entered and contains text to indicate the units of measure to which **RSP** refers (such as Rotations per minute). Otherwise, it is not entered.
- The fourth information item is **equalization description / EQD.** It is an optional text field and indicates the equalization that should be applied for faithful rendering of the voice recording on the physical media object.
- The fifth information item is the **track count / TRC.** It is an optional integer between 1 and 9999, inclusive, that gives the number of tracks on the physical media object. For example, a stereo phonograph record will have 2 tracks.
- The sixth information item is the **speaker track number / STK.** It is an optional list of integers which indicate which tracks carry the voices of the speaker(s). [2015a>] Lists are described in Section 7.7.13. [<2015a] A value of 0 or no entry for this information item indicates that all tracks contain voice data for the speaker(s).
- The seventh information item is **comments / COM.** It is optional and allows for additional comments describing the physical media object.

8.11.13 Field 11.013: Container / CONT

This [2015a>] conditional field, which need not appear in the record,[<2015a] contains information about the container format that encapsulates the audio data of the electronic file used to carry the voice data in the digital recording. This field is not used if the voice recording is stored on a physical media object as an analog signal – so it [2015a>] should [<2015a] only appear if **Field 11.003: Audio object descriptor code /AOD** is set to 0, 1 or 2. If present, this field overrides **Field 11.014: Codec / CDC**. There cannot be multiple container formats specified within a single **Type-11** record. The container format shall be entered as the appropriate integer code from **Table 90 Audio Visual Container Codes.** This field contains three information items. The first information item (**container code / CONC)** is mandatory. The second information item [2015a>] shall be used when **CONC** is set to 1; it is not used otherwise. [<2015a] The third information item is required when **CONC** is set to 1 and is optional otherwise.

Files having container formats incorporate audio specifications to properly decode the audio, such as the number of channels, sampling rate, bit/byte depth, and whether the data is big/little endian. More generally, container formats can specify an audio format used to encode the data, or simply encapsulate one or more audio channels as Linear PCM. The well-known Wave container specification (WAV) has fields such as chunk ID, chunk size, audio format (codec format), sampling rate, number of channels, space for extra parameters (for the codec or other uses).

Table 90 Audio Visual Container Codes

Container Type	Common file extension(s)	Container code
RAW audio format	undefined	0
Container Type Reference	various	1
Other	various	2
WAV (RIFF audio)	.wav	3
3GP and 3G2 mobile video	.3gp .3g2	4
AIFF	.aiff .aif	5
MP3 (MPEG-1, Layer 3 audio)	.mp3	6
NIST Sphere	.sph	7
QuickTime (Apple VBR-audio/video/image)(Note: allows pointers to external files and servers)	.mov .qt	8
Video for Windows	.avi	9
Vorbis (OGG audio)	.ogg	10
Windows Media Type 1	.wmv .wma	11
Windows Media Type 2 (Note: allows pointers to external files and servers)	.asf .asx	12
MPEG-4 Part 14	.mp4 .m4p	13

All of the audio characteristics required to properly interpret RAW format data (**CONC = 0)** must be provided; so if RAW is specified, then **Field 11.014: Codec / CDC** is mandatory.

If **CONC** has a value other than zero then the presence of **Field 11.014: Codec / CDC** is dependent upon the type of container format.

- If a container format specifies a codec which cannot be changed, then **Field 11.014: Codec / CDC** should not be included in the record.
- For container types that allow different codecs and codec format, and if the container format does not specify the codec format, then **Field 11.014: Codec / CDC** should be included in the record.

The information items for this field are described below.

- The first information item, which is mandatory, is **container code / CONC**. It is taken from the container code column of **Table 90 Audio Visual Container Codes** . A **container code** of Other (**CONC** = 2) indicates that the container is given neither in **Table 90 Audio Visual Container Codes** nor in the external container table and must be specified. If **CONC** = 2, the **Field 11.051: Comment / COM** shall be used to describe the container. See http://www.nist.gov/itl/iad/ig/ansi_standard.cfm for additional containers. Such additional containers (not listed in **Table 90 Audio Visual Container Codes**) shall use the value **CONC** = 1.
- The second information item only appears if **CONC = 1.** It is the **external container reference code / ECON** and contains the 'reference code' from the table of containers available at

http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

- The third information item is **comments / COM.** It is an optional, unrestricted text string. However, it is required if **CONC** = 2**.** It can contain additional information about the container or additional instructions for reconstruction of audio output from the stored digital data. Container parameters shall be specified in this information item when required for unambiguous decoding. This item should include a description of any noise reduction processing or equalization that must be applied to faithfully render the voice recording.

8.11.14 Field 11.014: Codec / CDC

This is an optional field that gives information about the codec used to encode the voice and audio data in the digital recording. It may only appear when **Field 11.003: Audio object descriptor code /AOD** is set to 0, 1 or 2. (This field is not used if the voice recording is stored on a physical media object as an analog signal).

- If a container format in **Field 11.013: Container / CONT** specifies a codec which cannot be changed, then **Field 11.014: Codec / CDC** should not be included in the record.
- For container types specified in **Field 11.013: Container / CONT** that allow different codecs and codec formats then **Field 11.014: Codec / CDC** should be included in the record.
- **Field 11.013: Container / CONT** need not be present for RAW files, but **CDC** is mandatory if **CONT** is set to RAW.
- This field should be present if **Field 11.013: Container / CONT** is not present in the record.

The information items in the field are described below:

- The first information item is the **codec code / CODC.** It is mandatory if this field is used and indicates the single codec type used for all audio segments in the record. This standard does not accommodate multiple codec types within a single record. **CODC** shall be a numeric entry selected from the Codec code column of **Table 91 Codec Type Codes**.

  If the codec code is identified as Other (**CODC** = 2), the final information item (**comments / COM**) shall be used to describe the codec.

See http://www.nist.gov/itl/iad/ig/ansi_standard.cfm for additional codecs. Such additional codecs (not listed in **Table 91 Codec Type Codes)** shall use the value **CODC** = 1 and the 'reference code' shall be entered in **external codec reference code / ECOD.**

It is STRONGLY encouraged that the other information items in this field be used. However, they are optional since the record creator may not be able to correctly specify

these values.

Table 91 Codec Type Codes

Codec type	Codec code
Linear PCM	0
Codec type reference	1
Other	2
Floating-point linear PCM[208]	3
ITU-T G.711[206] (PCM): μ-law with forward order digital samples	4
ITU-T G.711 (PCM): μ-law with reverse order digital samples	5
ITU-T G.711 (PCM): A-law with forward order digital samples	6
ITU-T G.711 (PCM): A-law with reverse order digital samples	7

- The second information item is the **sampling rate number / SRTN.** It indicates the number of digital samples per second that represent a second of analog voice data upon conversion to an acoustic signal. The sampling rate is expressed in Hz and must be an integer value. Acceptable values are between 1 and 100,000,000 Hz, but unknown or variable sampling rates shall be given the value of 0. Common values of **SRTN** are 8000, 11025, 16000, 22050, 32000, 44100, and 48000 Hz. The value of 0 shall only be used to indicate unknown or variable sampling rate.
- The third information item is the **bit depth count / BITD.** It indicates the number of bits that are used to represent a single digital sample of voice data. Acceptable values are between 1 and 1024 [207], inclusive. Encoders of unknown or variable bit depth shall be given the value of 0. (This field is not intended to be an indication of the actual dynamic range of the voice data). Changes to the bit depth should be logged in **Field 98.900: Audit log / ALF** or **Field 11.902: Annotation information / ANN** audit logs. Common values for **BITD** are 8, 16, 24, and 32 bits.
- The fourth information item is the **endian code / ENDC.** It indicates which byte goes first for digital samples containing two or more bytes. The values for **ENDC** are 0 = big and 1 = little. (**ENDC** is optional and ignored for digital samples that do not contain two or more integer multiples of bytes).
- The fifth information item is the **numeric format / NFMT.** Integer and floating point representations are described below:

  A) An integer followed by s (signed) indicates a signed integer:

  8s = 8 bit signed integer

[206] ITU-T G.711, *Pulse code modulation (PCM) of voice frequencies,* is available at http://www.itu.int/rec/T-REC-G.711/e

[207] At the time of the 2013 Update, the maximum value used in practice is 128.

13s = 13 bit signed integer

B) Floating point representation is entered as an integer and optional letter b (binary) or d (decimal). Rounding is assumed towards zero at the half point (i.e. 12.50 → 12. and 12.51 → 13.), unless otherwise stated in **COM.** Examples are:

32b = 32 bit floating point (binary)[208]

64b = 64 bit floating point (binary) [208]

64d = 64 bit floating point (decimal) [208]

80 = 80 bit double extended precision floating point [209]

128b = 128 bit floating point (binary) [208]

128d = 128 bit floating point (decimal) [208]

- The sixth information item is the **channel count / CHC.** It contains the integer number of channels of data represented in the digital voice data file. The number of channels must be between 1 and 9999, inclusive. Common values for **CHC** are 1 and 2 channels.
- The seventh information item is the **external codec reference code / ECOD.** It can only appear if **CODC** = 1. It contains the 'reference code' from the table of codecs available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm. If the codec is not listed in the external table, enter the name and description of the codec in **COM.**
- The eighth information item is **comments / COM.** It is an unrestricted text string. It can contain additional information about the codec or additional instructions for reconstruction of audio output from the stored digital data. Codec parameters shall be specified in this information item when required for unambiguous decoding. This item should include a description of any noise reduction processing or equalization that must be applied to faithfully render the voice recording.

8.11.15 Field 11.021: Redaction / RED

This field is optional and indicates whether the voice recording has been redacted, meaning that some of the audio record has been overwritten ("Beeped") or erased to delete speech content without altering the relative timings within, or the length of, the segments. This field is not to be used to indicate that audio content has been snipped with the alteration of the relative timings in, or length of, the recording. This field may be present to indicate that redaction has or has not occurred, even if **Field 11.022: Redaction diary / RDD** is not present in the record to provide timings and tracks for

[208] Formatted according to *IEEE 754-2008, IEEE Standard for Floating-Point Arithmetic. See* http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=4610933

[209] Used in AIFF. See http://www-mmsp.ece.mcgill.ca/Documents/AudioFormats/AIFF/Docs/AIFF-1.3.pdf for an explanation. It is based on the 1985 version of *IEEE Standard for Floating-Point Arithmetic.*

the affected segments (if redaction did occur).

- The first information item is the **redaction indicator / RDI.** It is mandatory if this field is present in the record. It indicates whether the voice recording contains overwritten or erased sections intended to remove, without altering the length of the segment, semantic content deemed not suitable for transmission or storage. A value of 0 indicates no redaction occurred and a value of 1 indicates that redaction has occurred. A value of 2 indicates that the organization creating this record is not able to assert or does not assert that redaction has occurred or not occurred.
- The second information item is the **redaction authority organization name / RDA.** It is an optional field (but can only be present if **RDI** = 1) of up to 300 characters in length containing information about the agency that directed, authorized or performed the redaction. Agencies undertaking redaction activities should log their actions by noting the change of field contents in **Field 98.900: Audit log / ALF** and/or **Field 11.902: Annotation information / ANN**.
- The third information item is **comments / COM.** It is an optional unrestricted text string that may contain text information about the redactions affecting the stored voice recording.

8.11.16 Field 11.022: Redaction diary / RDD

This optional field indicates that redaction has occurred and lists the timings within the voice recording of redacted (overwritten) audio segments. This field accommodates up to 600,000 redactions. It may be present even if **Field 11.021: Redaction / RED** is not in the record. If **Field 11.021: Redaction / RED** is present in this instance of the record, then this field shall only appear if the **redaction indicator / RDI** is set to a value of 1. **RDD** isn't required to be present when **RDI** is set to 1 – although it is highly recommended that it be present.

- The first information item is the **segment identifier / SID.** It is mandatory. It uniquely numbers the redaction to which the following items in the subfield apply. There is no requirement that the redactions be numbered sequentially. The number of redactions is limited to 600,000.
- The second information item is the **track and channel number list / TRK.** It is mandatory if item **TRC** in **Field 11.012: Physical media object / PMO** or **CHC** of **Field 11.014: Codec / CDC** is greater than one and it lists all tracks or channels on the recording to which the segment identifier applies. This information item may appear even if neither **TRC** nor **CHC** are present in the record. No value in this list shall be greater than the value of **TRC** or **CHC**, whichever applies. For example, in the case of a two-track stereo recording where both tracks contain a redaction at the same start and end times, this list will be "1" and "2". A single value of 0 indicates that all tracks or channels are to be used. [2015a>] Lists are described in Section 7.7.13. [<2015a]

- The third information item is the **relative start time / RST.** It is a mandatory entry for the redaction identified by **SID** within each subfield. It is an integer. It indicates in microseconds the time of the start of the redaction relative to the beginning of the voice recording in this **Type-11** record (not in the **Type-20** original source recording, if such a record exists in this transaction). Redactions on the same track of the audio object should not overlap. The **RST** of a redaction specified in one subfield should not occur between the **RST** and **RET** of any other redaction on the same track specified in any other subfield. If the **Type-11** record refers to an analog recording, the method of determining the start time shall be given in the comment item of this field. See **Section 7.7.2.6 Relative start time / RST, relative end time / RET and voice recording time / TIM -- measured in microseconds.**
- The fourth information item is the **relative end time / RET.** It is a mandatory integer for the redaction identified by **SID** within each subfield. It is an integer. It indicates in microseconds the time of the end of the redaction relative to the beginning of the voice recording. As with the **RST**, redactions on the same track of the audio object should not overlap. See **Section 7.7.2.6 Relative start time / RST, relative end time / RET and voice recording time / TIM -- measured in microseconds.**
- The fifth information item is **comments/COM.** It is an optional unrestricted text string that allows for comments of any type to be made on a redaction.

8.11.17 Field 11.023: Discontinuities / DIS

This field is optional and indicates by its presence that the voice recording referenced in this **Type-11** record has had segments removed or that signals are not present for another reason. This field is used to indicate post-recording removal (cutting) of a signal ***or*** non-presence of a useful signal, for any reason, from the original recording of the acoustic vocalizations in a way that disrupts time references. This field may be present to indicate that signals are discontinuous in time, even if **Field 11.024: Discontinuities diary / DCD** is not present in the record to provide timings and tracks for the timing discontinuities. Non-presence of a signal can occur, for instance if there is a partial equipment failure – such as for a particular channel. Such a case should be indicated in **COM,** since the lack of a signal was not caused by a post-recording action upon the recording. Non-presence of a useful signal can be total absence of any recorded data, or a case such as having a constant hum due to failure to correctly connect all of the recording devices.

- The first information item is the **discontinuity indicator / DCI.** It is mandatory if this field is used. It indicates whether the voice recording contains temporal discontinuities. A value of 0 indicates that there are no discontinuous signals on the recording and a value of 1 indicates that there are discontinuities. A value of 2 indicates that the organization creating this record is not able to assert or does not assert that there are or are not discontinuities in the recording.

- The second information item is the **cutting authority organization name / CTA.** It is an optional text field of up to 300 characters containing information about the agency that performed a post-processing cutting upon the original recording (removing signal content). Agencies undertaking post-processing cutting activities should log their actions in **Field 98.900: Audit log / ALF** and/or **Field 11.902: Annotation information / ANN** of this record. This information item shall only appear if **DCI** = 1.
- The third information item is **comments / COM.** It is an optional unrestricted text string that may contain text information about the snip activities affecting the voice recording. A practical use of this information item is to log the reasons for discontinuities that occurred during the recording of the signals (such as when the equipment was turned off for 18 ½ minutes).

8.11.18 Field 11.024: Discontinuities diary / DCD

This optional field allows the documentation of discontinuities in the signal. There may be up to 600,000 segments, each registered in an individual subfield. If there are no discontinuities (**DCI** = 0 in **Field 11.023: Discontinuities / DIS**), then all of the data in the voice recording shall be considered as being *in toto* and this field shall not be present in this instance of the record. This field may be present even if **Field 11.023: Discontinuities / DIS** is not present in the record. This field need not be present if **Field 11.023: Discontinuities / DIS** is present in the record and **DCI** = 1, but it is highly recommended in such a case that this field be present. A very practical use of **DCD** is when an original recording is stored in a **Type-20** record and segments relating to a single speaker are combined together and conveyed in a **Type-11** record. **DCD** then indicates the locations of the temporal discontinuities within the resulting **Type-11** record.

- The first information item is the **segment identifier / SID.** It is mandatory in each subfield and uniquely numbers the discontinuity to which the following items in the subfield apply. There is no requirement that the discontinuities be numbered sequentially. The **SID** may list up to 600,000 segments (discontinuities). If **Field 11.023: Discontinuities / DIS** is present and it indicates discontinuities (**DCI** = 1), then the voice recording shall have at least one discontinuity indicated.
- The second information item is **track and channel number list / TRK.** It is mandatory if **TRC** in **Field 11.012: Physical media object / PMO** or **CHC** of **Field 11.014: Codec / CDC** is greater than one and lists all tracks or channels on the recording to which **SID** applies . No value in this list should be greater than the value of **TRC** or **CHC**, whichever applies. For example, in the case of a two-track stereo recording where both tracks have snipped segments (removed signal) at the same start and end times, this list will be "1" and "2". If a single track recorder failed for a period of time (such as having the cord accidentally unplugged to it), then it could be possible to have a list comprised solely of the value "2". A single value of 0 indicates that all tracks or channels are to be used. [2015a>] Lists are

described in Section 7.7.13. [<2015a]

- The third information item is the **relative start time / RST.** It is mandatory for every discontinuity identified by an **SID.** It is an integer. It indicates in microseconds the time of the start of the discontinuity relative to the beginning of the voice recording contained in this **Type-11** record (not the original source recording contained in a **Type-20** record, if such a record exists in the transaction). Discontinuities on a single track on the audio object described in **Field 11.003: Audio object descriptor code /AOD** shall not overlap, meaning that the **RST** of a discontinuity shall not occur between the **RST** and **RET** of any other discontinuity on the same track. If the **Type-11** record refers to an analog recording, the method of determining the start time shall be given in the comment item of this field. See **Section 7.7.2.6.**
- The fourth information item is the **relative end time / RET.** It is a mandatory integer for every discontinuity identified by an **SID** and indicates in microseconds the time of the end of the discontinuity relative to the beginning of the voice recording contained in this **Type-11** record (not the original source recording contained in a **Type-20** record, if such a record exists in the transaction). Discontinuities on the same track of the audio object of **Field 11.003: Audio object descriptor code /AOD** shall not overlap, meaning that the **RET** for a particular discontinuity shall not occur between the **RST** and **RET** of any other discontinuity on the same track. See **Section 7.7.2.6.** It is possible for **RET** to be equal to **RST** (such as when a recording session is stopped and later restarted). If **RET > RST**, that indicates that the content has been removed or is not present[210], but not redacted (masked).
- The fifth information item is **comments / COM.** It is an optional unrestricted text string that allows for comments of any type to be made about a discontinuity. This comment field could contain word or phonic level transcriptions, language translations or security classification markings, as specified in exchange agreements.

8.11.19 Field 11.025: Vocal content / VOC

This field is optional and indicates whether the voice recording content has been diarized, meaning that time markings are included in **Field 11.026: Vocal content diary / VCD** to indicate the speech segments of interest pertaining to the subject of this **Type-11** record. If content has been extracted from a longer recording, it is referred to as a 'snip.' This field may be used for individual snips, as well as concatenated snips. If snips are handled in this **Type-11** record, it is highly recommended that the original recording be contained in, or referenced by a **Type-20** record. This field may also be used to indicate diarization of a complete recording that has not been snipped.

- The first information item is the **diarization indicator / DII.** It is mandatory

[210] It may happen that there is a failure to pick up audio signals for a period of time (perhaps only in selected channels or tracks).

if this field is used. It indicates whether the voice recording is accompanied by a segment diary in **Field 11.026** indicating speech segments from the voice signal subject of the **Type-11** record. A value of 0 indicates that there is no accompanying diary and a value of 1 indicates the presence of **Field 11.026: Vocal content diary / VCD**.

- The second information item is the **diarization authority / DAU.** It is an optional text field of up to 300 characters containing information about the agency that performed the diarization. Agencies undertaking diarization activities on the original speech should log their actions by appending to this item and noting the change of field contents in the **Type-98** record and/or **Field 11.902: Annotation information / ANN** of this record. This information item shall only appear if **DII** = 1.
- The third information item is **comments / COM.** It is an optional unrestricted text string that may contain text information about the diarization activities undertaken on the voice data.

8.11.20 Field 11.026: Vocal content diary / VCD

This field contains subfields that locate the segments within the voice recording of this **Type-11** record that are associated with a single speaker – the subject of the record (not necessarily the subject of the transaction).[211] Although **Field 11.025: Vocal content / VOC** need not be present in the record if this field is included in the record, it is highly recommended that it be present. If **Field 11.025** is included in the record, then this field shall be present only if **DII** = 1.

A speaker's involvement in a conversation may be segmented in a way independent of turn taking as the content, speaking style and collection conditions change. Within each **Type-11** record, there may be only one segment diary describing a single speaker within the single voice recording. If additional diarizations of this voice recording are necessary -- for example, to locate segments of speech from a second speaker in the voice recording, additional **Type-11** records must be created. The identity of each speaker can be cross-referenced to biographic information contained in a **Type-2** record**.**

This field may be used for individual snips, as well as concatenated snips. If snips are handled in this **Type-11** record, it is highly recommended that the original recording be contained in, or referenced by a **Type-20** record. This field may also be used for a complete recording that has not been snipped.

Each diarized segment shall contain speech from the subject of this record, although a segment may contain speech collisions. This record type accommodates up to 600,000 speech segments.

- The first information item is the **segment identifier / SID.** It is mandatory in each subfield and uniquely numbers the segment to which the following items in the subfield apply. There is no requirement that the segments be numbered sequentially in sequential subfields. The **SID** may contain up to 6

[211] It is possible to have multiple **Type-11** records, each dealing with a separate subject, from the same recording.

digits. The number of segments identified in the field is limited to 600,000.

- The second information item is the **track and channel number list / TRK.** It is mandatory if **TRC** in **Field 11.012: Physical media object / PMO** or **CHC** of **Field 11.014: Codec / CDC** is greater than one and lists all tracks or channels on the recording to which the segment identifier applies. No value in this list should be greater than the value of **TRC** or **CHC**, whichever applies. For example, in the case of a two-track stereo recording where both tracks contain a segment at the same start and end times, this list will be "1" and "2". A single value of 0 indicates that all tracks or channels are to be used. [2015a>] Lists are described in Section 7.7.13. [<2015a]

- The third information item is the **relative start time / RST.** It is mandatory. It is an integer. It indicates in microseconds the time of the start of the segment relative to the absolute beginning of the voice recording contained in this **Type-11** record (not the original source recording contained in a **Type-20** record, if such a record exists in the transaction). Because each segment is expected to be dominated by the primary subject of this **Type-11** record, segments from the same track of the audio object identified in **Field 11.003: Audio object descriptor code /AOD** should not overlap. The **RST** of a segment should not occur earlier than the end of a previous segment from the same track, although this is not prohibited. If the **Type-11** record refers to an analog recording, the method of determining the start time shall be given in the comment item of this subfield. See **Section 7.7.2.6 Relative start time / RST, relative end time / RET and voice recording time / TIM -- measured in microseconds.**
- The fourth information item is the **relative end time / RET.** It is mandatory. It indicates in microseconds the time of the end of the segment relative to the absolute beginning of the voice recording contained in this **Type-11** record (not the original source recording contained in a **Type-20** record, if such a record exists in the transaction). **RET** from different segments in this **Type-11** record should not overlap, although this is not prohibited. See **Section 7.7.2.6 Relative start time / RST, relative end time / RET and voice recording time / TIM -- measured in microseconds.**
- The fifth information item is **comments / COM.** It is an optional unrestricted text string that allows for comments of any type to be made on a segment.

The following information items concern the tagged date and time. These are useful, for instance, if a video recorder had not had the correct date and time set.

- The sixth information item is the **tagged date / TDT.** It is optional and gives the date indicated on the original, contemporaneous capture of the voice recording in the segment identified in this **Type-11** record (not the original source recording contained in a **Type-20** record, if such a record exists in the transaction). This item may be different from the value of the **ORD** if the tag is determined to be inaccurate. See **Section 7.7.2.3 Local date.**
- The seventh information item is the **tagged start time / TST.** It is optional

and gives the time tagged on the original, contemporaneous capture of the voice recording in the segment identified. See **Section 7.7.2.4 Local date & time** for details.

- The eighth information item is the **tagged end time / TET.** It is optional and gives the time tagged on original, contemporaneous capture of the voice data at the end of the segment identified. See **Section 7.7.2.4 Local date & time** for details.
- The ninth information item is the **original recording date / ORD.** It is optional and gives the date of the original, contemporaneous capture of the voice recording in the segment identified. This item may be different from the value of **TDT** if the tag is determined to be inaccurate. See **Section 7.7.2.3 Local date** for details.
- The tenth information item is the **segment recording start time / SRT.** It is optional and gives the local start time of the original, contemporaneous capture of the voice recording in the segment identified. This item may be different from the value of **TST** if the tag is determined to be inaccurate. See **Section 7.7.2.4 Local date & time** for details.
- The eleventh information item is the **segment recording end time / END.** It is optional and gives the local end time of the original, contemporaneous capture of the voice recording in the segment identified. This item may be different from the value of **TET** if the tag is determined to be inaccurate. See **Section 7.7.2.4 Local date & time** for details.
- The twelfth information item is the **time source description text / TMD.** It is an optional string that gives the reference for the values used in **ORD, SRT** and **END.**
- The thirteenth information item is **timing comments / TCOM.** It is an unrestricted text string that allows for comments of any type to be made on the timings of the segment recording, including the perceived accuracy of the values of **ORD**, **SRT** and **END**.

8.11.21 Field 11.027: Other content / OCON

This field is optional and indicates whether the recording content has been diarized, meaning that time markings are included, in **Field 11.028: Other content diary / OCD** in order to indicate the segments of the recording that may contain sounds other than the voice of the subject of the record that could assist in the investigation (such as the sound of an automobile accident in a recording).

If content has been extracted from a longer recording, it is referred to as a 'snip.' The use of snips is for the convenience of the user. The start and end times for a snip could, for instance, be very approximate when initially submitted, and be refined upon analysis in a laboratory.

- The first information item is the **diarization indicator / DII.** It is mandatory if this field is used. It indicates whether the recording is accompanied by a

segment diary in **Field 11.028** indicating segments from the signal contained in or referred to by the **Type-11** record. A value of 0 indicates that there is no accompanying diary and a value of 1 indicates the presence of **Field 11.028: Other content diary / OCD**.

- The second information item is the **diarization authority / DAU.** It is an optional text field containing information about the agency that performed the diarization. Agencies undertaking diarization activities should log their actions by appending to this item and noting the change of field contents in the **Type-98** record and/or **Field 11.902: Annotation information / ANN** of this record. This information item shall only appear if **DII** = 1.
- The third information item is **comments / COM.** It is an optional unrestricted text string that may contain text information about the diarization activities undertaken on the recording.

8.11.22 Field 11.028: Other content diary / OCD

This field contains subfields that locate the segments within the recording of this **Type-11** record that may be of interest for investigatory purposes but are not focused upon speech. Although **Field 11.027: Other content / OCON** need not be present in the record if this field is included in the record, it is highly recommended that it be present. If **Field 11.027** is included in the record, then this field shall be present only if **DII** = 1.

This record type accommodates up to 600,000 segments.

- The first information item is the **segment identifier / SID.** It is mandatory in each subfield and uniquely numbers the segment to which the following items in the subfield apply. There is no requirement that the segments be numbered sequentially in sequential subfields. The **SID** may contain up to 6 digits. The number of segments identified in the field is limited to 600,000.
- The second information item is the **track and channel number list / TRK.** It is mandatory if **TRC** in **Field 11.012: Physical media object / PMO** or **CHC** of **Field 11.014: Codec / CDC** is greater than one and lists all tracks or channels on the recording to which the segment identifier applies. No value in this list should be greater than the value of **TRC** or **CHC**, whichever applies. For example, in the case of a two-track stereo recording where both tracks contain a segment at the same start and end times, this list will be "1" and "2". A single value of 0 indicates that all tracks or channels are to be used. [2015a>] Lists are described in Section 7.7.13. [<2015a]
- The third information item is the **relative start time / RST.** It is mandatory. It is an integer. It indicates in microseconds the time of the start of the segment relative to the absolute beginning of the recording. Segments from the same track of the audio object identified in **Field 11.003: Audio object descriptor code /AOD** should not overlap. The **RST** of a segment should not occur earlier than the end of a previous segment from the same track, although this is not prohibited. If the **Type-11** record refers to an analog recording, the method of determining the start time shall be given in the

comment item of this subfield. See **Section 7.7.2.6.**

- The fourth information item is the **relative end time / RET.** It is mandatory. It indicates in microseconds the time of the end of the segment relative to the absolute beginning of the recording. **RET** from different segments in this **Type-11** record should not overlap, although this is not prohibited. See **Section 7.7.2.6.**
- The fifth information item is **comments / COM**. It is an optional unrestricted text string that allows for comments of any type to be made on a segment.

The following information items concern the tagged date and time. These are useful, for instance, if a video recorder had not had the correct date and time set.

- The sixth information item is the **tagged date / TDT.** It is optional and gives the date indicated on the original, contemporaneous capture of the recording in the segment identified. This item may be different from the value of the **ORD**, if the tag is determined to be inaccurate. See **Section 7.7.2.3.**
- The seventh information item is the **tagged start time / TST.** It is optional and gives the time tagged on the original, contemporaneous capture of the recording in the segment identified. See **Section 7.7.2.4** for details.
- The eighth information item is the **tagged end time / TET.** It is optional and gives the time tagged on original, contemporaneous capture of the data at the end of the segment identified. See **Section 7.7.2.4** for details.
- The ninth information item is the **original recording date / ORD.** It is optional and gives the date of the original, contemporaneous capture of the recording in the segment identified. This item may be different from the value of **TDT** if the tag is determined to be inaccurate. See **Section 7.7.2.3** for details.
- The tenth information item is the **segment recording start time / SRT.** It is optional and gives the local start time of the original, contemporaneous capture of the recording in the segment identified. This item may be different from the value of **TST** if the tag is determined to be inaccurate. See **Section 7.7.2.4** for details.
- The eleventh information item is the **segment recording end time / END.** It is optional and gives the local end time of the original, contemporaneous capture of the recording in the segment identified. This item may be different from the value of **TET** if the tag is determined to be inaccurate. See **Section 7.7.2.4** for details.
- The twelfth information item is the **time source description text / TMD.** It is an optional string that gives the reference for the values used in **ORD, SRT** and **END.**
- The thirteenth information item is **timing comments / TCOM.** It is an unrestricted text string that allows for comments of any type to be made on the timings of the segment recording, including the perceived accuracy of the values of **ORD**, **SRT** and **END**.

The fields numbered **11.03x** pertain to the vocal content segments individually (or in groups) or to the entire recording. There may be different **segment identifier list / SIL** values for the different subfields in each of these fields. Note that **Field 11.034** only has one set of values (a list of the segments having voice collision). A value of zero in **SIL** indicates that the values in that particular subfield are the default values for the entire recording. Values in other subfields of the same field, with lists of specific segment identifiers, take precedence over the default values specified in the subfield with **SIL** set to a single value of zero.

8.11.23 Field 11.032: Vocal segment geographical information / SGEO

This field gives the geographical location of the primary subject of the **Type-11** record at the beginning of that segment. If **Field 11.025: Vocal content / VOC** is present, then this field shall only be present if **DII** = 1. This field shall only be present if **Field 11.026: Vocal content diary / VCD** is present.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. A value of 0 in this subfield indicates the segment geographical information in this subfield shall be considered the default value for all segments not specifically identified in other occurrences of this subfield. If multiple segments are identified, they are designated as integers in a list. [2015a>] Lists are described in Section 7.7.13. [<2015a]

- The second information item is the **segment cell phone tower code / SCT.** It is optional and identifies the cell phone tower, if any, that relayed the audio data at the start of the segment or segments referred to in this subfield. It is a text field of up to 100 unrestricted characters.
- The next six information items are latitude and longitude values. **See Section 7.7.3.**
- The ninth information item is the **elevation / ELE.** It is optional. It is expressed in meters. See **Section 7.7.3.** Permitted values are in the range of -442 to 8848 meters. For elevations outside of this range, the lowest or highest values shall be used, as appropriate (e.g., in an airplane).
- The tenth information item is the **geodetic datum code / GDC.** It is optional. See **Section 7.7.3.**
- The eleventh, twelfth, and thirteenth information items (**geographic coordinate universal transverse mercator zone / GCM; geographic coordinate universal transverse mercator easting / GCE;** and **geographic coordinate universal transverse mercator northing /GCN**) are treated as a group and are optional as a group – however, if one appears all three shall be present (thus they are listed as Dependent in the record layout table). These three information items together are a coordinate which represents a location with a Universal Transverse Mercator (**UTM**) coordinate. See **Section 7.7.3.**

- The fourteenth information item is the **geographic reference text / GRT.** It is optional. See **Section 7.7.3.**
- A fifteenth information item is the **geographic coordinate other system identifier / OSI.** It is optional and allows for other coordinate systems and the inclusion of geographic landmarks. See **Section 7.7.3.**
- A sixteenth information item is the **geographic coordinate other system value / OCV.** It is optional and may only be present if **OSI** is present in the record (which is the dependency listed in the record layout table)**.** See **Section 7.7.3.**

8.11.24 Field 11.033: Vocal segment quality values / SQV

If **Field 11.025: Vocal content / VOC** is present, then this field shall only be present if **DII** = 1. This field shall only be present if **Field 11.026: Vocal content diary / VCD** is present. If segments have multiple quality values based on different types of quality assessments, a separate subfield is entered for each assessment.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. [2015a>] This is a list of codes. Lists are described in Section 7.7.13. [<2015a]

A value of 0 in this subfield indicates the segment geographical information in this subfield shall be considered the default value for all segments not specifically identified in other occurrences of this subfield. If multiple segments are identified, they are designated as integers in a list.

- The second information item is the **quality value / QVU.** It is mandatory and shall indicate the segment quality value between 0 (low quality) and 100 (high quality). A value of 255 indicates that quality was not assessed. An example would be the *Speech Intelligibility Index, (*ANSI S3.5-1997).
- A third information item is the **algorithm vendor identification / QAV.** It is mandatory and shall specify the ID of the vendor of the quality assessment algorithm used to calculate the quality score. 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 subfield to a registered organization. A value of 0000 indicates a vendor without a designation by IBIA. In such case, an entry shall be made in COM of this subfield describing the algorithm and its owner/vendor.
- A fourth information item is the **algorithm product identification / QAP.** It is mandatory and shall specify a numeric product code assigned by the vendor of the quality assessment algorithm, which may be registered with the IBIA, but registration is not required. This information item 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 0 to 65,534. A value of 0 indicates a vendor without a designation by IBIA. In such case, an entry shall be made in **COM** of this subfield describing the algorithm and its owner/vendor.

- The fifth information item is **comments / COM.** It is optional but shall be used to provide information about the quality assessment process, including a description of any unregistered quality assessment algorithms used. (if **QAV**= 0x00 or **QAP** = 0).

8.11.25 Field 11.034: Vocal segment collision identifier / VCI

If **Field 11.025: Vocal content / VOC** is present, then this field shall only be present if **DII** = 1. This field shall only be present if **Field 11.026: Vocal content diary / VCD** is present. This optional field indicates that a vocal collision (two or more persons talking at once) occurs within the segment. This field has repeating values. Each value represents a separate segment. There may be up to 600,000 segments identified in this field.

8.11.26 Field 11.035: Vocal segment processing priority / PPY

This optional field shall only appear if **Field 11.025: Vocal content / VOC** exists in this record. If this field exists, segments not identified should be given the lowest priority. The priority specified in this field does not conflict with that of **Field 1.006: Priority / PRY**, which indicates the processing priority of the entire transaction.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. A value of 0 indicates the segment geographical information in this subfield shall be considered the default value. If multiple segments are identified, they are designated as integers in a list. [2015a>] This is a list of codes. Lists are described in Section 7.7.13. [<2015a]
- The second information item is the **processing priority/ PTY.** It is mandatory if this field is used and indicates the priority with which the segments identified in this subfield should be processed. Priority values shall be between 1 and 9 inclusive. A value of 1 will indicate the highest priority and 9 the lowest.

8.11.27 Field 11.036: Vocal segment content description / VSCD

This optional field shall only appear if **Field 11.025: Vocal content / VOC** exists in this record. Each subfield gives an assessment of the content of the voice data within the identified segment and includes provision for semantic transcripts, phonetic transcriptions and translations of the segment. At least one of the information items in addition to [2015e>] **SIL** [<2015e] shall be present in this field.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the

values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. A value of 0 in this subfield indicates the segment geographical information in this subfield shall be considered the default value for all segments not specifically identified in other occurrences of this subfield. If multiple segments are identified, they are designated as integers in a list. [2015a>] This is a list of codes. Lists are described in Section 7.7.13. [<2015a]

- The second information item is the **transcript text / TRN.** It is dependent and is a text field. It may contain a semantic transcription of the segment.
- The third information item is the **transcript language / LNG.** [2015a>]It is optional but shall only be in the subfield if **TRN** is present in the subfield. [<2015a] It states the 3 character *ISO 639-3* code for the language of the translation included in this subfield.
- The fourth information item is the **phonetic transcript text / PTT.** It is an dependent text field containing a phonetic transcription of the segment. This may be informal (based upon the language conventions of the record creator), the International Phonetic Alphabet, the Americanist phonetic notation, or other system. The IPA extensions in Unicode, such as ɣ or ʁ or ɾ, can thus be used.
- The fifth information states the **phonetic transcript convention / PTC.** It is dependent but shall only be in the subfield if **PTT** is present in the subfield. It is a text entry. Recommended entries are:

IPA	International Phonetic Alphabet[212]
Informal	Informal transcription using spelling conventions of the language of the transcriber
American	Americanist phonetic notation[213]
Arpabet	Advanced Research Projects Agency (ARPA) phonetic transcription[214], also used in the CMU Pronouncing Dictionary[215]
Merriam	Pronunciation symbols defined in the Merriam-Webster dictionary [216]

- The sixth information item is the **translation text / TLT.** It is an dependent text field containing a translation of the segment into a language other than the one in which the original segment was spoken. If a text is translated into multiple languages, a separate subfield is generated for each language.
- The seventh information item is the **translation language /TLG.** [2015a>]It is optional but shall only be in the subfield if **TRN** is present in the subfield. [<2015a] It states the 3 character *ISO 639-3* code for the language of the translation included in this subfield.

[212] See http://en.wikipedia.org/wiki/International_Phonetic_Alphabet
[213] See http://en.wikipedia.org/wiki/Americanist_phonetic_notation
[214] See http://en.wikipedia.org/wiki/Arpabet
[215] See www.speech.cs.cmu.edu/cgi-bin/cmudict
[216] See http://assets2.merriam-webster.com/mw/static/pdf/help/guide-to-pronunciation.pdf

- The eighth information item is the **segment content comments / COM.** It is an dependent text field containing comments on the content of the segment.

- The ninth information item is the **transcript authority comment text / TAC.** It is an dependent text field and, if used, it states the authority providing the transcription, translation or comments in **TRN, PTT, TLT** or **COM**. If an automated process was used to develop the transcript, information about the process (i.e., the automated algorithm used) should be stated.

8.11.28 Field 11.037: Vocal segment speaker characteristics / SCC

This optional field gives an assessment of the characteristics of the voice within the segment, including intelligibility, emotional state and impairment. This field shall only appear if **Field 11.025: Vocal content / VOC** exists in the record. At least one of the information items in addition to [2015e>] **SIL** [<2015e] shall be present in this field.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. 0 in this subfield indicates the segment geographical information in this subfield shall be considered the default value for all segments not specifically identified in other occurrences of this subfield. If multiple segments are identified, they are designated as integers in a list. [2015a>] this is a list of codes. Lists are described in Section 7.7.13. [<2015a]
- The second information item is the **speaker list / SPL.** It is dependent. It is a list of unique identifiers for the speakers in the segments identified in **SIL.** The identifiers are user-specified and are not in any pre-specified or correlated order of appearance in the information item. Examples may be: 'S1 S2 S3' or 'Whisperer-A Crier-A Whisperer-B' The entries are Unicode The special character "|" shall not be in the text, since this reserved as a separator character between the elements in this list, when using Traditional encoding. This information item may be used in conjunction with **T2C**. It is also used when separate **Type-2** records are not contained in the transaction for each speaker in a recording, but when it is possible to establish them as separate identities, or as possibly separate identities (which in certain circumstances could later be consolidated into one identity reference if the determination is so made). The level of certainty of the creator of the record of a truly unique separate identity is not implied by this information item or by **T2C.** [2015a>] this is a list of codes. Lists are described in Section 7.7.13. [<2015a]

- The third information item is the **type-2 record cross reference / T2C**. It is dependent. When used, it contains the **IDC** value of the **Type-2** record that contains relevant biographic information and other data concerning the subject of this instance of the record, who may be different from the subject of the

transaction. Its content is similar to **Field xx.992** in certain other Record types. See **Section 7.3.1.1 Type-2 Record cross reference / T2C.**

1. The fourth information item is the **impairment level number / IMP.** It is dependent and shall indicate a subjective, observed level of neurological diminishment, whether from fatigue, disease, trauma, or the influence of medication/substances, across the speech segments identified. No attempt is made to differentiate the sources of impairment**.** The value shall be an integer between 0 (no noticed impairment) and 5 (significant), inclusive.

- The fifth information item is the **dominant spoken language code / DSL.** It is dependent and gives the 3 character *ISO 639-3* code for the dominant language in the segments identified in this subfield.
- A sixth information item is the **language proficiency scale number / LPS.** It is an dependent integer and rates the subjective estimation of the fluency of the language being spoken on a scale of 0 (no proficiency) to 9 (high proficiency).
- The seventh information item is the **speech style code / STY.** It is is dependent and shall be an integer as given in **Table 92 Speech Style Codes**. There may be no more than one value for each of the segments identified in this subfield and will indicate the dominant style of speech within the segments. If attribute code "12" is chosen to indicate "other", additional explanation should be included in (**comments / COM**) below.

Table 92 Speech Style Codes

Speech style description	Speech style code
Unknown	0
Public speech (oratory)	1
Conversational telephone	2
Conversation face-to-face	3
Read	4
Prompted/repeated	5
Storytelling/Picture description	6
Task induced speech	7
Interview	8
Recited/memorized	9
Spontaneous/free	10
Variable	11
Other	12

- The eighth information item is the **intelligibility scale code / INT.** It is dependent. It is an integer describing the subjective evaluation of the speech from 0 (unintelligible) to 9 (clear and fully intelligible).
- The ninth information item, **familiarity degree code / FDC,** is dependent. It is an integer between 0 and 5, inclusive, and indicates the perceived degree

of familiarity between the data subject and the interlocutor, which ranges from 0 indicating no familiarity to 5 indicating high familiarity/intimacy.

- The tenth information item is a **health comment / HCM.** It is dependent text noting any observable health issues impacting the data subject during the speech segment, such as symptoms of the common cold (hoarse voice, pitch lowering, increased nasality), has emphysema, and/or if the data subject regularly smokes tobacco or uses other products that may affect the voice.
- The eleventh information item is the **emotional state code / EMC.** It is dependent. It is an integer giving a subjective estimation of the emotional state of the data subject across the segments identified in this subfield. Admissible emotional state codes are given in **Table 93 Emotional State Codes**. Only one value for this item is allowed across all of the segments identified in this subfield. If emotional state code "9" or "10" is chosen to indicate "variable" or "other", additional explanation may be included in the information item (**comments/COM**) below.

Table 93 Emotional State Codes

Emotional state description	Emotional state code
Unknown	0
Calm	1
Hurried	2
Happy/joyful	3
Angry	4
Fearful	5
Agitated /Combative	6
Defensive	7
Crying	8
Variable	9
Other	10

- The twelfth information item is the **vocal effort scale number / VES.** It is a dependent integer between 0 (very low vocal effort) and 5 (screaming/crying) which reports the subjective, perceived vocal effort of the subject across the identified segments. Only one value is allowed for this item in each subfield.
- The thirteenth information item is the **vocal style code / VSC.** It is an optional integer assessing the subjective predominant vocal style of the data subject across the identified segments. The vocal style code shall be chosen from **Table 94 Vocal Style Codes**. Only one value is allowed for this item in each subfield.

Table 94 Vocal Style Codes

Vocal style description	Vocal style code
Unknown	0
Spoken	1
Whispered	2
Sung	3
Chanted	4
Rapped	5
Mantra	6
Falsetto/Head voice	7
Spoken with laughter	8
Megaphone/Public Address System	9
Shouting/yelling	10
Other	11

- The fourteenth information item is the **recording awareness indicator / RAI.** It is dependent and indicates whether the data subject is aware that a recording is being made. 0 indicates unknown, 1 indicates aware and 2 indicates unaware.
- The fifteenth information item is the **script text / SCR.** It is dependent and may be used to give the script used for read, prompted or repeated speech.
- The sixteenth information item is **comments / COM.** It is dependent and may be used to give additional information about the characteristic assessment process, including a description of any characteristic assessment algorithms used, notes on any known external stresses applicable to the data subject, such as extreme environmental conditions or heavy physical or cognitive load, and a description of how the values in the items of this subfield were assigned. If the sixth information item indicates read or prompted speech, this item may contain the read or prompted text.

[2015n>] The restriction limiting this information to 4,000 characters is lifted. There is now no size restriction. However, application profiles may still restrict the number of characters. [<2015n]

8.11.29 Field 11.038: Vocal segment channel / SCH

This field describes the transducer and transmission channel within the identified segments. This field shall only be present if **Field 11.025: Vocal content / VOC** appears in this record.

- The first information item is the **segment identifier list / SIL.** It is mandatory in each subfield and gives the segment identifiers to which the values in this subfield pertain. The number of segment identifiers listed is limited to 600,000. A value of 0 in this subfield indicates the segment geographical information in this subfield is the default value for all segments

not specifically identified in other occurrences of this subfield. If multiple segments are identified, they are designated as integers in a list. [2015a>] this is a list of codes. Lists are described in Section 7.7.13. [<2015a]

- The second information item is the **audio capture device type code / ACD.** It is optional. It is an integer with values given in **Table 95 Audio Capture Device Type Codes.** A value of "2" indicates that more than one type of microphone is being used simultaneously to collect the audio signal. For many of the acquisition sources in **Field 11.008: Acquisition source / AQS**, as specified by **Table 121 Acquisition source**, the audio capture device type and microphone type code (**MTC)** shall be unknown.

Table 95 Audio Capture Device Type Codes

Device type description	Device type code
Unknown	0
Array	1
Multiple style microphones	2
Earbud	3
Body Wire	4
Microphone	5
Handset	6
Headset	7
Speaker phone	8
Lapel Microphone	9
Other	10

- The third information item is the **microphone type code / MTC.** It is optional. It is an integer that specifies the transducer type from **Table 96 Microphone Type Codes.** Transducer arrays using mixed transducer types shall be designated "other".

Table 96 Microphone Type Codes

Microphone type description	Microphone type code
Unknown	0
Carbon	1
Electret	2
Dynamic	3
Other	4

- The fourth information item is the **capture environment description text / ENV.** It is an optional text field describing the acoustic environment of the recording. Examples of text placed in this item would be "busy restaurant", "urban street", "public park during day".

- The fifth information item is the **transducer distance / DST.** It is optional. It is an integer and specifies the approximate distance in centimeters, rounded to the nearest integer number of centimeters, between the speaker in the identified segments and the transducer. A value of 0 will be used if the distance is less than one-centimeter. Some example distances: handheld = 5 cm; throat mic = 0 cm, mobile telephone = 15 cm; voice-over-internet-protocol (VOIP) with a computer = 80 cm, unless other information is available.
- The sixth information item is the **acquisition source code / AQC.** It is an optional integer that specifies the source from which the voice in the identified segments was received. Only one value is allowed. Permissible values are given in **Table 121 Acquisition source** of the **Record Type-20: Source Representation record.** Any conflict between this value and **Field 11.008: Acquisition source / AQS** shall be resolved by taking this item to be correct for all segments identified in the [2015>a] relevant [<2015a] subfield in **Field 11.038**.
- The seventh information item is the **voice modification description text / VMT.** It is an optional, unrestricted string for a description of any digital masking between transducer and recording, disguisers or other attempts to change the voice quality. Any processing techniques used on the recording should be indicated, such as Automated Gain Control (AGC), noise reduction, etc.
- The eighth information item is **comments / COM.** It is an optional, unrestricted string for additional information to identify or describe the transduction and transmission channels of the identified segments.

8.11.30 Field 11.051: Comment / COM

This field is an optional unrestricted text string that may contain comments of any type on the **Type 11** record as a whole. Comments on individual segments shall be given in the information item **COM** in **Field 11.024: Discontinuities diary / DCD**, or **Field 11.026: Vocal content diary / VCD**. This field should record any intellectual property rights associated with any of the segments in the voice recording, any court orders related to the voice recording and any administrative data not included in other fields. See **Section 7.4.4.**

8.11.31 Field 11.100-900: 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.

8.11.32 Field 11.902: 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. This field logs information pertaining to this **Type-11** record and the voice recording pointed to or included herein.

See **Section 7.4.1.** This section is not intended to contain any transcriptions or translations themselves, but may contain information about the source of such fields in the record.

8.11.33 Field 11.993: Source agency name / SAN

This is an optional field. It may contain up to 125 Unicode characters. This is the name of the agency referred to in **Field 11.004: Source agency / SRC**.

8.11.34 Field 11.994: 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 digital representations, if the data is not contained in **Field 11.999: Voice record data / DATA.** It may be a physical location, as well, such as for analog recordings**.** If this field is used, **Field 11.999** shall not be set. However, one of the two fields shall be present in all instances of this record type unless **Field 11.003: Audio object descriptor code /AOD** is set to a value of 5. A non-URL reference might be similar to: "Case 2009:1468 AV Tape 3 from Convenience Store We-Got-It-All-4U". It is highly recommended that the user state the format of the external file in **Field 11.051: Comment / COM.**

8.11.35 Field 11.995: Associated Context / ASC

This optional field refers to one or more Records **Type-21** instances with the same **ACN**. See **Section 7.3.3.** Record **Type-21** contains images that are NOT used to derive biometric data but may be relevant to the collection of that data, such as an image of a document authorizing redaction.

8.11.36 Field 11.996: Hash / HAS

This optional field applies to all digital audio records, whether stored in **Field 11.999: Voice record data / DATA** or reference to an external storage location in **Field 11.994: External file reference / EFR** and shall contain the hash value of the data, calculated using SHA-256. See **Section 7.5.2**. Use of the hash enables the receiver of the digital data to check that the data has been transmitted correctly, and may also be used for quick searches of large databases to determine if the data already exist in the database. It is not intended as an information assurance check, which is handled by **Record Type-98: Information assurance record.**

8.11.37 Field 11.997: Source representation / SOR

This optional field refers to a representation in **Record Type-20: Source Representation record** with the same **SRN**. This may be useful if, for instance, a recorded television program is stored in its entirety at a location denoted in Record **Type-20**, but only a segment of it is relevant to the transaction and has been cut from the original for further analysis using Record **Type-11**. Note that for this record type, the information item RSP is not used, since segementation of an image is not applicable to voice.

8.11.38 Field 11.999: Voice record data / DATA

If this field is used, **Field 11.994: External file reference / EFR** shall not be set. One of the two fields shall be present in this record unless **Field 11.003: Audio object descriptor code /AOD** has a value of 5. See **Section 7.2** for details. [<2013v] [2013d>]

8.12 Record Type-12: Forensic dental and oral record

Record **Type-12** is designed to accommodate oral biometric and forensic data based upon the *ANSI/ADA Standard No. 1058 - Forensic Dental Data Set* and *ANSI/ADA Standard No. 1067 – Standard Functional Requirements for an Electronic Dental Record System.* This record type facilitates the exchange of data to agencies that may use different data storage and/or matching systems, such as NCIC, WinID, NamUs, UVIS/UDIM, and FastID.

The term 'current data' refers to the available data for the individual in his/her current state, and does not necessarily mean data sampled at the present point in time. 'Prior data' refers to data collected when that individual was in a different, previous state/condition than the current condition.

Disaster Victim Identification and Unknown Deceased Identification

Prior data (antemortem)

Current data (postmortem)

Person Unable (or Unwilling) to Identify Themselves

Prior data (antemortem)

Current data (antemortem)

In the first case (which is the most common use of **Type-12** record), separate **Type-12** records are generated for the prior (antemortem) and for the current data (postmortem). Likewise, separate **Type-12** records are created for prior and current data for persons unable / unwilling to identify themselves. Data elements are included in the **Type-12** record to clearly distinguish the timeframe of the data collection from the subject of the transaction. In order to minimize confusion the word *antemortem* is used in this document instead of prior data and *postmortem* is used instead of current data in those cases where identification *only* concerns a decedent.

The **Type-12** record shall contain and be used to exchange information that may be used to identify or confirm the identity of persons using dental biometrics and forensic odontological procedures. It is consistent with the *ANSI/ADA Standard No. 1058 - Forensic Dental Data Set* of the American Dental Association (ADA) and uses the tooth numbering system stated in ANSI/ADA *Designation System for Teeth and Areas of the Oral Cavity, Standard No. 3950.*

For identification of unknown deceased, as noted by the ADA in Section 6 of *Standard No. 1058,* the antemortem forensic data set should consist of:

- familial data set (recommended to be contained in Record **Type-2**)

- dental history data set (contained in Record **Type-12**)
- tooth data set (contained in Record **Type-12**)
- mouth data set (contained in Record **Type-12**)
- visual image data set (contained in Record **Type-10**)
- radiographic image data set (contained in Record **Type-22**)

The postmortem forensic dental data set should consist of 4 components:

- tooth data set (contained in Record **Type-12**)
- mouth data set (contained in Record **Type-12**)
- visual image data set (contained in Record **Type-10**)
- radiographic image data set (contained in Record **Type-22**)

For living persons unable / unwilling to identify themselves, the same sets of data apply but the first group should be viewed as 'prior' and the second grouping as 'current.' For cases involving the transmission of dental and oral data about an individual for potential law enforcement purposes, the most current data available on that individual should be supplied in a **Type-12** record.

It is important to emphasize that lack of specification of a condition in the data for this record does NOT mean that a condition is NOT present, but simply that the sender did not convey the information.

Application profiles of this standard shall specify the applicable upper limit for all elements with a maximum occurrence of * (unlimited).

While the standard allows Traditional encoding for a **Type-12** record, the user should be aware that many forensic dental systems are (or are being) designed to use XML encoding for ANSI/NIST-ITL transactions.

Table 97 Type-12 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
12.001		**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
12.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 integer	1	1
12.003	**FDS**	**FORENSIC DENTAL SETTING**	O					0	1
	FACC	forensic analyst category code	M↑	A	1	1	FACC = M, D, A, T, or O	1	1
	FOPC	forensic organization primary contact information	O↑	U	1	1000	none	0	1
	FSCC	forensic source country code	O↑	AN	2	3	value from *ISO-3166-1* or GENC	0	1
12.004	**SRC**	**SOURCE AGENCY IDENTIFICATION ID**	M	U	1	*	none	1	1
12.005		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.006	**DSI**	**DENTAL SUBJECT INFORMATION**	M					1	1
	DSC	subject status code	M	A	1	1	DSC = X, A or D	1	1
	DLCD	subject - last contact date	O	See **Section 7.7.2.3**			See **Section 7.7.2.3**	0	1
	DRLC	subject - range of last contact date estimate	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
	DPBD	subject - person birth date	O	see **Section 7.7.2.3**			see **Section 7.7.2.3**	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	DRBD	subject - range of birth date estimate	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
	DPET	subject - person ethnicity text	O	U	1	50	none	0	1
	DRAC	subject - DNA records availability code	O	N	1	1	DRAC = 1 or 2 integer	0	1
	DCLD	subject collection location description	O	U	1	*	none	0	1
	DEDD	subject - estimated death date	O	See **Section 7.7.2.4 Local date & time**			See **Section 7.7.2.4 Local date & time**	0	1
	DRDE	subject - range of death date estimate	D	AN	2	15	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day, h hour, m minute	0	1
	DTER	subject – death time estimate rationale text	D	U	1	*	none	0	1
	DEAT	subject – death age estimate text	D	U	1	*	none	0	1
12.007	**ODES**	**ORIGINAL DENTAL ENCODING SYSTEM INFORMATION**	D					0	1
	OSNC	original system name code	M↑	A	3	6	See **Table 98 Dental System Codes**	1	1
	OSVT	original system version text	D	U	1	*	None	0	1
	OTPC	original tooth permanence category code	M↑	N	1	1	See **Table 99 Tooth Permanency Codes**	1	1
	ORDG	original restoration data granularity code	M↑	N	2	2	See **Table 100 Restoration Data Granularity Codes**	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	OMPN	original morphology – positional numbering code	O↑	N	1	1	See **Table 101 Morphology / Positional Numbering Codes**	0	1
12.008	**TDES**	**TRANSMITTAL DENTAL ENCODING SYSTEM INFORMATION**	D					0	1
	TSNC	transmittal system name code	M↑	A	3	6	See **Table 98 Dental System Codes**	1	1
	TSVT	transmittal system version text	D	U	1	100	None	0	1
	TTPC	transmittal tooth permanence category code	M↑	N	1	1	See **Table 99 Tooth Permanency Codes**	1	1
	TRDG	transmittal restoration data granularity code	M↑	N	2	2	See **Table 100 Restoration Data Granularity Codes**	1	1
	TMPN	transmittal morphology – positional numbering code	O↑	N	1	1	TMPN = 0, 1, 2, 3 or 4	0	1
12.009	**HDD**	**DENTAL HISTORY DATA DETAIL**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	HARC	dental history ADA reference code[217]	M↑	NS	3	30	valid code from *ANSI/ADA Standard No. 1058*, Section 8 (integers and periods are in the codes)	1	1
	HADT	dental history additional descriptive text	D	U	1	*	none	0	1
12.010	**TDD**	**TOOTH DATA DETAIL**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	TDR	tooth data - date of recording	D [218]	See **Section 7.7.2.3**			See **Section 7.7.2.3**	0 [218]	1

[217] Note that this is not a list, unlike TARC or MARC. Each code is entered in a separate subfield. This is due to the nature of the data, with most codes requiring text.

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	TDRR	tooth data - date of recording estimated accuracy range	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
	TID	tooth ID	M↑	N	2	2	tooth numbers chosen from *ANSI/ADA Standard No. 3950*	1	1
	TOET	tooth data – original system data encoding text	D	U	1	*	none	0	1
	TARC	tooth data– ADA reference code list	M↑	NS	3	30	list of valid codes from *ANSI/ADA Standard No. 1058*, Section 9 (integers, and periods are in the codes)	1	LIST[203] with no fixed upper count limit.
	TTET	tooth data - transmitted encoding text	D	U	1	*	none	0	1
	TICC	tooth ID certainty code	O↑	N	1	1	TICC = 0, 1 or 2	0	1
	TADT	tooth data - additional descriptive text	D	U	1	*	none	0	1
12.011	**MDD**	**MOUTH DATA DETAIL**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	MDR	mouth data - date of recording	D[218]	see **Section 7.7.2.3**			see **Section 7.7.2.3**	0[218]	1
	MDRR	mouth data - date of recording estimated accuracy range	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1

[218] It is mandatory that this information item appear in at least one subfield. However, it need not appear in all subfields of this field.

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	MARC	mouth data - ADA reference code list	M↑	NS	3	30	list of valid codes from *ANSI/ADA Standard No. 1058*, Section 10 (integers and periods are in the codes)	1	LIST[203] with no fixed upper count limit.
	MADT	mouth data - additional descriptive text	D	U	1	*	none	0	1
12.012	**DSTI**	**DENTAL STUDY AND TOOTH IMPRINTS**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	SDR	dental study and tooth imprints - date of recording	D [218]	See **Section** 7.7.2.3			See **Section** 7.7.2.3	0 [218]	1
	SDRR	dental study and tooth imprints - date of recording estimated accuracy range	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
	SRC	dental study and tooth imprints - reference code [217]	M↑	N	1	1	SRC = 1, 2, 3 or 4	1	1
	SADT	dental study and tooth imprints - additional descriptive text	M↑	U	1	*	none	1	1
12.013 – 12.019		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.020	**COM**	**COMMENT**	O	U	1	*	none	0	1
12.021 – 12.046		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.047	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
12.048 – 12.199		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
12.200 – 12.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
12.901		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.902	**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**			See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT**	1	1
	NAV	processing algorithm name / version	M↑	U	1	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
12.903 – 12.989		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.990	**T10C**	**TYPE-10 RECORD CROSS-REFERENCE**	O					0	1
		Subfields: Repeating values	M↑	N	1	2	0 ≤ T10C ≤ 99 integer	1	99
12.991	**T22C**	**TYPE-22 RECORD CROSS-REFERENCE**	O					0	1
		Subfields: Repeating values	M↑	N	1	2	0 ≤ T22C ≤ 99 integer	1	99
12.992	**T2C**	**TYPE-2 RECORD CROSS-REFERENCE**	O	N	1	2	0 ≤ T2C ≤ 99 integer	0	1
12.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
12.994	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
12.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
		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
12.996	**HAS**	**HASH**	O	H	64	64	none	0	1
12.997		RESERVED FOR FUTURE USE only by ANSI/NIST-ITL	Not to be used						
12.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1
	UTE	universal time entry	O↑	See **Section** 7.7.2.2			See **Section** 7.7.2.2	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 7 Geographic coordinate datum code values**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D	AN	2	3	one or two digits 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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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
12.999	**DATA**	**DENTAL CHART DATA**	D	Base64	1	*	none	0	1

8.12.1 Field 12.001: Record header

This field is mandatory. See **Section 7.1 Record header.**

8.12.2 Field 12.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this **Type-12** record as listed in the information item **IDC** for this record in **Field 1.003: Transaction content / CNT.** See **Section 7.3.1 Information designation character / IDC.**

8.12.3 Field 12.003: Forensic dental setting / FDS

This optional field is used to describe the forensic setting that carried out the analysis of the dental and oral data to identify or confirm the identity of the subject. This field is not used when data is gathered and transmitted without forensic analysis. The field is comprised of the following information items:

- The first information item is the **forensic analyst category code / FACC**. It is mandatory if this field is used. It contains a single letter describing the head of the team that processed the forensic data:

M	Medical Examiner
D	Dental Professional / Forensic Odontologist
A	Forensic Anthropologist
T	Technician
O	Other

- The second information item is the **forensic organization primary contact information / FOPC** for the forensic analysis. This is an optional item. It should include the name, telephone number, and e-mail address of the person responsible for the analysis.
- The third information item is optional. It is the **forensic source country code**

/ **FSCC**. This is the code of the location where the forensic analysis was performed, not the code of the location from which the forensic data or sample were sent for analysis. **FSCC** defaults to *ISO-3166-1* coding. If **Field 1.018: Geographic name set / GNS** is set to GENC, then **FSCC** is from the GENC list.

8.12.4 Field 12.004: Source agency identification ID / SRC

This is a mandatory field. See **Section 7.6** for details. The **SRC** is a code for a particular agency that is assigned by the implementation domain (such as NORAM, which is maintained by the FBI). It is often not a readable name. The source agency name may be entered in **Field 12.993: Source agency name / SAN.**

This field denotes the agency that prepared this record. It is not necessarily the agency that is transmitting this transaction (which is designated in **Field 1.008: Originating agency identifier / ORI**). It also need not be the agency that gathered the biometric samples and/or metadata. That organization (if different) is specified in **Field 12.047: Capture organization name / CON.**

Note that changes and additions or subtractions to/from the original **Type-12** record may be noted in **Field 98.900: Audit log / ALF**. Thus, when an agency updates a **Type-12** record, **Field 12.004** is updated to reflect this new agency name and the previous value for **Field 12.004** may be recorded in **Field 98.900**.

8.12.5 Field 12.006: Dental subject information / DSI

This field is mandatory. The first information item is mandatory. This field contains data that would not typically be contained in **Type-2** records but are very important for identification of unknown deceased or persons unable to identify themselves. Here, the term 'subject' refers to the person (alive or dead) to whom the information applies.

This field is used to record the status of the individual at the time when the relevant data was recorded. For instance, if data is provided from a dentist's office to assist in Disaster Victim Identification, the value for **DSC** would be A, since the patient was alive at the time of the last dental appointment. For a different instance of a **Type-12** record, created by a Medical Examiner, the value for **DSC** would be D.

- The first information item is the **subject status code / DSC**. It is an integer with one of the following values:

  X Status of individual unknown

  A Data obtained from a living person (for unknown deceased = antemortem)

  D Data obtained from a non-living person (deceased)

  Note that separate records shall exist for prior and current information, which may have the same or different **DSC** value, depending upon the circumstances.

- The second information item, **subject – last contact date / DLCD**, is an

optional information item. This is particularly useful in missing persons cases. See **Section** 7.7.2.3 for the format. This is typically the last examination date if the records are from a dentist's office.

- The third information item, **subject – range of last contact date estimate / DRLC** is entered in the format $\mathbf{Y^{yy}M^{mm}D^{dd}}$. The bold letters are entered with Y indicating years, M indicating months, D indicating days. Not all levels of time need be entered – only the relevant one(s). Leading zeros need not be entered. The range is centered upon **DLCD**. Thus, for a value of **DLCD** being 20020500 (zeros being used to indicate lack of knowledge of the day), a range might be M1, indicating plus or minus 1 month from March, 2002.

[2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

- The fourth information item, **subject – person birth date / DPBD**, is an optional information item. See **Section** 7.7.2.3 for the format. If records are available, enter the birth date as known. In forensic examination, enter an approximate date.
- The fifth information item, **subject – range of birth date estimate / DRBD** is entered in the format $\mathbf{Y^{yy}M^{mm}D^{dd}}$. The bold letters are entered with Y indicating years, M indicating months, D indicating days. Not all levels of time need be entered – only the relevant one(s). Leading zeros need not be entered. The range is centered upon **DPBD**. Thus, for a value of **DPBD** being 19910000 (zeros being used to indicate indicate lack of knowledge of month or day), a range might be Y3, indicating plus or minus 3 years from 1991.

[2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

- The sixth information item, **subject – person ethnicity text / DPET**, is an optional string of 50 Unicode characters used to describe the ethnic group to which the subject belongs. This is not selected from a fixed list, since terminology that is useful in one area may not be relevant in another. For instance, in certain locations, if tribal membership (e.g., Zulu, Hopi) is known, it may be entered in this information item. In the United States, 'Hispanic' is a common term that may assist in identification, but that term would be meaningless (or simply cause confusion) in Guatemala or

Argentina. 'Aboriginal' describes specific peoples in Australia but is not a term commonly in use in the U.S.

- The seventh information item is optional and indicates if DNA records are available for the subject. It is **subject DNA records availability code / DRAC**. This need not be specified if a **Type-18** record is contained in the transaction, but it is highly suggested to do so. Allowed values are:

  1 = Yes

  2 = No

- The eighth optional information item is the **subject collection location description / DCLD**. It is an optional string of Unicode characters. An example is "Lower jaw recovered 4.3 meters from the tip of the left wing of the airplane, in grid 7W. Separated from skull. Four teeth found within 20 centimeters of the lower jaw." This may be a more descriptive entry than that of **Field 12.998: Geographic sample acquisition location / GEO**, which is typically the geographic location specified in GPS coordinates or with reference to a fixed landmark.

- The ninth item is optional but shall only appear if the subject is deceased and the data sample was collected postmortem. (**DSC** = [2015e>] **D** [<2015e]). It is the **subject – estimated death date / DEDD**. See **Section 7.7.2.4** for the format.

- The tenth item is optional but shall only appear if **DEDD** is present in the field. It is **subject – range of death date estimate / DRDE**. This is the amount of time (plus and minus) of which **DEDD** is the center point during which the death could have taken place. It is entered in the format $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}\mathbf{h}^{hh}\mathbf{m}^{mm}$. The bold letters are entered with Y indicating years, M indicating months, D indicating days, h indicating hours and m indicating minutes. Not all levels of time need be entered – only the relevant one(s). Thus, with **DEDD** set at 201203150000 **DRDE** could have a value of D05, meaning that the death could have occurred from March 10 through March 20. The letters do not need to be in bold case in the actual data. Leading zeros need not be entered.

  [2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

- The eleventh item is optional but shall only appear if **DRDE** is present in the field. It is **subject- death time estimate rationale text / DTER**. It is entered in Unicode. A typical entry may be "Using the Glaister equation, time of death was able to be estimated to be approximately 4 hours before the measurements were taken at 18:15 on May 2. Thus, the time of death was

approximately 14:15 on May 2." [219]

- The twelfth item is optional but shall appear only if **DRDE** is present in the field. It is **subject – death age estimate text/ DEAT**. It is entered in UNICODE and a typical entry may be "DCIA {dental cementum increment analysis} was performed on the left mandibular second premolar. The tooth was embedded in epoxy, sectioned, and mounted to a glass slide ground and polished and examined under 10, 20 and 40X magnification under polarized light. Subject estimated to be 23.5 to 24.5 years based on DCIA."[220]

8.12.6 Field 12.007: Original dental encoding system information / ODES

This field is used to describe the data collection schema that was used for the original recordation of dental information. **ODES** need not be a forensic data system or a system capable of formulating an *ANSI/NIST-ITL* conformant record or transaction. The purpose of this field is to specify the rules and definitions that were used to specify the original data collection. If **Field 12.010: Tooth data detail / TDD** appears in this record, then this field should appear in the record.[221] Either this field and / or **Field 12.008: Transmittal dental encoding system information / TDES** shall be present in the record if **Field 12.010: Tooth data detail / TDD** appears in this record.

Table 98 Dental System Codes

Dental System Code	Description
EDR	Electronic Dental Record System
FastID	Interface for completing the INTERPOL Disaster Victim Identification forms[222]
NamUs	The National Missing and Unidentified Persons System[223]
NCIC	The National Dental Image Repository of the National Crime Information Center (NCIC) run by the Federal Bureau of Investigation (FBI)[224]

[219] See Silver W.E., Souviron R.R, *Dental Autopsy*, CRC Press, 2009 p.9: "*Algor mortis* occurs as body temperature changes after death occurs. There is usually decline in temperature until the body reaches the ambient temperature. According to the seasons and the geographical area, the ambient temperature may vary widely and should be a consideration. Using the Glaister equation: 36.9ºC (98.6ºF) minus the rectal temperature divided by 1.5 will give the approximate hours elapsed since death. Then, as decomposition occurs, the temperature of the body tends to increase. The rate of decomposition will depend upon local conditions, for example, sun, water, or ice."

[220] See: Wedel V, Found G, Nusse G, *A 37-Year-Old Case Identification Using Novel and Collaborative Methods*, Journal of Forensic Identification, Vol. 63. No. 1 p. 10.

[221] If the transmitting system is different than the original system, then both **Field 12.007** and **Field 12.008** should be contained in the record. However, the standard allows a record to be created with only the transmitting system data, for cases where the original system data may no longer be available.

[222] Information is available at http://www.interpol.int/INTERPOL-expertise/Forensics/DVI

[223] Information is available at http://namus.gov/

[224] Information is available at http://www.fbi.gov/about-us/cjis/ncic/ncic

PLASS	The DVI System International marketed by Plass Data Software A/S[225]
UDIM	The Unified Dental Identification Module (UDIM) of the Unified Victim Identification System (UVIS) [226]
WinID	Dental Identification System[227]
Other	The coding system is not listed but is formally documented
None	The *ANSI/ADA Standard No. 1058 – Forensic Dental Codes* are selected and entered directly.

- The first information item is mandatory. It is the **original system name code / OSNC**. The code is selected from **Table 98.**
- The second information item is the **original system version text / OSVT**. This item is optional unless 'Other' or 'EDR' is specified for **OSNC**. It specifies version of the data system that was used in the original coding (such as '2012 version' for UVIS/UDIM). When **OSNC** is set to 'Other' or 'EDR', this information item is mandatory and specifies the official brand name of the software utilized, and optionally the version number if known. If information of the location of documentation for the software is available such as a URL / URI it can also be included with a text beginning with the word "URL: ".
- The third information item is the **original tooth permanence category code / OTPC**. It is mandatory. It is used to designate the way that permanent and deciduous teeth are coded according to the system used to enter the data. Codes are listed in **Table 99 Tooth Permanency Codes**.

Table 99 Tooth Permanency Codes

Tooth Permanency Code	Description
0	Specified by tooth number (e.g., FastID, PLASS). For systems such as WinID and UDIM, which internally list the tooth number with a permanent tooth number but use a deciduous indicator, those two pieces of information shall be combined together to assign the tooth number according to *ANSI/ADA Standard No. 3950* prior to inclusion in this record.
1	Unable to determine if the teeth are permanent or deciduous at the tooth level but the system does allow a marker to indicate that deciduous teeth are present in the dentition (e.g., NCIC). The permanent tooth number shall be used.

[225] Information is available at http://www.plassdata.com/products-services/software-products.html#dvi

[226] Information is available at http://www.nyc.gov/html/ocme/downloads/pdf/Special%20Operations/UVIS%20Information%20Guide_20090917.pdf

[227] Information is available at http://abfo.org/winid/

2	Coding system incapable of distinguishing deciduous from permanent teeth (e.g., NamUs). The permanent tooth number shall be used.
3	Unknown whether the coding is capable of indicating deciduous and permanent teeth and / or whether the coding was performed using that capability. The permanent tooth number shall be used.

- The fourth information item is the **original restoration data granularity code / ORDG**. It is mandatory. This index indicates the type and level of restoration and surface information coded in **Field 12.010: Tooth data detail / TDD**. The codes in **Table 100 Restoration Data Granularity Codes** are entered[228].

Table 100 Restoration Data Granularity Codes

Granularity Codes	Description
11	The system is capable of specifying individual restorations with the restored surface information and material composition coded separately for each restoration on the tooth; however, the submission of restorations with materials specified for each restoration is optional.
21	The system is capable of specifying individual restorations with the restored surface coded separately; however, all of the individual material compositions are combined into a single code for the tooth. Material specification is optional. Unknown material composition may be implicitly or explicitly coded.
31	The system is capable of coding individual restorations with restored surfaces into a single code. All the materials utilized in all the restorations are combined into a single code when materials are represented. The codes are specified by tooth.
41	The presence of restorations without surface information is combined to a single code for the tooth. All materials utilized in all the restorations are combined into a single code for the tooth, when materials are represented.
51	Only the presence of restorations without surface or material information is included in the coding.
99	The level of detail contained in **Field 12.010: Tooth data detail / TDD** concerning restorations, materials and/or surfaces is unknown.

- The fifth information item is the **original morphology – positional numbering code / OMPN.** It is optional. It is used to indicate whether the assignment of tooth numbers was done on a morphological basis (shape of the tooth regardless of the location in the arch) or positional basis (the location of the tooth regardless of the morphology). There is often no distinction, but in certain cases, the result can be different. Values are selected from the Code column of **Table 101 Morphology / Positional**

[228] In 2013, the granularity codes for some major systems are: 11=Plass, FastID, any EHR that utilized the ADA Code on Dental Procedures and Nomenclature (CDT) Coding system; 21=None; 31=WinID, UDIM; 41=NCIC; 51=NamUs

Numbering Codes.

Table 101 Morphology / Positional Numbering Codes

Code	Description
0	Unknown
1	Developer specified morphological coding
2	Developer specified positional coding
3	Coder specified morphological coding independent of developer specification
4	Coder specified positional coding independent of developer specification

8.12.7 Field 12.008: Transmittal dental encoding system information / TDES

This field is mandatory only if the record creation data reference / encoding system is different from the original system and **Field 12.010: Tooth data detail / TDD** appears in this record. This field is used to describe the encoding system that is associated with this record. Either this field and / or **Field 12.007: Original dental encoding system information / ODES** shall be present in the record if **Field 12.010: Tooth data detail / TDD** appears in this record.

If there is a chain of systems involved in creating the record, it is highly recommended that **Fields 12.200 through 12.900: User-defined fields / UDF** be used to log the steps involved from origin to present state. Note that if the record creation organization wishes to transmit the information that was received from an intermediate organization (before modification), **Field 12.010: Tooth data detail / TDD** allows for this possibility.

- The first information item is mandatory. It is the **transmittal system name code / TSNC**. The code is selected from **Table 98 Dental System Codes**.
- The second information item is the **transmittal system version text / TSVT**. This item is optional unless 'Other' is specified for **TSNC**. It specifies the version of the system that was used in the transmitted coding (such as '2012 version' for UVIS/UDIM). When **TSNC** is set to 'Other' or 'EDR', this information item is mandatory and specifies the official brand name of the software utilized, and optionally the version number if known. If information for the location of documentation concerning the software is available, such as a URL / URI, it can also be included with a text beginning with the word "URL:".
- The third information item is the **transmittal tooth permanence category code / TTPC**. It is mandatory. It is used to designate the way that permanent and deciduous teeth are coded according to the system used to enter the data. Possible values are the codes in **Table 99 Tooth Permanency Codes.**

- The fourth information item is the **transmittal restoration data granularity code / TRDG**. It is mandatory. This index indicates the type and level of restoration and surface information coded in **Field 12.010: Tooth data detail / TDD**. The codes in **Table 100 Restoration Data Granularity Codes** are entered[229].
- The fifth information item is the **transmittal morphology – positional numbering code / TMPN.** It is optional. It is used to indicate whether the assignment of tooth numbers was done on a morphological basis (shape of the teeth) or positional. There is often no distinction, but in certain cases, the result can be different. Values are selected from the Code collumn of **Table 101 Morphology / Positional Numbering Codes.**

8.12.8 Field 12.009: Dental history data detail / HDD

This optional field should be included when prior data is available. This field includes a subfield with a repeating set of information items. Each subfield has one mandatory information item. There may be multiple subfields.

- The first information item is the **dental history ADA reference code / HARC**. It is mandatory. Any code value corresponding to the data set descriptors in Section 8 of the *ANSI/ADA Standard No. 1058* may be entered. An example is 8.1.3.9.1.5 f*or the National Provider Identifier Number of Dentist that treated the patient*.
- The second information item is the **dental history additional descriptive text / HADT**. It is a Unicode free text information item. It is used for those codes that require text, such as 8.1.1 Name of Practice – *the full name of the practice where the patient was treated*. Other reference codes, such as 8.1.3.8.4 Chart Available – *used when chart information is available from the practice where the patient was treated*, would not have any information recorded in **HADT**.

If **HARC** is set to 8.1.3.10 (the ADA code for CHART), the chart is contained in **Field 12.999: Dental chart data / DATA**. If the chart is already in electronic format, it should be converted into Base 64 prior to sending to avoid the use of any 'reserved' characters in XML. If the chart is physical, the most common approach is to scan the chart and transmit the PDF or JPEG of the scan, also converted to Base 64. However, it is possible to specify an external storage location for the chart in **Field 12.994**.

8.12.9 Field 12.010: Tooth data detail / TDD

If this field is present, then **Field 12.007: Original dental encoding system information / ODES** and / or **Field 12.008: Transmittal dental encoding system information / TDES** shall also be also present in the record.[221] There may be multiple subfields with the same tooth number. For coding systems that combine

[229] In 2013, the granularity codes are: 11=Plass, FastID, any EHR that utilized the ADA Code on Dental Procedures and Nomenclature (CDT) Coding; 21=None; 31=WinID, UDIM; 41=NCIC; 51=NamUs

tooth conditions into a single subfield at the tooth level, one subfield is used per tooth. If information is available separately for conditions on a particular tooth, each condition shall be a separate subfield with the same tooth number.

All destination systems should be capable of receiving data relating to a single tooth in multiple subfields, even if tooth conditions in the destination system are expressed jointly at the tooth level. If a destination system that is capable of expressing tooth conditions separately does receive information from a system that is not capable of expressing tooth conditions separately, the destination system should take care concerning the assignment of *ANSI/ADA Standard No. 1058* codes to individual conditions on the tooth.

For cases when there is no information about a tooth (e.g., even whether it was missing or present on the subject), there shall be no field entry. However, if it is known that a tooth was missing, the appropriate ANSI/ADA Standard No. 1058 – Forensic Dental Codes should be represented, such as 9.3.2.2 – Missing not replaced – *used regardless of the etiology of the lost (extracted, congenital, unknown) with the exception of the case where the tooth lost was believed to be an avulsion*, or 9.4.4.5.3 – Avulsion of Tooth – *describing that a tooth has been forcefully exfoliated from its socket and the socket has exhibited virtually no healing, used only if there is substantial evidence that the loss was traumatic and not therapeutic or through natural causes*.

- The first information item is the **tooth data - date of recording / TDR**. It corresponds to Section 9.2 of *ANSI/ADA Standard No. 3950.* It is mandatory that this information item appear in one subfield. It need not appear in all subfields. See **Section 7.7.2.3** for the format.
- The second information item is optional. However, it shall not appear in a subfield if **TDR** is not present in that instance of the subfield. It is **tooth data - date of recording estimated accuracy range / TDRR**. This is the amount of time (plus and minus) of which **TDR** is the center point during which the tooth data could have been originally collected. [2015a>] In Traditional format,[<2015a] it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **TDR.** Leading zeros need not be entered.

  [2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

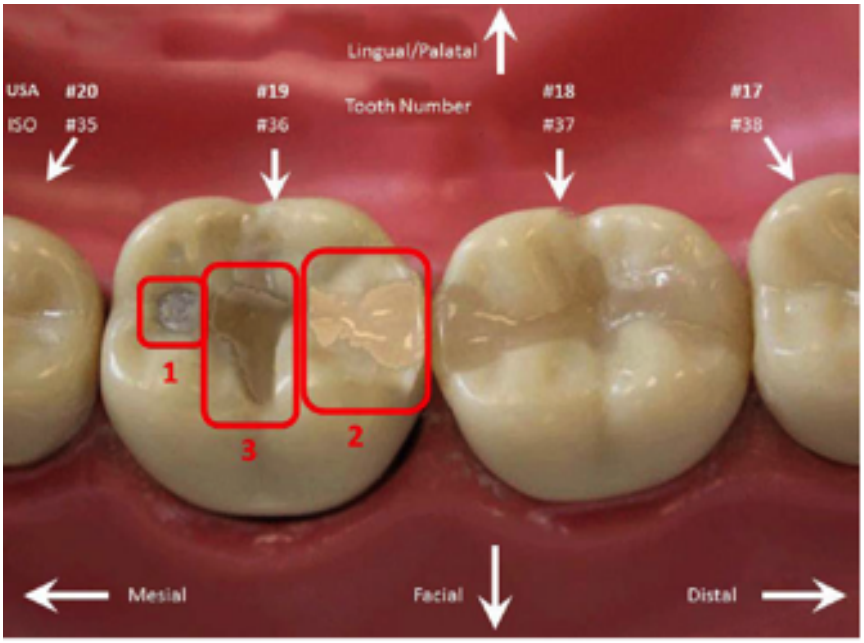
- The third information item is the **tooth ID / TID**. It is mandatory. Teeth shall be numbered utilizing the permanent and deciduous teeth codes in *ANSI/ADA Specification No. 3950*. Note that if **OTPC** indicates that there is no distinction between deciduous teeth and permanent teeth in the original coding, the tooth shall be listed as permanent, even if the transmittal coding

is capable of distinguishing between the two types of teeth. The analyst should be aware of this when reviewing the data.

Figure 17: Digital designation of the teeth and of the oral cavity as specified in *ANSI/ADA Standard No. 3950*

Right																Left	
							00										Oral cavity
							01										Maxillary area
					10					20							Quadrant
			03				04				05						Sextant
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28		Permanent teeth
			55	54	53	52	51	61	62	63	64	65					Deciduous teeth
			85	84	83	82	81	71	72	73	74	75					Deciduous teeth
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38		Permanent teeth
			08				07				06						Sextant
					40					30							Quadrant
							02										Mandibular area

Figure 18: Simulated Restorations in Tooth 36



- The fourth information item is the **tooth data - original system data encoding text / TOET**. It is a Unicode field. It shall be entered unless **OSNC** has a value of 'None' (representing that the coding was performed by

using the codes of *ANSI/ADA Standard No. 1058 – Forensic Dental Data Set* without specific reference to a dental forensic processing system's data restrictions).

If data is coming from a dental practice management software system (**OSNC** is set to 'EDR'), this information item shall contain all of the conditions treated and they shall be listed in order, from the most recent to the first treated. The order is critical for the forensic analysis.

A tooth with three restorations (as in **Figure 18: Simulated Restorations in Tooth 36**) may be described differently by various storage and comparison systems. See the XML exemplar for the actual coding.

Plass : amf O cef DO tif O

Plass distinguishes each restoration and describes their material content individually. The Plass coding is:

restoration 1 is an amalgam restoration (amf) in occlusal location (O)

restoration 2 is a composite restoration (cef) in distal – occlusal location (DO)

restoration 3 is a tooth colored restoration (tif) in occlusal location (O)

Note: This would be coded using three subfields.

UDIM: DO mAC

UDIM does not distinguish the number of restorations or describe them individually. The coding indicates the presence of restorations at the distal and occlusal locations (DO) and that the materials (m) are amalgam (A) and composite (C). UDIM has four code types: tooth surface status (required), restoration code – r (optional), condition code – c (optional), material code – m (optional).

WinID: DO ES

WinID does not distinguish the number of restorations or describe them individually. The coding indicates the presence of restorations at the distal and occlusal locations (DO). The fillings are listed as resin (E) and silver (S).

NCIC: OD

NCIC does not distinguish the number of restorations or describe them individually. The required surface sequence for restoration data is MODFL. This coding example indicates the presence of restorations in the distal and

occlusal locations (OD).

NamUs: F

NamUs does not distinguish the number of restorations or describe them individually. In addition, NamUs does not directly code the restoration composition, nor does NamUs describe which surfaces are restored. The coding only indicates the presence of a restoration.

- The fifth information item is the **tooth data - ADA reference code list / TARC**. This information item is mandatory. Any code value in Section 9 of the *ANSI/ADA Standard No. 1058* may be entered. The *ANSI/ADA Standard No. 1058* coding system has a hierarchical arrangement so that codes with more nodes (represented by periods) provide greater specificity of the information concerning a characteristic. Note that if only general information is available, a code with fewer nodes may be entered, such as 9.3.2.5, which corresponds to *present – restored*. If available information is more detailed, a code with more nodes should be entered, such as 9.3.2.5.1.3, which indicates *present – restored; surfaces restored; distal*. The listing of a reference code indicates the presence of the characteristic. [2015a>] this is a list of codes. Lists are described in Section 7.7.13. [<2015a]

Several values can be entered for the same tooth in TARC. There may be 100 entries for **TARC.** In XML, each code is listed separately. The coding is order independent, so a code of 9.3.2.5.1.3 (Distal) followed by 9.3.2.5.1.2 (Occlusal) is treated identically to an entry of 9.3.2.5.1.2 (Occlusal) followed by a code of 9.3.2.5.1.3 (Distal). If the original system coding is very detailed but the transmitting system coding is at a summary (represented by codes with fewer nodes) level the mapping is straightforward. However, if the converse is true, care must be taken not to introduce 'false' information in the mapping of codes. Using the example for **Figure 18: Simulated Restorations in Tooth 36:**

Plass: Three subfields describe the tooth.

In the first subfield, for the first condition (restoration 1) (amf O)

TARC = 9.3.2.5.1.2 9.3.2.5.4.1

(present-restored, occlusal location)

(present-restored, amalgam material)

In the second subfield, for the second condition (restoration 2) (cef DO)

TARC = 9.3.2.5.1.3 9.3.2.5.1.2 9.3.2.5.4.2

(present-restored, distal location)

(present-restored, occlusal location)

(present-restored, composite/acrylic material)

In the third subfield, for the third condition (restoration 3) (tif O)

TARC = 9.3.2.5.1.2 9.3.2.5.4.9

(present-restored, occlusal location)

(present-restored, other – by report) Note: 'By report' indicates that **TADT** should explain that 9.3.2.5.4.9 here represents tooth colored filling. 9.3.2.5.4.9 is used since the composition of the restorative material is not specified in the code.

UDIM: **TOET** = OD mAC

One subfield that describes the entire tooth:

TARC = 9.3.2.5.1.2 9.3.2.5.1.3 9.3.2.5.4.1 9.3.2.5.4.2

(present-restored, occlusal location)

(present-restored, distal location)

(present-restored, amalgam material)

(present-restored, composite/acrylic material)

WinID: **TOET** = OD ES

One subfield that describes the entire tooth:

TARC = 9.3.2.5.1.2 9.3.2.5.1.3 9.3.2.5.4.1 9.3.2.5.4.2

(present-restored, occlusal location)

(present-restored, distal location)

(present-restored, amalgam material)

(present-restored, composite/acrylic material)

NCIC: **TOET**= OD

One subfield describes the entire tooth:

TARC = 9.3.2.5.1.2 9.3.2.5.1.3

(present-restored, occlusal location)

(present-restored, distal location)

NamUs: **TOET** = F

One subfield that describes the entire tooth:

TARC = 9.3.2.5

(present-restored)

An example of how a person might code the tooth without reference to a particular system using the *ANSI/ADA Standard No. 1058 – Forensic Dental Codes* could be:

Two subfields with one describing the tooth.

In the first subfield, the restoration is described, but without a location.

TARC = 9.3.2.5.4.1

(present-restored, amalgam material)

In the second subfield, the other restorations are jointly described, again without location associated to the restorations on the tooth.

TARC = 9.3.2.5.4.9

(present-restored, other – by report) The analyst may have indicated in **TADT** that there are other restorations that appear to be NON-metallic on the same tooth.

- The sixth information item is the **tooth data - transmitted system encoding text/ TTET**. This is important since the record creation systems may be different from the original system where the coding of the test first occurred. It is a Unicode information item.

  Using some of the examples above (also referring to **Figure 18: Simulated Restorations in Tooth 36**):

  The first subfield for Plass would be *amf O;* the second subfield would be *cef DO*

  The entry for UDIM would be *OD mAC*.

  For **OSNC** = 'None' in **Field 12.007: Original dental encoding system information / ODES** and when **Field 12.008: Transmittal dental encoding system information / TDES** is not present in the record, there shall not be an entry in this information item. For all other coding, this information item is mandatory.

- The seventh information item is the **tooth ID certainty code / TICC**. This information item is optional. If it is not entered, a **TICC** of 0 is assumed. Possible values are:

  0 Unspecified (the system does not have the capability of stating that there is certainty or uncertainty in the tooth

number)

1 Certain

2 Uncertain

- The eighth information item is the **tooth data - additional descriptive text / TADT**. It is Unicode free text information. It is used for those codes that require text, such as 9.3.2.5.3.1.1.5 – *restoration material / Other (by report) – used to describe a restoration material not described by other descriptors*. Other reference codes, such as 9.3.2.1.2.1.3 Type of Pontic / Resin – *used for a pontic that is adhesive attached to adjacent teeth by an extra coronal partial coverage restoration of any material*, would not have any information recorded in **TADT**.

8.12.10 Field 12.011: Mouth data detail / MDD

This optional field allows the entry of information concerning the mouth. For instance, periodontal disease may be noted, as may partial removable dentures.

- The first information item is the **mouth data – date of recording / MDR**. It is mandatory that it appear in at least one subfield of this field. See **Section 7.7.2.3** for the format.
- The second information item is optional. However, it shall not appear in a subfield if [2015e>] **MDR** [<2015e] is not present in that instance of the subfield.

It is **mouth data – date of recording estimated accuracy range/ MDRR**. It is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$. It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **MDR**. Leading zeros need not be entered.

[2015a>]For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

- The third information item is the **mouth data - ADA reference code list / MARC**. It is mandatory. Any code value in Section 10 of the *ANSI/ADA Standard No. 1058* may be entered. If only general information is available, a high level number may be entered, such as 10.3.2.4, which corresponds to *Maxillofacial Prosthesis*. If more detailed information is available, a lower level code should be entered,

such as 10.3.2.4.1.1, which indicates *Maxilla (The prosthesis is used to replace portions of the maxilla)*. The listing of a code indicates that the characteristic is present. If only general information is available, a code with fewer nodes may be entered, such as 10.3.2.2, which corresponds to *Partial Removable Denture*. If available information is more detailed, a code with more nodes should be entered, such as 10.3.2.2.1, which indicates *Kennedy Class I – This Descriptor is used to describe a removable prosthesis replacing teeth on both sides of the arch where no other teeth exist posterior to the edentulous area.* [2015a>] this is a list of codes. Lists are described in Section 7.7.13. [<2015a]

- The fourth information item is the **mouth data - additional descriptive text / MADT**. It is a Unicode free text information item. It is used for those codes that require text, such as 10.3.5.1 Prosthetic / ID Data – *used to describe any identifying Serial number on the appliance*. Other reference codes, such as 10.5.1.1.8.1 Cleft lip – *used to indicate the non-union of the soft tissue of the lip*, would not have any information recorded in **MADT**.

8.12.11 Field 12.012: Dental casts and impressions / DSTI

This field is optional and is used to transmit information about models fabricated from a dental arch impression or tooth imprints.

- The first information item is the **dental casts and impression – date of recording / SDR**. It is mandatory that it appear in at least one subfield of this field. See **Section 7.7.2.3** for the format.
- The second information item is optional. However, it shall not appear in a subfield if [2015e>] **SDR** [<2015e] is not present in that instance of the subfield. It is **dental casts and impresssions – date of recording estimated accuracy range/ SDRR**. [2015a>] In Traditional format, it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **SDRR.** Leading zeros need not be entered. For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]
- The third information item is the **dental casts and impressions - reference code / SRC**. It is mandatory. If the model data has been digitally stored, it may be transmitted in a **Type-22** record. Values are:

1 = Dental Study Model – Maxillary arch model only

2 = Dental Study Model – Mandibular arch model only

3 = Dental Study Model - Maxillary and Mandibular arch models

4 = Tooth Impression(s)

- The fourth information item is mandatory. It is the **dental casts and impressions - additional descriptive text / SADT**. It is a Unicode free text information item. It may be used to describe the physical location of the tooth imprint or dental study, if not stored in electronic format. If the study (or cast model) is available in 3D electronic format (such as ply or stl), it is transmitted in a **Type-22** record. This information item should also be used to describe any special characteristics of note concerning the dental study or tooth imprint. In the case of tooth imprints, the tooth or teeth numbers should be stated, using the tooth numbering specified in **Figure 17: Digital designation of the teeth and of the oral cavity**.

8.12.12 Field 12.020: Comment / COM

This is an optional field. See **Section** 7.4.4 for details.

8.12.13 Field 12.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 12.004: Source agency identification ID / SRC** and **Field 12.993: Source agency name / SAN**. **SRC** and **SAN** describe the agency that created the record.

Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section** 7.6 for details about **SRC, SAN**, and **ORI**. For example:

> The metadata was recorded at a dentist's office two years ago (such as a record of a chipped tooth)– and now could be used for possible identification of a body following a disaster. That Dentist office is entered as the **CON.** The local police department would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 12.004: Source agency identification ID / SRC** (for example *NA54-X*) and its name in **Field 12.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency**

identifier / ORI. Its name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**.

8.12.14 Fields 12.200 through 12.900: 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.

8.12.15 Field 12.902: 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.**

8.12.16 Field 12.990: Type-10 Record cross reference / T10C

This is an optional field. When used, it contains the **IDC** value(s) of the **Type-10** record(s) that contain images of the oral cavity of the subject of this record. **Field 10.003: Image type / IMT i**s normally set to INTRAORAL, EXTRAORAL, LIP and / or FACE for these photographic images.

8.12.17 Field 12.991: Type-22 Record cross reference / T22C

This is an optional field. When used, it contains the **IDC** value(s) of the **Type-22** record(s) that contain radiographs or other non-photographic imagery or modeling data for the subject of this record.

8.12.18 Field 12.992: Type-2 Record cross reference / T2C

This is an optional field. When used, it contains the **IDC** value of the **Type-2** record that contains relevant biographic information and other data concerning the subject of this instance of the record, who may be different from the subject of the transaction. See **Section 7.3.1.1 Type-2 Record cross reference / T2C.**

8.12.19 Field 12.993: 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 12.004: Source agency identification ID / SRC.**

8.12.20 Field 12.994: External file reference / EFR

This conditional field shall be present only if **HARC** has been set to a value of 8.1.3.10. It is used to enter the URL/URI or other unique reference to a storage location of the dental chart if the data is not contained in **Field 12.999: Dental chart data / DATA.** It may be a physical location, as well, such as for analog

recordings. If this field is used, **Field 12.999** shall not be set. A non-URL reference might be similar to: "Charts placed in File NA3.346 at New Artichoke Police Headquarters". It is highly recommended that the user state the format of the external file in **Field 12.020: Comment / COM**.

8.12.21 Field 12.995: Associated context / ASC

This optional field refers to one or more Record(s) **Type-21**. An example of the use of this field would be to transmit an image of a jaw containing teeth at the location where it was discovered, such as near a shallow grave dug up by an animal. When present, this field is comprised of subfields. There is one mandatory information item and one optional information item per subfield, as described in **Section 7.3.3**.

8.12.22 Field 12.996: Hash / HAS

This optional field shall contain the hash value of the data in **Field 12.999: Dental chart data / DATA** of this record, calculated using SHA-256. See **Section 7.5.2.**

8.12.23 Field 12.998: Geographic sample acquisition location / GEO

This optional field contains the location where the image(s) / sample(s) was acquired – not where it is stored. See **Section 7.7.3**. This information applies to the entire **Record Type-12**. If different locations are applicable for the images / samples / data then separate instances of **Record Type-12** should be created and transmitted jointly in the same transaction.

8.12.24 Field 12.999: Dental chart data / DATA

This field contains the dental chart data if a value for **HARC** has been set to a value of 8.1.3.10. This field shall not appear if **Field 12.994: External file reference / EFR** is contained in the record.

[<2013d]

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.

[2013>a] Friction ridge images from deceased individuals are often submitted as latent prints for processing, due to the compromised quality of the image in many circumstances. However, whether all such submissions are handled as **Type-13** records is a decision of the implementation domain [<2013a]

Table 102 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	$0 \leq$ IDC ≤ 99 integer	1	1
13.003	**IMP**	**IMPRESSION TYPE**	M	N	1	2	$4 \leq$ IMP ≤ 7 or $12 \leq$ IMP ≤ 15 or IMP= 28 or 29 or $32 \leq$ IMP ≤ 39 integer see **Table 8**	1	1
13.004	**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 #
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
13.006	**HLL**	**HORIZONTAL LINE LENGTH**	M	N	2	5	$10 \leq HLL \leq 99999$ positive integer	1	1
13.007	**VLL**	**VERTICAL LINE LENGTH**	M	N	2	5	$10 \leq VLL \leq 99999$ 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	CGA = NONE, JPEGL, JP2L, or PNG[230]	1	1
13.012	**BPX**	**BITS PER PIXEL**	M	N	1	2	$8 \leq BPX \leq 99$[231]	1	1
13.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M					1	1
		Subfields: Repeating values	M↑	N	1	2	integers from **Table 9** Allowed values are 0 to 10 or 16 to 38 or 60 to 79 or 81 to 86 – all inclusive of beginning and ending values.	1	6
13.014	**SPD**	**SEARCH POSITION DESCRIPTORS**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	9

[230] [2013a>] Specific values listed for clarity. [<2013a]

[231] [2013a>] Specific bounds added for clarity [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	PDF	probable decimal finger position code	M↑	N	1	2	non-negative integers 0 ≤ PDF ≤ 10, or PDF = 16 or 17 from **Table 9**	1	1
	FIC [163]	finger image code	M↑	AN	3	3	EJI, TIP, FV1, FV2, FV3, FV4, PRX, DST or MED from Table 10	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 10**	1	1
	LOS	location of a segment	M↑	A	2	3	LOS = NA, PRX, DST or MED See **Table 10**	1	1
	LHC	left horizontal coordinate	M↑	N	1	5	0 ≤ LHC < HLL integer [232]	1	1
	RHC	right horizontal coordinate	M↑	N	1	5	LHC < RHC < HLL integer [232]	1	1
	TVC	top vertical coordinate	M↑	N	1	5	0 ≤ TVC < VLL integer [232]	1	1
	BVC	bottom vertical coordinate	M↑	N	1	5	TVC < BVC < VLL integer [232]	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

[232] [2015e>] Typographical correction. [<2015e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
13.018 [233]	**RSP**	**RULER OR SCALE PRESENCE**	O					0	1
	RSU	ruler or scale units	D	A	2	4	RSU = IN, MM, or BOTH	0	1
	RSM	ruler or scale make	D	U	1	50	none	0	1
	RSO	ruler or scale model	D	U	1	50	none	0	1
	RSF	standard fingerprint form number	D	U	1	99	none	0	1
13.019 [233]	**REM**	**RESOLUTION METHOD**	O					0	1
	MDR	means of determining resolution	M↑	AS	1	9	MDR = value from **Table 103 Means of determining resolution**	1	1
	KSL	known scale length	D	NS	1	6	0.01 ≤ KSL ≤ 999.00 maximum of two digits to right of decimal	0	1
	KSU	known scale units	D	A	2	2	KSU = IN or MM	0	1
	SXA	known scale x coordinate for point A	D	N	1	5	integer	0	1
	SYA	known scale y coordinate for point A	D	N	1	5	integer	0	1
	SXB	known scale x coordinate for point B	D	N	1	5	integer	0	1
	SYB	known scale y coordinate for point B	D	N	1	5	integer	0	1
	COM	comment	O↑	U	1	99	none	0	1
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

[233] [2013n>] New field in the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FRMP	friction ridge metric position	M↑	N	1	2	integers from Table 9	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 – 13.045		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.046 [233]	**SUB**	**IMAGE SUBJECT CONDITION**	O					0	1
	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1 or 2	0	1
13.047 [233]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
13.048 - 13.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
13.200-13.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
13.901[234]	**FCT**	**FRICTION RIDGE CAPTURE TECHNOLOGY**	O	N	1	2	FCT = 0, 18, 19, 20, 21 or 22 See section 7.7.4.5	0	1
13.902	**ANN**	**ANNOTATION INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*

[234] [2015n>] This is a new field in the 2015 Update. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
13.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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	**EFR**	**EXTERNAL FILE REFERENCE**	D[235]	U	1	200	none	1	1
13.995	**ASC**	**ASSOCIATED CONTEXT**	O					0	1

[235] [2015n>] **Field 13.994** has been added to allow a latent print image to be in a location that can be remotely accessed. **Field 13.999** may still used to transmit the image in the record. These two fields are mutually exclusive. Only one may appear in the record. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
		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
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 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O↑	N	1	2	1 ≤ RSP ≤ 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 ≤ 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 [236]	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

[236] [2013e>] corrected typographical error: < → ≤ [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	LGS	longitude second value	D	NS	1	8	0 ≤ LGS < 60 [236]	0	1
	ELE	elevation	O	NS	1	8	422.000≤ ELE ≤ 8848.000 real number [236]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [237]	AN	2	3	one or two digits 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**	D [238]	B	1	*	none	1	1

8.13.1 Field 13.001: Record header

The content of this mandatory field is dependent upon the encoding. 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.**

[237][2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

[238] [2015n>] **Field 13.994** has been added to allow a latent print image to be in a location that can be remotely accessed. **Field 13.999** may be used to transmit the image in the record. These fields are mutually exclusive. Only one may appear in the record.[<2015n]

[2015a>] **Fields 13.003** through **13.012** are mandatory. This applies whether **Field 13.994: External file reference / EFR** (for an externally stored image) or **Field 13.999: Latent friction ridge image / DATA** (for an image transmitted in this record) is used. [<2015a]

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 19 Compression codes** for the labels, 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 palm print 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 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 9** 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 9**, 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 10**. [239]

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.** [239]

8.13.16 Field 13.016: Scanned horizontal pixel scale / SHPS

This is an optional field. See **Section 7.7.8.7 Scanned horizontal pixel scale / SHPS** for details.

8.13.17 Field 13.017: Scanned vertical pixel scale / SVPS

[239] [2013a>] Note that TIP is used in latent print processing (not TPP), even if the impression is not rolled. This is for historical continuity purposes. [<2013n]

This is an optional field. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS**for details.

[2013n>]

8.13.18 Field 13.018: Ruler or scale presence / RSP

This optional field allows the user to state whether a ruler or other known scale is present in the image. The field consists of four information items.

- The first information item, **ruler or scale units / RSU,** indicates the units of measurement visible on the ruler or measurement scale:

  IN = inches

  MM = millimeters

  BOTH = both inches and millimeters

- The second information item, **ruler or scale make / RSM,** lists the maker of the ruler or scale (if known).
- The third information item, **ruler or scale model / RSO,** lists the model of the ruler or scale (if known).
- The fourth information item, **standard fingerprint form number / RSF** permits entry of a standard fingerprint form number such as FD-249, FD-258 or C-216C. [2015a>] **RSF** is present if and only if none of the other three information items (**RSU, RSM,** or **RSO)** are specified. [<2015a]

8.13.19 Field 13.019: Resolution method / REM

This optional field states the method used for determining the pixel density of the image. The field consists of eight information items. The second through the seventh information items are mandatory if **MDR** = RULER and are optional if **MDR** = FORM**.** They shall not be used for other values of **MDR.** When the known scale coordinates are used, the resolution can be calculated as the distance in pixels between points A and B divided by **KSL.** The pixel counts used in **SXA, SYA, SXB, SYB** are zero-based. The top left pixel has coordinates (0,0).

If the transmitted pixel density of an image in **Field 13.009: Transmitted horizontal pixel scale / THPS** and **Field 13.010: Transmitted vertical pixel scale / TVPS** differs from the scanned (original) pixel density stated in **Field 13.016: Scanned horizontal pixel scale / SHPS** and **Field 13.017: Scanned vertical pixel scale / SVPS**, then the values in this field are with respect to the scanned pixel density and shall not be recalculated to correspond to the transmitted pixel density.

- The first information item, **means of determining resolution / MDR,** specifies whether the resolution is calculated (from a ruler or known scale), estimated (by a human or computer), or is from a known source (such as a flatbed scanner or standard form). Enter the CODE from **Table 103 Means of determining resolution**.

- The second information item, **known scale units / KSL**, specifies the length of the known scale from point A to point B. It may contain a period.
- The third information item, **known scale units / KSU** indicates whether the known scales units are in inches or millimeters.

  IN = inches MM = millimeters
- The fourth information item, **known scale x coordinate for point A / SXA** is expressed in number of pixels from the left of the image.
- The fifth information item, **known scale y coordinate for point A / SYA** is expressed in number of pixels from the top of the image.
- The sixth information item, **known scale x coordinate for point B / SXB** is expressed in number of pixels from the left of the image.
- The seventh information item, **known scale y coordinate for point B / SYB** is expressed in number of pixels from the top of the image.
- The eighth information item, **comment / COM,** is a UNICODE text comment or description provided by the examiner about the resolution method.

Table 103 Means of determining resolution

Code	Definition
FLATBED	Resolution is known since the image was acquired from a flatbed scanner with a fixed resolution
FIXED	Resolution is known since the image was acquired from a fixed-resolution capture device other than a flatbed scanner
RULER	Resolution was calculated based upon a ruler present in the image
FORM	Resolution was calculated based upon the use of a standard form with a known scale
EST-HUMAN	Resolution was estimated by a human
EST-AUTO	Resolution was estimated by an automated process. It is recommended that the process be described in **comment / COM**

[<2013n]

8.13.20 Field 13.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

8.13.21 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 9**. 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.

[2013n>]

8.13.22 Field 13.046: Image subject condition / SUB

This field is optional. This field is particularly useful if the image is obtained from a deceased person. However, its use is not limited to such circumstances. Some implementation domains support the submission of fingerprints taken from deceased individuals as latent prints, due to the quality of the friction ridges and the resulting images. In such cases, **SSC** is specified as D. For latent images taken from a surface, the value is typically X.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or person unable to identify themselves

  D = Data obtained from a non-living person (deceased)

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

8.13.23 Field 13.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 13.004: Source agency/ SRC**and **Field 13.993: Source agency name / SAN**. **SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example:

- The friction ridge prints are taken from a decedent's body in a morgue. The coroner's office or medical examiner's office would be **CON.**
- The local police department that would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 13.004: Source agency/ SRC** (for example *NA54-X*) and its name in **Field 13.993: Source agency name / SAN** (for example *New Artichoke Police)*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**. [<2013n]

8.13.24 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.

8.13.25 Field 13.901: Friction ridge capture technology / FCT

[2015n>] This is an optional field. It is a two-digit code from signifying the type of technology that was used to capture the print for transmission. See **Section 7.7.4.5** for more detail and the meanings of the codes. For latent prints conveyed in **Type-13** records, the only valid codes are: 0, 18, 19, 20, 21 and 22. [<2015n]

8.13.26 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**

8.13.27 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 128 Character encoding set values** are allowed.

8.13.28 Field 13.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.13.29 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**.

[2015n>]

8.13.30 Field 13.994: 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 digital representations, if the data is not contained in **Field 13.999: Latent friction ridge image / DATA.** If this field is used, **Field 13.999** shall not be set. However, one of the two fields shall be present in all instances of this record type. It is highly recommended that the user state the format of the external file in **Field 13.020: Comment / COM.** [<2015n]

8.13.31 Field 13.995: Associated context / ASC

This optional field refers to one or more Records **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.**

8.13.32 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**.

8.13.33 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**.

8.13.34 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**.

8.13.35 Field 13.999: Latent friction ridge image / DATA

[2015n>] This conditional field, if present, contains the latent image. See **Section 7.2** for details. If this field is used, **Field 13.994: External file reference / EFR** shall not be set. One of these two fields shall be present in this record. [<2015n]

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** was added as an optional field to the 2011 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 104 Type-14 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 ≤ IDC ≤ 99 integer	1	1
14.003	**IMP**	**IMPRESSION TYPE**	D	N	1	2	0 ≤ IMP ≤ 3 IMP = 8 20 ≤ IMP ≤ 29 [2015n>] 40 ≤ IMP ≤ 41 [<2015n] integer see **Table 8**	1	1
14.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
14.005	**FCD**	**FINGERPRINT CAPTURE DATE**	M[240]	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 ≤ HLL ≤ 99999 positive integer	0	1
14.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	10 ≤ VLL ≤ 99999 positive integer	0	1
14.008	**SLC**	**SCALE UNITS**	D	N	1	1	0 ≤ SLC ≤ 2 integer	0	1
14.009	**THPS**	**TRANSMITTED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1

[240] [2013e>] Corrected to M (was listed as D) [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 19 Compression codes**	0	1
14.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	$8 \leq BPX \leq 99$[241]	0	1
14.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M					1	1
		Subfields: Repeating values	M	N	1	2	$0 \leq FGP \leq 19$ or FGP = 33 or FGP = 36 or $40 \leq FGP \leq 54$[242] integer[243] see **Table 9**	1	1
14.014	**PPD**	**PRINT POSITION DESCRIPTORS**	D					0	1

[241] [2013a>] Specific bounds added for clarity [<2013a]

[242] [2013n>] Codes 51 through 54 added for plain multiple fingertip impressions. [<2013n]

[243] 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			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	DFP	decimal finger position code	M↑	N	1	2	1 ≤ DFP ≤ 10 or DFP = 16 or 17 (from **Table 9**)	1	1
	[2015e>] **FIC** [<2015e]	finger image code	M↑	AN	3	3	EJI, TIP, TPP, FV1, FV2, FV3, FV4, PRX, DST or MED [244] from **Table 10**	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 , TIP, or TPP [244] see **Table 10**	1	1
	LOS	location of a segment	M↑	A	2	3	LOS = NA, PRX, DST or MED see **Table 10**	1	1
	LHC	left horizontal coordinate	M↑	N	1	5	0 ≤ LHC < HLL integer [245]	1	1
	RHC	right horizontal coordinate	M↑	N	1	5	LHC < RHC < HLL integer [245]	1	1

[244] [2013n>] Plain fingertip images (TPP) added in 2013 Update. [<2013n]

[245] [2013n>] Upper limit changed from ≤ to < for consistency with other record types. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	TVC	top vertical coordinate	M↑	N	1	5	0 ≤ TVC < VLL integer [245]	1	1
	BVC	bottom vertical coordinate	M↑	N	1	5	TVC < BVC < VLL integer [245]	1	1
14.016	**SHPS**	**SCANNED HORIZONTAL PIXEL SCALE**	D	N	1	5	positive integer	0	1
14.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	D	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 9	1	1
	ABC	amputated or bandaged code	M↑	A	2	2	ABC = XX , UP [2015n>] or SR See **Table 105** [<2015n]	1	1
14.019		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FRSP	friction ridge segment position	M↑	N	1	2	1 ≤ FRSP ≤ 10 or FRSP = 16 or 17 [246]	1	1
	LHC	left horizontal coordinate value	M↑	N	1	5	0 ≤ LHC < HLL integer [245]	1	1
	RHC	right horizontal coordinate value	M↑	N	1	5	LHC < RHC < HLL integer [245]	1	1
	TVC	top vertical coordinate value	M↑	N	1	5	0 ≤ TVC < VLL integer [245]	1	1
	BVC	bottom vertical coordinate value	M↑	N	1	5	TVC < BVC < VLL integer [245]	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 9**	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	45 [247]

[246] [2013a>] Specific values added for clarity.[<2013a]

[247] [2015n<] The repeat count is increased to 45 to be consistent with other quality metrics, as explained in **Section 7.7.7** which allow up to 9 quality algorithms. With 5 fingers assumed, 5 * 9 = 45. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FRQP	friction ridge segment quality position	M↑	N	1	2	1 ≤ FRQP ≤ 10 or FRQP = 16 or 17 see Table 9	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	45^{247}
	FRMP	friction ridge metric position	M↑	N	1	2	1 ≤ FRMP ≤ 10 or FRMP = 16 or 17 see Table 9	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
14.025	**ASEG**	**ALTERNATE FINGER SEGMENT POSITION(S)**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	5

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	FRAS	friction ridge alternate segment position	M↑	N	1	2	1 ≤ FRAS ≤ 10 or FRAS = 16 or 17 see Table 9	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 integer [245]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [245]	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**	Not to be used						
14.030	**DMM**	**DEVICE MONITORING MODE**	O	A	7	10	value from Table 6	0	1
14.031[248]	**FAP**	**SUBJECT ACQUISITION PROFILE – FINGERPRINT**	O	N	2	3	FAP = 10, 20, 30, 40, 45, 50, 60, 145, 150 or 160 integer see Table 14	0	1
14.032-14.045		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
14.046 [249]	**SUB**	**IMAGE SUBJECT CONDITION**	O					0	1
	SSC	subject status code	M↑	A	1	1[160]	SSC = X, A or D	1	1

[248] [2015n>] New FAP codes added in 2015 Update to allow for 1000 ppi units. [<2015n]

[249] [2013n>] New field for the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1,or 2	0	1
14.047 [249]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
14.048-14.199		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						
14.200 – 14.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
14.901 [250]	**FCT**	**FRICTION RIDGE CAPTURE TECHNOLOGY**	O	N	1	2	FCT = 0 through 7 or 9 through 17, inclusive. "See Table 11	0	1
14.902	**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	*	none	1	1

[250] [2015n>] New field for the 2015 Update. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
14.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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	**EFR**	**EXTERNAL FILE REFERENCE**	D[251]	U	1	200	none	1	1
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

[251] [2015n>] Field 14.994 has been added to allow a print image to be in a location that can be remotely accessed. Field 14.999 may be used to transmit the image in the record. These two fields are mutually exclusive. Only one may appear in the record. However, if **Field 14.018: Amputated or bandaged / AMP** has a value of "UP" neither field need appear in the record. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 [252]	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 [252]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [252]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [253]	AN	2	3	one or two digits followed by a single letter	0	1
	GCE	geographic coordinate universal transverse Mercator easting	D	N	1	6	integer	0	1

[252] [2013e>] corrected typographical error: < → ≤ [<2013e]

[253] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also show GCM as D. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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
14.999	**DATA**	**FINGERPRINT IMAGE** [251]	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. 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 [2015a>] dependent [<2015a] field shall indicate the manner by which the fingerprint was obtained. See **Section 7.7.4.1** for details. [2015a>] This field is mandatory if an image is present in**Field 14.999: Fingerprint image / DATA** [2015n>] or referenced in**Field 14.994: External file reference / EFR**[<2015n] Otherwise it is absent."

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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR**. [<2015n] 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] Otherwise it is absent. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 19 Compression codes** for the labels, 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: Fingerprint image / DATA** [2015n>] or referenced in **Field 14.994: External file reference / EFR.** [<2015n] 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 [2015n>] dependent field if an image is present in **Field 14.999: Fingerprint image / DATA** or referenced in **Field 14.994: External file reference / EFR.** Otherwise it is absent. [<2015n] See **Section 7.7.8.7 Scanned horizontal pixel scale / SHPS** for details.

8.14.17 Field 14.017: Scanned vertical pixel scale / SVPS

This is an [2015n>] dependent field if an image is present in **Field 14.999: Fingerprint image / DATA** or referenced in **Field 14.994: External file reference / EFR.** Otherwise it is absent. [<2015n] See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS** 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 9**. 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 105** shows allowable indicators for the AMPCD.

Table 105 Amputation / bandaged fingerprinting codes

Descriptor	AMPCD
Partial print due to amputation	XX

[2015n>] Scar	SR [<2015n]
Unable to print (e.g., bandaged [2015e>]or completely amputated) [<2015e]	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). [2015a>]A scarred finger should be printed and the SR code used. [<2015a] 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).

[2015a>]If all fingers for a specific slap are missing, the AMP codes for each missing finger shall be specified, and the image shall be sent or not in accordance to the agreement of the interchanging agencies.[<2015a]

An image with a scar should not be marked XX or UP. [2015n>] SR is used to denote a complete scar when the scarred pattern could have been any of the three general pattern types (e.g., loop, whorl and arch). [<2015n]

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 40-54[254] from **Table 9** 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 9**. 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

[254] [2013n>] Codes 51 through 54 added for plain fingertip impressions taken simultaneously. [<2013n]

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.** It 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 9.** 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 [2015n>] and quality algorithm combination (up to 9 algorithms are allowed for each finger). [<2015n]. 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 9**. 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 set 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 [2015n>] and quality algorithm combination (up to 9 algorithms are allowed for each finger). [<2015n]. 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 9**. 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 9**. 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. [2015n>] This field is not intended to apply to a single rolled image. [<2015n] 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 **Section**7.7.5.2 for details. This field was new for the 2011 version of the standard.

[2013n>]

8.14.29 Field 14.046: Image subject condition / SUB

This field is optional. There may be different values for **SUB** in different instances of **Type-14** records. For example, some images may have been acquired antemortem, while others were accquired post-mortem.

This field describes the condition of the subject at the time of imaging.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

X = Status of individual unknown

A = Data obtained from a living person – such as a victim or person unable to identify themselves

D = Data obtained from a non-living person (deceased)

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

8.14.30 Field 14.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 14.004: Source agency / SRC** and **Field 14.993: Source agency name / SAN**. **SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example,

- The friction ridge prints are taken from a decedent's body in a morgue. The coroner's office or medical examiner's office would be **CON.**
- The local police department that would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 14.004: Source agency / SRC** (for example *NA54-X*) and its name in **Field 14.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well.

The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**. [<2013n]

8.14.31 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.

[2015n>]

8.14.32 Field 14.901: Friction ridge capture technology / FCT

This is an optional field. It is a one or two-digit code signifying the type of technology that was used to capture the print for transmission. See **Section** 7.7.4.5 for more detail and the meanings of the codes. For exemplar prints conveyed in **Type-14** records, the only valid codes are 0 through 7, inclusive and 9 through 17 inclusive. [<2015n]

8.14.33 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.

8.14.34 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 128 Character encoding set values** are allowed.

8.14.35 Field 14.904: Make/model/serial number / MMS

This is an optional field. See **Section** 7.7.1.2 for details.

8.14.36 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**.

[2015n>]

8.14.37 Field 14.994: External file reference / EFR

This conditional field may be used to enter the URL/URI or other unique reference to a storage location for the image if the data is not contained in **Field 14.999: Fingerprint image / DATA.** If this field is used, **Field 14.999: Fingerprint image / DATA** shall not be used. Only one of the two fields may be present in this record type. It is highly recommended that the user state the format of the external file in **Field 14.020: Comment / COM** when using **Field 14.994**. Neither **Field 14.994** nor **Field 14.999** need be in the record when **Field 14.018: Amputated or bandaged / AMP** has a value of "UP".

Type-14 records generally contain an image in **Field 14.999**: Fingerprint image / **DATA**, or an external reference to an image in **Field 14.994**: External file reference / **EFR**, but not both. **Fields 14.994** and **14.999** are optional only if **Field 14.018** Amputated or bandaged / **AMP** has a value of "UP". **Fields 14.003**, and **14.006** through **14.012** are mandatory[<2015n]

8.14.38 Field 14.995: Associated context / ASC

This optional field refers to one or more Records **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.

8.14.39 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**.

8.14.40 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.**

8.14.41 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**.

8.14.42 Field 14.999: Fingerprint image / DATA

[2015n>] This conditional field, if present, contains the fingerprint image. If **Field 14.994: External file reference / EFR** is present in this record, then this field shall not appear. See **Section 7.2** for details. Neither **Field 14.999** nor **Field 14,994** need be present in the record when **Field 14.018: Amputated or bandaged / AMP** has a value of "UP". [<2015n] Some domains and application profiles may still require an image in this field (such as the word "Amputated"). Note that in previous versions of the standard [2015a>] (i.e., prior to 2011) [<2015a] 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 palm print 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**). The wrist bracelet is the series of lines/creases below and parallel to the carpal delta and thenar / hypothenar 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 palm print 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 palm print 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 palm prints in a transaction.

Table 106 Type-15 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 integer	1	1
15.003	**IMP**	**IMPRESSION TYPE**	D	N	2	2	[2015n>] IMP = 10, 11, 24, 25, 28, 29, 41 or 42 [<2015n] see **Table 8**	1	1
15.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
15.005	**PCD**	**PALM PRINT 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 19 Compression codes**	0	1
15.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	$8 \leq BPX \leq 99^{255}$	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
15.013	**FGP**	**FRICTION RIDGE GENERALIZED POSITION**	M	N	2	2	20 ≤ FGP ≤ 38 or 81 ≤ FGP ≤ 86 [256] see Table 9	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**	D	N	1	5	positive integer	0	1
15.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	D	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	2	2	21 ≤ FRAP ≤ 38 or 81 ≤ FRAP ≤ 86 [256] See Table 9	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 [257]	**SEG**	**[2015e>] PALM [<2015e] SEGMENT POSITION**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	17
	FRSP	friction ridge segment position	M↑	N	2	2	FSRP = 22, 24-36, 81, 82, 85 or 86 integer See Table 9	1	1
	LHC	left horizontal coordinate value	M↑	N	1	5	0 ≤ LHC < HLL integer [258]	1	1

[255] [2013a>] Specific bounds added for clarity [<2013a]

[256] [2013n>] Valid codes expanded to include 85 and 86 for wrist bracelets. [<2013n]

[257] [2013n>] New field added in the 2013 Update [<2013n]

[258] [2013n>] Upper limit changed from ≤ to < for consistency with other record types. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	RHC	right horizontal coordinate value	M↑	N	1	5	LHC < RHC < HLL integer [258]	1	1
	TVC	top vertical coordinate value	M↑	N	1	5	0 ≤ TVC < VLL integer [258]	1	1
	BVC	bottom vertical coordinate value	M↑	N	1	5	TVC < BVC < VLL integer [258]	1	1
15.022-15.023		**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	2	2	20 ≤ FRMP ≤ 38 or 81 ≤ FRMP ≤ 86 [256] positive integer See Table 9	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
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 6	0	1
15.031[259]	**PAP**	**SUBJECT ACQUISITION PROFILE _ PALM PRINT**	O	N	2	3	PAP = 70, 80, 170 or 180 See Table 16	0	1
15.032-15.045		**RESERVED FOR FUTURE USE only by ANSI/NIST-ITL**	Not to be used						

[259] [2015n>] New field added in Update 2015. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SUB	**IMAGE SUBJECT CONDITION**	O					0	1
15.046 [260]	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1 or 2	0	1
15.047 [260]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
15.048-15.199		**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 [261]	**FCT**	**FRICTION RIDGE CAPTURE TECHNOLOGY**	O	N	1	2	FCT = 0 through 7 or 9 through 17, inclusive. "See Table 11"	0	1
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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1

[260] [2013n>] New field for the 2013 Update [<2013n]

[261] [2015n>] New field for the 2015 Update. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
15.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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
15.994	**EFR**	**EXTERNAL FILE REFERENCE**	D[262]	U	1	200	none	1	1
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 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O↑	N	1	2	1 ≤ ASP ≤ 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 ≤ SRN ≤ 255 positive integer	1	1

[262] [2015n>] **Field 15.994** has been added to allow a print image to be in a location that can be remotely accessed. **Field 15.999** may be used to transmit the image in the record. These two fields are mutually exclusive. Only one may appear in the record. However, neither **Field 15.994** nor **Field 15.999** need appear if **Field 15.018: Amputated or bandaged / AMP** has a value of "UP".[<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	RSP	reference segment position	O↑	N	1	2	1 ≤ RSP ≤ 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 ≤ 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 [263]	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 [263]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [263]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [264]	AN	2	3	one or two digits followed by a single letter	0	1

[263] [2013e>] corrected typographical error: < → ≤ [<2013e]

[264] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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**	**PALM PRINT IMAGE** [262]	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. 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 [2015a>] dependent [<2015a] field shall indicate the manner by which the palm print was obtained. See **Section 7.7.4.1** for details. [2015a>] This field is mandatory if an image is present in **Field 15.999: Palm print image / DATA**[2015n>] or referenced in **Field 15.994: External file reference / EFR**. [<2015n] Otherwise it is absent."

8.15.4 Field 15.004: Source agency / SRC

This is a dependent 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: Palm print capture date / PCD

This field shall contain the date that the palm biometric data contained in the record was captured. See **Section 7.7.2.3** for details.

[2015a>] **Fields 15.006** through **15.012** are mandatory if an image is present. This applies whether **Field 15.994: External file reference / EFR** or **Field 15.999: Palm print image / DATA** (for an image transmitted in this record) is used. [<2015a]

8.15.6 Field 15.006: Horizontal line length / HLL

This field is mandatory if an image is present [2015a>]or referenced in this record [<2015a]. 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 [2015a>]or referenced in this record [<2015a]. 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 [2015a>]or referenced in this record [<2015a]. 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 [2015a>]or referenced in this record [<2015a]. 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 [2015a>]or referenced in this record [<2015a]. 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 [2015a>]or referenced in this record [<2015a]. Otherwise it is absent. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 19 Compression codes** for the labels, 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 [2015a>]or referenced in this record [<2015a]. 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 palm print image. Valid codes range from 20 to 38, or 81 to [2013n>] 86[265] [<2013n]. See **Table 9**. See **Section 7.7.4.2** for details.

[265] [2013n>] Codes 85 and 86 added for wrist bracelets. [<2013n]

8.15.14 Field 15.016: Scanned horizontal pixel scale / SHPS

This is an [2015a>] dependent field if an image is present or referenced in this record. Otherwise it is absent. [<2015a] See **Section 7.7.8.7 Scanned horizontal pixel scale / SHPS** for details.

8.15.15 Field 15.017: Scanned vertical pixel scale / SVPS

This is an [2015a>] dependent field if an image is present or referenced in this record. Otherwise it is absent. [<2015a]. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS** 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 [2013n>] 86 [265] [<2013n] as chosen from **Table 9**. 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 105** shows allowable indicators for the AMPCD.

[2015n>] Code SR in **Table 105** is not applicable to palm prints. [<2015n]

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.

[2015n>] When UP is specified, there may be no **Field 15.994: External file reference / EFR** or **Field 15.999: Palm print image / DATA** in the record. However, some implementation domains require the use of a 'dummy' image to be conveyed.[<2015n]

8.15.17 Field 15.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

[2013n>]

8.15.18 Field 15.021: Palm segment position / SEG

This field shall only be present if **FGP** = 20, 21, 23, 37, 38, 83 or 84 from **Table 9** as entered in **Field 15.013: 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 22, 24 – 36, 81, 82, 85 or 86 selected from **Table 9**. 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.** It 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.

[<2013n]

8.15.19 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 item shall be the **friction ridge metric position / FRMP** for the image stored in this record. Valid codes range from 20 to 38, and 81 to [2013n>] 86 [256] [<2013n]. See **Table 9.** See **Section 7.7.7** for a description of the remaining three information items.

8.15.20 Field 15.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

[2015n>]

8.15.21 Field 15.031: Subject acquisition profile – palm print / PAP

This optional field lists the **PAP** levels associated with palm print acquisition devices. See **Section 7.7.5.4** for details.

[<2015n]

[2013n>]

8.15.22 Field 15.046: Subject condition / SUB

This field is optional. There may be different values for **SUB** in different instances of **Type-15** records. For example, some images may have been acquired antemortem,

while others were accquired post-mortem. This field describes the condition of the subject at the time of imaging.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or person unable to identify themselves

  D = Data obtained from a non-living person (deceased)

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

8.15.23 Field 15.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 15.004: Source agency / SRC** and **Field 15.993: Source agency name / SAN. SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example:

- The friction ridge prints are taken from a decedent's body in a morgue. The coroner's office or medical examiner's office would be **CON.**
- The local police department that would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 15.004: Source agency / SRC** (for example *NA54-X*) and its name in **Field 15.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its

name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**. [<2013n]

8.15.24 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.

8.15.25 Field 15.901: Friction ridge capture technology / FCT

[2015n>] This is an optional field. It is a one or two-digit code signifying the type of technology that was used to capture the print for transmission. See **Section 7.7.4.5** for more detail and the meanings of the codes. For exemplar prints conveyed in **Type-15** records, the only valid codes are 0 through 7, inclusive and 9 through 17 inclusive. [<2015n]

8.15.26 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.**

8.15.27 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 128 Character encoding set values** are allowed.

8.15.28 Field 15.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details

8.15.29 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**.

8.15.30 Field 15.994: External file reference / EFR

[2015n>]This conditional field shall be used to enter the URL/URI or other unique reference to a storage location for all digital representations, if the data is not contained in **Field 15.999: Palm print image / DATA.** If this field is used, **Field 15.999: Palm print image / DATA** shall not be set. However, one of the two fields shall be present in all instances of this record type. It is highly recommended that the user state the format of the external file in **Field 15.020: Comment / COM.**

Type-15 records generally contain an image in **Field 15.999: Palm print image / DATA**, or an external reference to an image in **Field 15.994: External file reference / EFR,** but not both. Fields 15.994 and 15.999 are optional only if **Field 15.018: Amputated or**

bandaged / AMPhas a value of "UP". Fields 15.003, and 15.006 through 15.012 are mandatory if either Field 15.994 or 15.999 is used.

[<2015n]

8.15.31 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: Palm print image / DATA** but that may be relevant to the collection of that data**.**

8.15.32 Field 15.996: Hash/ HAS

This optional field shall contain the hash value of the data in **Field 15.999: Palm print image / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.15.33 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.**

8.15.34 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**.

8.15.35 Field 15.999: Palm print image / DATA

[2015n>] This conditional field, if present, contains the palm print image. If **Field 15.994: External file reference / EFR** is present in this record, then this field shall not appear. [<2015n] See **Section 7.2** for details. It can 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 the word "Amputated"). Note that in previous versions of the standard [2015a>] (i.e., prior to 2011) [<2015a] 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 of images not addressed by other record types in the standard. [2013n>] **Type-16** records shall not be used for images that can be conveyed using other record types. [<2013n] 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.

[2013a>] An example of the use of the **Type-16** could be to send an image of the ear for biometric purposes. Note that **Type-99** allows 'ear shape' as a biometric code, but in order to use **Type-99** records, there must be a BDB format owner that has specified the BDB format type. See **Field 99.103: BDB format owner / BFO**. At the time of the issuance of this standard, no such formal specification exists. [<2013a]

Table 107 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 ≤ IDC ≤ 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
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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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	* [266]	value from **Table 19 Compression codes** for friction ridge data or valid file suffix for other data	1	1
16.012	**BPX**	**BITS PER PIXEL**	M	N	1	2	$1 \leq BPX \leq 99$[267]	1	1
16.013	**CSP**	**COLOR SPACE**	O	A	3	4	values from **Table 28**	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						
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	$0 \leq$ QVU ≤ 100 or QVU = 254 or 255 integer	1	1

[266] [2015n>] Since any compression algorithm may be used in a **Type-16** record, there is no restriction on the upper limit of characters. [<2015n]

[267] [2013a>] Specific bounds added for clarity [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 6**	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
16.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	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	**EFR**	**EXTERNAL FILE REFERENCE**	D[268]	B	1	*	none	1	1
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 ≤ ACN ≤ 255 positive integer	1	1
	ASP	associated segment position	O↑	N	1	2	1 ≤ ASP ≤ 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 ≤ SRN ≤ 255 positive integer	1	1
	RSP	reference segment position	O↑	N	1	2	1 ≤ RSP ≤ 99 positive integer	0	1
16.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

[268] [2015n>] **Field 16.994** has been added to allow a user-defined test image to be in a location that can be remotely accessed. **Field 16.999** may be used to transmit the image in the record, if desired. These two fields are mutually exclusive. Only one may appear in the record. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 [269]	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 [269]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [269]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [270]	AN	2	3	one or two digits 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

[269] [2013e>] corrected typographical error: < → ≤ [<2013e]

[270] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

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
16.999	**DATA**	**TEST DATA**	D[268]	B	1	*	none	1	1

8.16.1 Field 16.001: Record header

The field is mandatory. It is dependent upon the encoding used. 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 19 Compression codes** for the labels and **Section 7.7.9.1** for a detailed description of this field. For other data, see **Section 7.7.9.5.**

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 Scanned horizontal pixel scale / SHPS** for details.

8.16.15 Field 16.017: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS** 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 128 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 16.994: External file reference / EFR

[2015n>]This conditional field shall be used to enter the **URL/URI** or other unique reference to a storage location for all digital representations, if the data is not contained in **Field 16.999: Test data / DATA**. If this field is used, **Field 16.999** shall not be set. However, one of the two fields shall be present in all instances of this record type.

It is highly recommended that the user state the format of the external file in **Field 16.020: Comment / COM.** [<2015n]

8.16.25 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.

8.16.26 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**.

8.16.27 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.**

8.16.28 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**.

8.16.29 Field 16.999: Test data / DATA

[2015n>] This field may contain the user-defined test image. If this field is used, then **Field 16.994: External file reference / EFR** shall not be in the record. One of the two fields shall appear in the record. See **Section 7.2** for details.[<2015n]

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 108 Type-17 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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	$10 \leq HLL \leq 99999$ positive integer	0	1
17.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	$10 \leq VLL \leq 99999$ positive integer	0	1
17.008	**SLC**	**SCALE UNITS**	D	N	1	1	$0 \leq SLC \leq 2$ 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	0	1
17.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	$8 \leq BPX \leq 99$[271]	0	1
17.013	**CSP**	**COLOR SPACE**	D	A	3	4	values from **Table 28**	0	1
17.014	**RAE**	**ROTATION ANGLE OF EYE**	O	H	1	4	$0000 \leq RAE \leq FFFF$	0	1
17.015	**RAU**	**ROTATION UNCERTAINTY**	D	H	1	4	$0000 \leq RAU \leq FFFF$	0	1
17.016	**IPC**	**IMAGE PROPERTY CODE**	O					0	1
	IHO	horizontal orientation code	M↑	N	1	1	$0 \leq IHO \leq 2$ integer	1	1
	IVO	vertical orientation code	M↑	N	1	1	$0 \leq IVO \leq 2$ 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

[271] [2013>] Specific bounds added for clarity [<2013]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	SER	serial number	M↑	U	1	50	none	1	1
17.020	**ECL**	**EYE COLOR**	O	A	3	3	value from **Table 29**	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 109**	0	1
17.026	**IRD**	**IRIS DIAMETER**	O	N	2	4	10 ≤ IRD ≤ 9999 positive integer [272]	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	1	1
	HIG	spectrum upper bound	M↑	N	3	4	510 ≤ HIG positive integer evenly divisible by 10	1	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 6**	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 31**	1	1
	NOP	number of points	M↑	N	1	2	2 ≤ NOP ≤ 99 positive integer	1	1

[272] [2013e>] 2011 version did had a typographical error: < should have been ≤. [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 integer [273]	2	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [273]	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 31**	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 integer [273]	2	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [273]	2	NOP
17.035	**UEB**	**UPPER EYELID BOUNDARY**	O					0	1
	BYC	boundary code	M↑	A	1	1	BYC = P see **Table 31**	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 integer [273]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [273]	3	NOP
17.036	**LEB**	**LOWER EYELID BOUNDARY**	O					0	1
	BYC	boundary code	M↑	A	1	1	BYC = P see **Table 31**	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 integer [273]	3	NOP

[273] [2013n>] Upper limit changed from ≤ to < for consistency with other record types. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [273]	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 32**	1	1
	OCT	occlusion type	M↑	A	1	1	OCT = L, S, C, R or O see **Table 33**	1	1
	NOP	number of points	M↑	N	1	2[274]	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 integer [273]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL integer [273]	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 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
		Subfields: Repeating sets of information items	M↑					1	*

[274] [2013e>] Max characters changed to 2 to correspond to the upper limit of 99 [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	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	**EFR**	**EXTERNAL FILE REFERENCE**	D[275]	U	1	200	none	1	1
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

[275][2015n>] **Field 17.994** has been added to allow an iris image to be in a location that can be remotely accessed. **Field 17.999** may still used to transmit the image in the record. These two fields are mutually exclusive. Only one may appear in the record. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
17.998	**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	$0 \leq LTS < 60$ [276]	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	$0 \leq LGS < 60$ [276]	0	1
	ELE	elevation	O	NS	1	8	$-422.000 \leq ELE \leq 8848.000$ real number [276]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [277]	AN	2	3	one or two digits 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

[276] [2013e>] corrected typographical error: < → ≤ [<2013e]

[277] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

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
17.999	**DATA**	**IRIS IMAGE DATA**	D	B	1	*	none	0[278]	1

8.17.1 Field 17.001: Record header

The content of this mandatory field is dependent upon the encoding. 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[279] 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: Iris image data / DATA**. Otherwise it is absent. See **Section 7.7.8.1** for details.

8.17.7 Field 17.007: Vertical line length / VLL

[278] [2013e>] Minimum occurrence changed to 0, in accordance with the dependency conditions [<2013e]

[279] In prior versions of this standard, this field was named **Feature identifier / FID**.

This field is mandatory if an image is present in **Field 17.999: Iris image data / DATA**. 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: Iris image data / DATA**. Otherwise it is absent. See **Section 7.7.8.3** for details.

8.17.9 Field 17.009: Transmitted horizontal pixel scale / THPS

This field is mandatory if an image is present in **Field 17.999: Iris image data / DATA**. 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: Iris image data / DATA**. 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: Iris image data / DATA**. Otherwise it is absent. It shall specify the algorithm used to compress the transmitted color or grayscale images. See **Section 7.7.9.3** 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: Iris image data / DATA**. 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: Iris image data / DATA**. 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

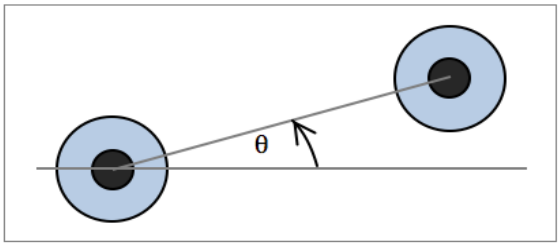
This optional field shall indicate the in-plane rotation angle of the iris. Such rotation can be caused by head tilt, camera tilt, and also by the common natural rotation of the eye itself. The rotation angle of the eye encoded in this field is defined here in terms of roll of the subject's head. The 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 19**, 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[280]. The value "FFFF" indicates that rotation angle of eye is undefined. This 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 19: Coordinate system for eye rotation angle



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)][280]. 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 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 of the image. "Flipped" orientation refers to images where the orientation is opposite from that described for "Base".

[280] In the 2007 and 2008 versions of the standard, there was a typographical error of 65536.

- 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 128 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 29** 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 Scanned horizontal pixel scale / SHPS** for details.

8.17.22 Field 17.023: Scanned vertical pixel scale / SVPS

This is an optional field. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS** 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 109.**

8.17.25 Field 17.026: Iris diameter / IRD

This optional field shall specify the expected iris diameter in pixels. [2013a>] This value may assist the processing algorithm(s) in the automated examination of the image. IRD need not be the measured value of the diameter. It may range in value from 10 to 9999, inclusive.[281] [<2013a]

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 **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.).

Table 109 Effective acquisition spectrum codes

[281] [2013a>] The 2011 text said: "The diameter of the iris should not be less than 140 pixels." That was only intended as a guideline, but was interpreted by many as as strict limit, which was not its intent. The purpose of this field is to assist the algorithm in looking for the approximage size of the iris when examining the image. [<2013a]

Value	Description	Spectrum
NIR	Near-infrared acquisition	Approx. 700–900[282] nm
DEFINED	Defined acquisition spectrum, in range of nanometers rounded to the nearest 10 nm, e.g., 828 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 cases may extend to the periocular region.	Approx. 380–750 nm
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 periocular 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.	

8.17.27 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 110**. "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 110 Missing and damaged eye codes

Descriptor	Code
Missing or artificial eye	MA

[282] 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.

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.

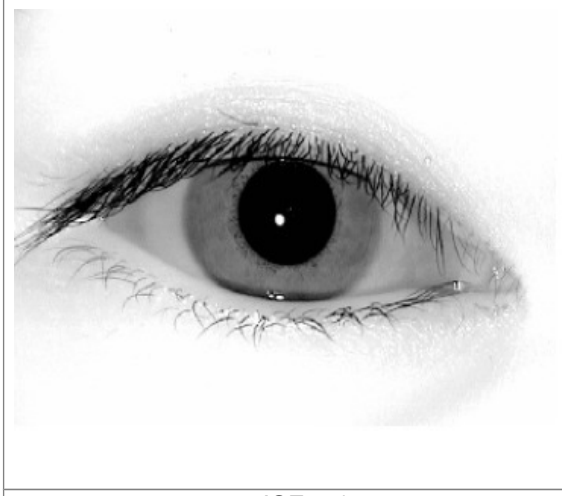
8.17.29 Field 17.031: Subject acquisition profile – iris / IAP

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

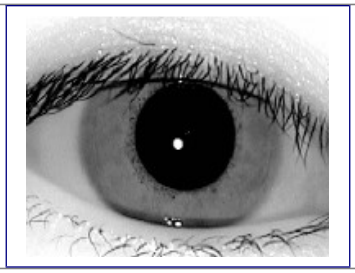
This optional field, when used, shall indicate the storage format of the iris image[283].

Figure 20: Examples of ISF image formats

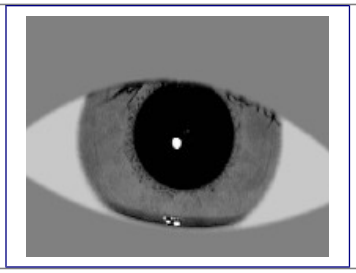


ISF = 1

ISF = 2



ISF = 3



ISF = 7

The codes are shown in **Figure 20** and **Table 111.** The value shall be a single digit corresponding to the column "ISF code". Image storage formats 1 and 2 might be the

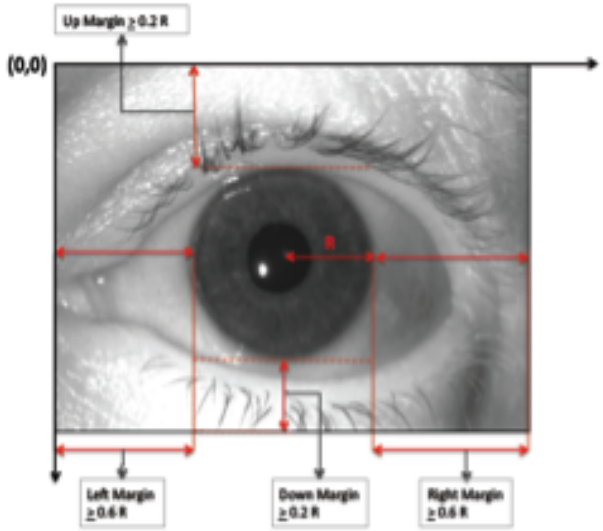
[283] This is a new field with the 2011 of the standard. All new applications should use this field.

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 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 111**). For ISF = 3 and 7, there are exact margin requirements. These requirements support accurate localization of the iris boundaries.

[2015a>] In order to be considered acceptable as non-intrusive and to avoid excessive geometric distortion, the minimum distance between the iris capture device's lens and the subject's eye must be at least 100 millimeters.

In order to provide an acceptable level of usability and ease of alignment, the camera must allow for some variability in the position of the iris center relative to the camera. This is consistent with *ISO/IEC 19794-6* and ISO/IEC 29794-6 specification concerning image margin requirements. The vertical margin shall be ≥ 0.2 times the radius of the iris. The horizontal margin shall be ≥ 0.6 times the radius. See **Figure 21**.

Figure 21: Image Margin Requirements



[<2015a]

Table 111 Iris storage formats

ISF code	Description	Iris	Iris Margin

		Centering	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 **Table 32: Occlusion opacity**
- The second information item contains the alphabetic code from **Table 33: Occlusion type**

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 17.994: External file reference / EFR

[2015n>] This conditional field shall be used to enter the URL/URI or other unique reference to a storage location for all digital representations, if the data is not contained in **Field 17.999: Iris image data / DATA**. If this field is used, **Field 17.999** shall not be set. However, one of the two fields shall be present in all instances of this record type. It is highly recommended that the user state the format of the external file in **Field 17.021: Comment / COM**. [<2015n]

8.17.42 Field 17.995: Associated context / ASC

This optional field refers to one or more Records **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 subject was found.

8.17.43 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**.

8.17.44 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.**

8.17.45 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**.

8.17.46 Field 17.999: Iris image data / DATA

This field contains the iris image. See **Section 7.2** for details. [2015a>]If **Field 17.994: External file reference / EFR** is present in this record, then this field shall not appear. Neither this field or **Field 17.994: External file reference / EFR** shall be present in this record when **Field 17.028: Damaged or missing eye / DME** is in this record (indicating an eye is missing or is unable to provide a usable iris image).[<2015a] Some domains and application profiles may require a field with a 'substitute image' such as 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 112 Type-18 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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
	CSC	code of sending country	O	AN	2	3	If **Field 1.018: Geographic name set / GNS** is present, then value is from the alternate GENC set specified in that field. Otherwise, the value is from *ISO-3166-1*.[284]	0	1

[284] [2013n>] This allows the GENC county codes supported by the US Government to be used [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	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 non-negative 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 non-negative 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
	SID	sample identifier	M↑	U	1	24	none	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	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 non-negative 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 non-negative 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			encoding specific	1	1
18.014	**PSD**	**PROFILE STORAGE DATE**	M	encoding specific			encoding specific	1	1
18.015	**DPD**	**DNA PROFILE DATA**	M					1	1
	PTP	profile type	M	N	1	1	PTP = 0 or 1 non-negative integer	1	1
	RES	result	O	N	1	2	0 ≤ RES ≤ 10 non-negative 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	*
	DST	DNA STR type	M↑	N	1	1	DST = 0, 1 or 2 non-negative 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 non-negative integer	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	LAI	locus analysis indicator	M↑	N	1	1	LAI = 0 or 1 non-negative integer	1	1
	PCDT	precise call determination	M↑	N	1	1	PCDT = 0 or 1 non-negative 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 non-negative 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	1	946 285	character string where each value is from Table 117 or a sequence value: A, G, C or T	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	MT2	mito control region 2	M↑	AS	1	977 [285]	character string where each value is from **Table 117** or a sequence value: A, G, C or T	1	1
	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

[285] [2013n>] Maximum character count extended to allow for up to 400 insertions [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	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	*
	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
18.903-18.991		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
18.992 [286]	**T2C**	**TYPE-2 RECORD CROSS REFERENCE**	O	N	1	2	0 ≤ T2C ≤ 99 integer	0	1
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

[286] [2013n>] New Field [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	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
	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 [287]	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 [287]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [287]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1

[287] [2013e>] corrected typographical error: < → ≤ [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	GCM	geographic coordinate universal transverse Mercator zone	D [288]	AN	2	3	one or two digits 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
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. 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:

[288] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

Table 113 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 GLP 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. It is entered 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. **CSC** defaults to *ISO-3166-1* coding. [2013n>] If GENC used, then the version of that alternate code is entered in **Field 1.018: Geographic name set / GNS**, which applies to ALL country codes in all records within the transaction. [<2013n]

- 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 an organization, 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 data analyses

or a single data analysis. Possible entries are:

0 = "Multiple" or
1 = "Single"

8.18.6 Field 18.006: Sample donor information / SDI

This field is mandatory. [2013a>] It indicates if the DNA information contained in the record is from the subject of the transaction or from another person (the subject of the record), that is being sent to assist in establishing or verifying the identity of the subject of the transaction. Each subject of a record may have a distinct **Type-2** record contained in the transaction. If that is the case, it is highly recommended that **Field 18.992: Type-2 Record cross reference / T2C** be used to link the **Type-18** record to the appropriate **Type-2** record.[<2013a] [289]

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: [2013a>]

  0 = Subject of the record is also the subject of the transaction

  1 = Claimed, purported or validated relative (subject of the record is known to be a different person than the subject of the transaction)

  2 = Unknown source (subject of the record may be different but need not be different than the subject of the transaction – such as when a dismembered body part's DNA is to be compared against the DNA of the body part already established to be associated with subject of the transaction) [<2013a] [289]

- 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

[289] [2013a>] Added more detailed explanations concerning subjects of the transaction and subject of the record [<2013a]

entered only if DSD = 0. Allowed numeric values are:

0 = No
1 = Yes
2 = Unknown

- The optional seventh 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 114**. It is a numeric value selected from the "Relationship code" column.

Table 114 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 114.** 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 115.**

Table 115 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

- 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

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 of 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 116**.

Table 116 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

Code	Description
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 table 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 following three[290] information items are mandatory.

- The thirteenth information item is the **kit name / KNM**. This is an alphanumeric

[290] [2013a>] Changed wording for clarity [<2013a]

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.[291] 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. [2013n>] The string may have up to 400 insertions [<2013n]. This string length allows for insertions in HV1. Each character is an IUPAC value from **Table 117** 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. [2013n>] Up to 400 insertions may be specified[<2013n] . Each character is an IUPAC value from **Table 117** [2013a>] or a sequence value: A, G, C or T. [<2013a][292]

- 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

[291] [2013a>] Mitochondrial DNA is a continuous circle with 16569 bases – each having a unique marker location. These locations are numbered from 00001 to 16569. The area from 16024 through 00576 is the most useful for analysis. Studies are often conducted using three subregions of this range: HV1 (defined as 16024 to 16365), HV2 (defined as 00073 to 00349) and HV3 (defined as 00438 to 00574) [<2013a]

[292] [2013a>] The sequence values were correctly specified in **Table 112 Type-18 record layout** but were not mentioned in the text of the 2011 version [<2013a]

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 117 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 / Gap [293]

8.18.18 Field 18.018: DNA user-defined profile data / UDP

[293] [2013a>] The IUPAC code is a hyphen (dash) to designate a deletion. See www.bioinformatics.org/sms2/iupac.html Although IUPAC also allows a period to be used, for purposes of this standard, only the hyphen (dash) is used. [<2013a]

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 112** 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.**

[2013n>]

8.18.26 Field 18.992: Type-2 Record cross reference / T2C

This is an optional field. When used, it contains the **IDC** value of the **Type-2** record that contains relevant biographic information and other data concerning the subject of this instance of the record, who may be different from the subject of the transaction. See **Section 7.3.1.1 Type-2 Record cross reference / T2C.** [<2013n]

8.18.27 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.**

8.18.28 Field 18.995: Associated context / ASC

This optional field refers to one or more Record(s) Type-21. See **Section 7.3.3.**

8.18.29 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 118 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 ≤ IDC ≤ 99 integer	1	1
19.003	**IMP**	**IMPRESSION TYPE**	D	N	2	2	28 ≤ IMP ≤ 31 [2015n>] IMP = 24, 25, 40 or 41 [<2015n] see **Table 8**	1	1
19.004	**SRC**	**SOURCE AGENCY**	M	U	1	*	none	1	1
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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
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 19 Compression codes**	0	1
19.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	$8 \leq BPX \leq 99$[294]	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**	D	N	1	5	positive integer	0	1
19.017	**SVPS**	**SCANNED VERTICAL PIXEL SCALE**	D	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
	FRAP	friction ridge amputated or bandaged position	M↑	N	2	2	FRAP = 61 or 62 or $64 \leq FRAP \leq 79$ See **Table 9**	1	1
	ABC	amputated or bandaged code	M↑	A	2	2	ABC = XX or UP	1	1

[294] [2013a>] Specific bounds added for clarity [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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	2	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 non-negative integer [295]	3	NOP
	VPO	vertical point offset	M↑	N	1	5	0 ≤ VPO < VLL non-negative integer [295]	3	NOP
19.020	**COM**	**COMMENT**	O	U	1	126	none	0	1
19.021 [296]	**SEG**	**PLANTAR SEGMENT POSITION**	D					0	1
		Subfields: Repeating sets of information items	M↑					1	17
	FRSP	friction ridge segment position	M↑	N	2	2	63 ≤ FSRP ≤ 79 integer	1	1
	LHC	left horizontal coordinate value	M↑	N	1	5	0 ≤ LHC < HLL integer [273]	1	1
	RHC	right horizontal coordinate value	M↑	N	1	5	LHC < RHC < HLL integer [273]	1	1
	TVC	top vertical coordinate value	M↑	N	1	5	0 ≤ TVC < VLL integer [273]	1	1
	BVC	bottom vertical coordinate value	M↑	N	1	5	TVC < BVC < VLL integer [273]	1	1

[295] [2013n>] Upper limit changed from ≤ to < for consistency with other record types. [<2013n]

[296] [2013n>] New field added in the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
19.022-19.023		**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
	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 6**	0	1
19.031[297]	**TAP**	**SUBJECT ACQUISITION PROFILE _ TOE and PLANTAR**	O	N	2	3	TAP = 70, 80, 170 or 180	0	1
19.032-19.045		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
19.046[298]	**SUB**	**IMAGE SUBJECT CONDITION**	O					0	1
	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1 or 2	0	1
19.047[298]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1

[297] [2015n>] New field added in Update 2015. [<2015n]

[298] [2013n>] New field for the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
19.048-19.199		**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[299]	**FCT**	**FRICTION RIDGE CAPTURE TECHNOLOGY**	O	N	1	2	FCT = 0 through 7 or 9 through 17, inclusive. "See Table 11"	0	1
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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
19.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	0	1
19.904	**MMS**	**MAKE/MODEL/SERIAL NUMBER**	O					0	1
	MAK	make	M↑	U	1	50	none	1	1

[299] [2015n>] New field for the 2015 Update. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	**EFR**	**EXTERNAL FILE[300] REFERENCE**	D	U	1	200	none	1	1
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

[300] [2015n>] **Field 19.994** has been added to allow a print image to be in a location that can be remotely accessed. **Field 19.999** may be used to transmit the image in the record. These two fields are mutually exclusive. Only one may appear in the record. However, if **Field 19.018: Amputated or bandaged / AMP** has a value of "UP" neither field need appear in the record. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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 [301]	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 [301]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [301]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [302]	AN	2	3	one or two digits 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

[301] [2013e>] corrected typographical error: < → ≤ [<2013e]

[302] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	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 300**	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. 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 [2015a>] dependent [<2015a] field shall indicate the manner by which the plantar print was obtained. See **Section 7.7.4.1** for details. [2015a>] This field is mandatory if an image is present in **Field 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR** [<2015n] Otherwise it is absent."

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.

[2015a>] Fields 19.006 through 19.012 are mandatory if an image is present. This applies whether **Field 19.994: External file reference / EFR** or **Field 19.999: Plantar image / DATA** (for an image transmitted in this record) is used. [<2015a]

8.19.6 Field 19.006: Horizontal line length / HLL

This field is mandatory if an image is present in **Field 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] 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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] Otherwise it is absent. See **Section** 7.7.8.1 for details. 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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] Otherwise it is absent. See **Section** 7.7.8.1 for details. 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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] Otherwise it is absent. See **Section** 7.7.8.1 for details.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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] **Otherwise it is absent. See Section 7.7.8.1 for details.** 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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] Otherwise it is absent. See **Section** 7.7.8.1 for details. It shall specify the algorithm used to compress the transmitted grayscale images. See **Table 19 Compression codes** for the labels, 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 19.999: Plantar image / DATA** [2015n>] or referenced in **Field 19.994: External file reference / EFR.** [<2015n] Otherwise it is absent. See **Section** 7.7.8.1 for details.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 9**. See **Section 7.7.4.2** for details.

8.19.14 Field 19.016: Scanned horizontal pixel scale / SHPS

This is an [2015n>] dependent field if an image is present in **Field 19.999: Plantar image / DATA** or referenced in **Field 19.994: External file reference / EFR.** Otherwise it is absent[<2015n]. See **Section 7.7.8.7 Scanned horizontal pixel scale / SHPS** for details.

8.19.15 Field 19.017: Scanned vertical pixel scale / SVPS

This is an [2015n>] dependent field if an image is present in **Field 19.999: Plantar image / DATA** or referenced in **Field 19.994: External file reference / EFR.** Otherwise it is absent[<2015n]. See **Section 7.7.8.8 Scanned vertical pixel scale / SVPS**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 9**. 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 105** shows allowable indicators for the AMPCD.

[2015n>] Code SR in **Table 105** is not applicable to plantar prints. [<2015n]

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.

[2013a>] This field uses an n-vertex polygon to encompass each toe image segment, where "n" is between 3 and 99. A minimum of three points is required to describe a toe 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 toe is represented in a different subfield. The number of information items within each subfield depends on the number of vertices (points).

- The first information item is called the **friction ridge segment position / FRSP** to differentiate it from **FGP.** Valid values are from 64 to 73, inclusive. See **Table 9 Friction ridge position code & recommended image dimensions** for a description of the codes. See **Section 7.7.12**.
- The second information item is the **number of points / NOP.** There shall be at least 3 points (vertices) but no more than 99.
- The following two information items are repeated as pairs, with **NOP** pairs present in the subfield.
  - The first information item of each pair is the **horizontal point offset / HPO.** It is an integer greater than or equal to zero but less than or equal to the horizontal line length (**HLL).**
  - The second information item of each pair is the **vertical point offset / VPO.** It is an integer greater than or equal to zero but less than or equal to the vertical line length (**VLL).** [<2013a]

8.19.18 Field 19.020: Comment / COM

This is an optional field. See **Section 7.4.4** for details.

[2013n>]

8.19.19 Field 19.021: Plantar segment position / SEG

This field shall only be present if **FGP** = 60, 61 or 62 from **Table 9** as entered in **Field 19.013: Friction ridge (plantar) 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. Note that this field does not restrict segementation to toes, as does **Field 19.019: Friction ridge - toe segment position(s) / FSP**.

- The first information item is the **friction ridge segment position / FRSP** with values of 63 - 79, selected from **Table 9**. 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.** It 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.

[<2013n]

8.19.20 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 item shall be the **friction ridge metric position / FRMP** for the image stored in this record. Valid codes range from 60 to 79. See **Table 9.**
- See **Section 7.7.7** for a description of the remaining three information items.

8.19.21 Field 19.030: Device monitoring mode / DMM

This is an optional field. See **Section 7.7.1.3** for details.

[2015n>]

8.19.22 Field 19.031: Subject acquisition profile – toe and plantar print / TAP

This optional field lists the **TAP** levels associated with plantar print acquisition devices. See Section 7.7.5.5 for details.

[<2015n]

[2013n>]

8.19.23 Field 19.046: Image subject condition / SUB

This field is optional. There may be different values for **SUB** in different instances of **Type-19** records. For example, some images may have been acquired antemortem, while others were accquired post-mortem. This field describes the condition of the subject at the time of imaging.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or person unable to identify themselves

  D = Data obtained from a non-living person (deceased)

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

8.19.24 Field 19.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 19.004: Source agency / SRC** and **Field 19.993: Source agency name / SAN. SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example:

- The friction ridge prints are taken from a decedent's body in a morgue. The coroner's office or medical examiner's office would be **CON.**

- The local police department that could create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 19.004: Source agency / SRC** (for example *NA54-X*) and its name in **Field 19.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency**

names / ANM.

[<2013n]

8.19.25 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.

8.19.26 Field 19.901: Friction ridge capture technology / FCT

[2015n>] This is an optional field. It is a one or two-digit code signifying the type of technology that was used to capture the print for transmission. See **Section 7.7.4.5** for more detail and the meanings of the codes. For plantar prints conveyed in **Type-19** records, the only valid codes are: 0 through 7, inclusive or 9 through 17, inclusive. [<2015n]

8.19.27 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.**

8.19.28 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 128 Character encoding set values** are allowed.

8.19.29 Field 19.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.19.30 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**.

[2015n>]

8.19.31 Field 19.994: External file reference / EFR

This conditional field may be used to enter the URL/URI or other unique reference to a storage location for an image, if the data is not contained in **Field 19.999: Plantar image / DATA.** If this field is used, **Field 19.999: Plantar image / DATA** shall not be used in the record. It is highly recommended that the user state the format of the external file in **Field 19.020: Comment / COM.** Neither **Field 19.994** nor **Field 19.999** need appear when **Field 19.018: Amputated or bandaged / AMP** has a value of "UP".

[<2015n]

8.19.32 Field 19.995: Associated context / ASC

This optional field refers to one or more Records **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.

8.19.33 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**.

8.19.34 Field 19.997: Source representation / SOR

This optional field refers to a representation in Record **Type-20** with the same **SRN**.

8.19.35 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**.

8.19.36 Field 19.999: Plantar image / DATA

[2015n>]This conditional field, if present, contains the plantar print image. If **Field 19.994: External file reference / EFR** is present in this record, then this field shall not appear. See **Section 7.2** for details. Neither **Field 19.994** nor **Field 19.999** need appear when **Field 19.018: Amputated or bandaged / AMP** has a value of "UP". [<2015n] Some domains and application profiles may still require an image in this field (such as the word "Amputated"). [<2015n]

8.20 Record Type-20: Source Representation record

New to the 2011 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 119 Type-20 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	$0 \leq$ IDC ≤ 99 integer	1	1
20.003	**CAR**	**SRN CARDINALITY**	M	A	1	1	CAR = 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	$10 \leq$ HLL ≤ 99999 positive integer	0	1
20.007	**VLL**	**VERTICAL LINE LENGTH**	D	N	2	5	$10 \leq$ 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 19 Compression codes**	0	1
20.012	**BPX**	**BITS PER PIXEL**	D	N	1	2	$8 \leq$ BPX $\leq 99^{303}$	0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
20.013	**CSP**	**COLOR SPACE**	D	A	3	4	value from **Table 28**	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 121**	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	$0 \leq HPO < HLL$ non-negative integer [304]	0	NOP
	VPO	vertical point offset	D	N	1	5	$0 \leq VPO < VLL$ non-negative integer [304]	0	NOP

[303] [2013a>] Specific bounds added for clarity [<2013a]

[304] [2013n>] Upper limit changed from ≤ to < for consistency with other record types. [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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
		Subfields: Repeating sets of information items	M↑					1	99
	TIS	time index start	M↑	NS	12	12	TIS ≥ zero time index (00:00:00.000) [305]	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	**ICDR**	**IMAGE CAPTURE DATE RANGE ESTIMATE**	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
20.023 – 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	*

[305] [2013a>] Changed from TIS ≥ 0 for clarity. [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1
20.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	0	1
20.904	**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
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 ≤ ACN ≤ 255 positive integer	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	ASP	associated segment position	O↑	N	1	2	1 ≤ ASP ≤ 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 ≤ 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 [306]	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 [163]	0 ≤ LGS < 60 [306]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [306]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from **Table 7**	0	1

[306] [2013e>] corrected typographical error: < → ≤ [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	GCM	geographic coordinate universal transverse Mercator zone	D [307]	AN	2	3	one or two digits 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. 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 120 CAR values**. 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 120 CAR values

[307] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

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.

[2013n>] It may not be possible to know the exact date of imagery capture. [2015e>]In such a case, specify the date to the level known. For traditional encoding, fill the unknown portions of the date with zeros. For XML, use a date element with the correct level of precision.[308] [<2015e] **Field 20.022: Imagery capture date range estimate/ ICDR** should be used in conjunction with this field. [<2013n]

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.

[308] [2015e>] Fixed and harmonized encoding guidance in accordance with section 7.7.2.3. [<2015e]

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 121**.

Table 121 Acquisition source

Acquisition source type	Attribute code	Type [309]
Unspecified or unknown	0	?
Static digital image from an unknown source	1	2D Image
Static digital image from a digital still-image camera	2	2D Image
Static digital image from a scanner	3	2D Image
Single video frame from an unknown source	4	2D Image
Single video frame from an analog video camera	5	2D Image

[309] [2013a>] Column added for clarity, particularly in determining whether to use **Fields 20.006** through **20.013**. Note that "?" indicates that the code in and of itself does not indicate the data type. The user should have more detailed knowledge of the data format to properly categorize it. [<2013a]

Acquisition source type	Attribute code	Type
Single video frame from a digital video camera	6	2D Image
Video sequence from an unknown source	7	Video
Video sequence from an analog video camera, stored in analog format	8	Video
Video sequence from an analog video camera, stored in digital format	9	Video
Video sequence from a digital video camera	10	Video
Computer screen image capture	11	2D Image
Analog audio recording device; stored in analog form (such as a phonograph record)	12	Audio
Analog audio recording device; converted to digital	13	Audio
Digital audio recording device	14	Audio
Landline telephone – both sender and receiver	15	Audio
Mobile telephone – both sender and receiver	16	Audio
Satellite telephone – both sender and receiver	17	Audio
Telephone – unknown or mixed sources	18	Audio
Television – NSTC	19	Video
Television – PAL	20	Video
Television - Other	21	Video
Voice-over-internet protocol (VOIP)	22	Audio
Radio transmission: short-wave (specify single side band or continuous wave in FDN)	23	Audio
Radio transmission: amateur radio (specify lower side band or continuous wave in FDN)	24	Audio
Radio transmission: FM (87.5 MHz to 108 MHz)	25	Audio
Radio transmission: long-wave (150 kHz to 519 kHz)	26	Audio
Radio transmission: AM (570 kHz to 1720 kHz)	27	Audio
Radio transmission: Aircraft frequencies	28	Audio
Radio transmission: Ship and coastal station frequencies	29	Audio
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**.

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 Scanned horizontal pixel scale / SHPS** 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 Scanned vertical pixel scale / SVPS** 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**.

[2013n>]

8.20.22 Field 20.022: Imagery capture date range estimate/ ICDR

This is the amount of time (plus and minus) of which **SRD** is the center point during which the image data could have been originally collected. In Traditional format,it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **SRD.** Leading zeros need not be entered. [<2013n]

[2015a>]For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

8.20.23 Field 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.

8.20.24 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.**

8.20.25 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 128 Character encoding set values** are allowed.

8.20.26 Field 20.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.20.27 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.**

8.20.28 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.**

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.**

8.20.29 Field 20.995: Associated context / ASC

This is an optional field. See **Section** 7.3.3 for details.

8.20.30 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.

8.20.31 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.

8.20.32 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 concerning this field entry. In Traditional format, this field shall be the last field in the record layout.

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 122 Type-21 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	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	$0 \leq IDC \leq 99$ 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 [310]	**MDI**	**MEDICAL DEVICE INFORMATION**	O					0	1
		Subfields: Repeating sets of information items	M↑					1	*
	TYP	type of device	O↑	U	1	500	none	0	1
	MFG	device manufacturer	O↑	U	1	500	none	0	1
	MAK	device make	O↑	U	1	500	none	0	1
	MOD	device model	O↑	U	1	500	none	0	1
	SER	device serial number	O↑	U	1	500	none	0	1
	COM	comments	O↑	U	1	*	none	0	1
21.007 – 21.014		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.015	**AFT**	**ASSOCIATED CONTEXT FORMAT**	M					1	1

[310] [2013n>] New field added in the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
	FTY	file type	M	U	3	6	none	1	1
	DEI	decoding instructions	O	U	1	1000	none	0	1
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	non-negative integer	0	NOP
	VPO	vertical point offset	D	N	1	5	non-negative 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 ≥ zero time index (00:00:00.000) [311]	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 [312]	**ICDR**	**IMAGE CAPTURE DATE RANGE ESTIMATE**	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1

[311] [2013a>] Changed from TIS ≥ 0 for clarity [<2013a]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
21.023-21.045		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
21.046 [312]	**SUB**	**IMAGE SUBJECT CONDITION**	O					0	1
	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1, 2, or 3	0	1
21.047 [312]	**CON**	**CAPTURE ORGANIZATION NAME**	O	U	1	1000	none	0	1
21.048 -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
	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	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1

[312] [2013n>] New field for the 2013 Update [<2013n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
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
	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 [313]	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 [163]	0 ≤ LGS < 60 [164]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [313]	0	1

[313] [2013e>] corrected typographical error: < → ≤ [<2013e]

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 7	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [314]	AN	2	3	one or two digits 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
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. 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

[314] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

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 local date and time** for details.

[2013n>] It may not be possible to know the exact date of imagery capture. [2015e>]In such a case, specify the date to the level known. For traditional encoding, fill the unknown portions of the date with zeros. For XML, use a date element with the correct level of precision.[315][<2015e] **Field 21.022: Imagery capture date range estimate/ ICDR** should be used in conjunction with this field. [<2013n]

[2013n>]

8.21.5 Field 21.006: Medical device information / MDI

This field is designed to allow the transmission of information concerning medically implanted devices or devices used by an individual externally that may be discovered in or on unknown deceased and may assist in the person's identification. Each subfield is comprised of six information items, any combination of which may be entered. Each subfield describes a single device (such as a pacemaker or an artificial knee). See **Section 7.7.1.4**

- The first information item is the **type of device / TYP**. It is optional. A typical entry may be 'metal plate in right arm' or 'external leg brace for left leg'.
- The second information item is the **device manufacturer / MFG.** It is optional.
- The third information item is the **device make / MAK.** It is optional.
- The fourth information item is the **device model / MOD.** It is optional.
- The fifth information item is the **device serial number / SER.** It is optional.
- The sixth information item is optional. It is any **comment / COM** concerning the device. [<2013n]

8.21.6 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'. [2013a> For digital data stored in formats (such as digital tape) that do not have computer file names and suffixes, enter 'OTHER'. Examples of suffixes indicating file types are: WAV and TXT. There are many file extensions in common use, depending upon the type of data. [<2013a]
- The second information item is **decoding instructions / DEI**. It is optional and contains free text up to 1000 characters.

[315] [2015e>] Fixed and harmonized encoding guidance in accordance with section 7.7.2.3. [<2015e]

8.21.7 Field 21.016: Segments / SEG

This is an optional field. See **Section** 7.7.12.2 for details.

8.21.8 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.

8.21.9 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**.**

8.21.10 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**.

[2013n>]

8.21.11 Field 21.022: Imagery capture date range estimate/ ICDR

This is the amount of time (plus and minus) of which **ACD** is the center point during which the image data could have been originally collected. In Traditional format, it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **ACD.** Leading zeros need not be entered.

[2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

8.21.12 Field 21.046: Image subject condition / SUB

This field is optional. TThere may be different values for **SUB** in different instances of **Type-14** records. For example, some images may have been acquired antemortem, while others were accquired post-mortem. This field describes the condition of the subject at the time of imaging.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or person unable to identify themselves

  D = Data obtained from a non-living person

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

  3 = Skeletal

8.21.13 Field 21.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 21.004: Source agency / SRC** and **Field 21.993: Source agency name / SAN.** **SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. For example,

- The organization that traced the information about an implanted medical device for **Field 21.006: Medical device information / MDI** would be **CON.**
- The local police department could create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 21.004: Source agency / SRC** (for example *NA54-X*) and its name in **Field 21.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its

name may be entered in **Originating agency name /OAN** in **Field 1.017: Agency names / ANM**.

[<2013n]

8.21.14 Fields 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.**

8.21.15 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.**

8.21.16 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.**

8.21.17 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.**

8.21.18 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**.

8.21.19 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**.

8.21.20 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.

[2013d>]

8.22 Record Type-22: Non-photographic imagery data record

The **Type-22** record shall contain and be used to exchange imagery that is not standard 2D photography captured with a camera using visible light. Those types of images are placed in a **Type-10** record. Note that 2D iris images are handled in **Type-17** records and 2D friction ridge images in **Type-4, Type-13, Type-14, Type-15** and **Type-19** records; they should not be included in a **Type-22** record. Original Source images are handled in **Type-20** records and Associated context images in **Type-21**, regardless of the format.

The **Type-22** record type may be used in conjunction with the **Type-12** record for transmission of imagery stored using DICOM[316]. Specialized medical imagery used for 3D printing of cast models is another example of data that may be transmitted using this record type[317]. It can also transmit scanned radiographs, as commonly used in dentistry.

Table 123 Type-22 record layout

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
22.001		**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
22.002	**IDC**	**INFORMATION DESIGNATION CHARACTER**	M	N	1	2	0 ≤ IDC ≤ 99 non-negative integer	1	1

[316] DICOM stands for "Digital Imaging and Communications in Medicine" and is a standard used in medical imagery. It is issued by the National Electrical Manufacturers Association (NEMA).

[317] The American Board of Orthodontics (ABO) states : "Digital model files must be one of three universal file formats: PLY, STL, or OBJ." in *The American Board of Orthodontics (ABO) Digital Model Requirements.* It is available at https://www.americanboardortho.com/media/1157/abo-digital-model-requirements.pdf

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
22.003	ICD	IMAGE CAPTURE DATE	O	See Section 7.7.2.3 Local date			See Section 7.7.2.3 Local date	0	1
22.004	SRC	SOURCE AGENCY	M	U	1	*	none	1	1
22.005	ICDR	IMAGE CAPTURE DATE RANGE ESTIMATE	D	AN	2	9	time measure indicator followed by 1 or 2 digits. May be concatenated, with larger time units first. Units: Y year, M month, D day	0	1
22.006	BIC	BODY IMAGE CODE	O	AS	4	11	value from Table 71 Type-10 image types	1	1
22.007-22.019		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
22.020	COM	COMMENT	O	U	1	*	none	0	1
22.021-22.045		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
22.046	SUB	IMAGE SUBJECT CONDITION	O					0	1
	SSC	subject status code	M↑	A	1	1	SSC = X, A or D	1	1
	SBSC	subject body status code	D	N	1	1	SBSC = 1 or 2	0	1
	SBCC	subject body class code	D	N	1	1	SBCC = 1, 2, or 3	0	1
22.047	CON	CAPTURE ORGANIZATION NAME	O	U	1	1000	none	0	1
22.048-22.100		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						
22.101	ITYP	NON-PHOTOGRAPHIC IMAGERY TYPE CODE	M	U	1	*	Code values from Table 124	1	1
22.102	IFMT	NON-PHOTOGRAPHIC IMAGERY DATA FORMAT CODE	M	U	1	*	none	1	1
22.103	DRID	DENTAL RADIOGRAPH IMAGE DATA	D					0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	RGS	radiograph size	M↑	NS	3	30	Valid code from *ANSI/ADA Standard No. 1058*, Section 12.5 (integers and periods are in the codes)	1	1
	RIS	radiograph image series	M↑	NS	3	30	Valid code from *ANSI/ADA Standard No. 1058*, Section 12.6 (integers and periods are in the codes)	1	1
	RIIS	radiograph image in series text	O↑	U	1	50	none	0	1
	RIIT	radiograph image information text	O↑	U	1	*	none	0	1
22.104-22.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
22.200-22.900	**UDF**	**USER-DEFINED FIELDS**	O	user-defined			user-defined	user-defined	
22.901		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
22.902	**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**			See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT**	1	1
	NAV	processing algorithm name / version	M↑	U	1	*	none	1	1
	OWN	algorithm owner	M↑	U	1	64	none	1	1
	PRO	process description	M↑	U	1	*	none	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
22.903	**DUI**	**DEVICE UNIQUE IDENTIFIER**	O	ANS	13	16	first character = M or P any character with type A, N or S in **Table 128 Character encoding set values**	0	1
22.904	**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
22.905-22.991		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
22.992	**T2C**	**TYPE-2 RECORD CROSS REFERENCE**	O	N	1	2	$0 \leq T2C \leq 99$ non-negative integer	0	1
22.993	**SAN**	**SOURCE AGENCY NAME**	O	U	1	125	none	0	1
22.994	**EFR**	**EXTERNAL FILE REFERENCE**	D	U	1	200	none	0	1
22.995	**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
22.996	**HAS**	**HASH**	O	H	64	64	none	0	1
22.997	**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
22.998	**GEO**	**GEOGRAPHIC SAMPLE ACQUISITION LOCATION**	O					0	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	UTE	universal time entry	O↑	See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT**			See **Section 7.7.2.2 Greenwich Mean Time (coordinated universal time – UTC) / GMT**	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 7**	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D	AN	2	3	one or two digits 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
22.999	**DATA**	**MEDICAL IMAGE DATA BLOCK**	D	Base64	1	*	none	0	1

8.22.1 Field 22.001: Record header

This field is mandatory. See **Section 7.1 Record header.**

8.22.2 Field 22.002: Information Designation Character / IDC

This mandatory field shall contain the **IDC** assigned to this **Type-22** 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 22.003: Imagery capture date / ICD

This is [2015e>] an optional [<2015e] field. See **Section 7.7.2.3** for details. It may not be possible to know the exact date of imagery capture. [2015e>]In such a case, specify the date to the level known. For traditional encoding, fill the unknown portions of the date with zeros. For XML, use a date element with the correct level of precision.[318] [<2015e] **Field 22.005: Imagery capture date range estimate/ ICDR** should be used in conjunction with this field.

8.22.4 Field 22.004: Source agency / SRC

This is a mandatory field. See **Section 7.6** for details. The source agency name may be entered in **Field 22.993: Source agency name / SAN.**

8.22.5 Field 22.005: Imagery capture date range estimate/ ICDR

This is the amount of time (plus and minus) of which **ICD** is the center point during which the image data could have been originally collected. In Traditional format, it is entered in the format as $\mathbf{Y}^{yy}\mathbf{M}^{mm}\mathbf{D}^{dd}$**.** It is possible to enter only a year, month and/or day range, such as D5, meaning that the actual date of collection is estimated to be 5 days plus or minus from that specified in **ICD.** Leading zeros need not be entered.

[2015a>] For XML implementations, this element is represented using an XML duration type with the format PnYnMnDTnHnMnS, P indicates that there is a date value range and T indicates that there is a time value range. Under P, nY is the number of years, nM is the numbers of months, nD is the number of days. Under T, nH is the number of hours, nM is the number of minutes, and nS is the number of seconds. [<2015a]

8.22.6 Field 22.006: Body image code / BIC

This optional field may be used to indicate the type of image contained in this record, if this record contains an image of a human body. It shall contain a character string from the "Image Code" column of **Table 71 Type-10 image types** to indicate the appropriate image type.

[318] [2015e>] Fixed and harmonized encoding guidance in accordance with section **7.7.2.3**. [<2015e]

For instance, if an X-Ray image of a chest is to be transmitted, **BIC** = CHEST. For dental radiographs, **BIC** = INTRAORAL and **Field 22.103: Dental radiograph image data / DRID** shall be contained in the record.

8.22.7 Field 22.020: Comment / COM

This optional field may be used to insert comments or other text information with the representation data. See **Section 7.4.4.**

8.22.8 Field 22.046: Image subject condition / SUB

This field is optional. There may be different values for **SUB** in different instances of **Type-14** records. For example, some images may have been acquired antemortem, while others were accquired post-mortem. This field describes the condition of the subject at the time of imaging.

SUB is comprised of the following information items:

- The first information item is mandatory if this field is present. It is **subject status code / SSC.** Possible entries are:

  X = Status of individual unknown

  A = Data obtained from a living person – such as a victim or person unable to identify themselves

  D = Data obtained from a non-living person (deceased)

- The second information item shall be entered if and only if **SSC** is D. It is **subject body status code / SBSC.** Its purpose is to indicate whether the information relates to an entire corpse or a separate body part. The numeric value is selected from the descriptors below:

  1 = Whole

  2 = Fragment

- The third information item shall be entered if and only if **SSC** is D. It is **subject body class code/ SBCC.** The numeric value is selected from the descriptors below:

  1 = Natural Tissue

  2 = Decomposed

  3 = Skeletal

8.22.9 Field 22.047: Capture organization name / CON

This field is optional. Note that this can be different from the agency entered in **Field 22.004: Source agency / SRC** and **Field 22.993: Source agency name / SAN. SRC** and **SAN** describe the agency that created the record. Since the record may have been forwarded by another agency to the final destination, **Field 1.008: Originating agency identifier / ORI** is used to indicate the transmitting organization. See **Section 7.6** for details about **SRC, SAN**, and **ORI**. This field is not needed if the transmitted

information (for instance in DICOM) contains the capture organization information.

- The x-ray of the subject's spine (showing scoliosis) was taken at a medical office two years ago – and now could be used for possible identification of a body following a disaster. That office is entered as the **CON.**
- The local police department that would create the actual *ANSI/NIST-ITL 1-2011* conformant record. Such an organization's code would be entered in **Field 22.004: Source agency / SRC** (for example *NA54-X*) and its name in **Field 22.993: Source agency name / SAN** (for example *New Artichoke Police).*

In many implementation domains, there are a limited number of transmission organizations that can send data. Therefore, the agency listed in **SRC** may send the transaction to another location that has access rights to the final destination. This intermediary may add information to the transaction, as well. The final transmitting organization code is listed in **Field 1.008: Originating agency identifier / ORI**. Its name may be entered in **Originating agency name / OAN** in **Field 1.017: Agency names / ANM**.

8.22.10 Field 22.101: Non-photographic imagery type code / ITYP

This is a mandatory field. If the code for the particular image type is listed in the following table, enter that code. If it is not listed, enter a description of the image type.

Table 124 Type-22 image types

Description	Code
Radiographs (X-rays)	XRAY
Sonogram	Sonogram
CT Scan	CT
Cone Beam	CONE
Magnetic Resonance Image	MRI
3D Cast Model	3DCM
Infrared	IR
Ultraviolet	UV
Multiple (such as is possible in a DICOM record)	Multiple
Other	*Enter description*

8.22.11 Field 22.102: Non-photographic imagery data format code / IFMT

This is a mandatory field. It describes the format of the data contained in **Field 22.999: Imagery data block / DATA** or **Field 22.994: External file reference / EFR.** DICOM

is a commonly used medical imaging data format. Cast data (such as used for 3D printing of models of a patient's dentition by othodontists) are often in PLY or STL format. If specific parameters were chosen to store / save the data that could affect the use or interpretation of the data, they should be stated. It is recommended that the system / algorithm / and version that generated the data be listed, if known.

8.22.12 Field 22.103: Dental radiograph image data / DRID

This field contains information specific to dental radiographic imagery. It shall appear if and only if **BIC** = INTRAORAL and **ITYP** = XRAY.

- The first information item is the **radiograph size / RGS**. It is mandatory. Any code value in Section 12.5 of the *ANSI/ADA Standard No. 1058* may be entered. Note that only one value may be entered. Each image requires a separate record within the transaction.
- The second information item is mandatory. It is the **radiograph image series / RIS**. It is mandatory and any code value in Section **12.6** of the *ANSI/ADA Standard No. 1058* may be entered.
- The third information item is optional. It is the **radiograph image in series text / RIIS**. This is used to specify which individual image in a particular series. This is a text field of up to 50 characters.
- The fourth information item is optional. It is the **radiograph image information text/ RIIT.** This is a Unicode free text information item. It should contain the practitioner's name, address and telephone or other contact information. This corresponds to code **12.6.13** of the *ANSI/ADA Standard 1058*, but also allows additional explanatory text, such as any unique features associated with the radiograph.

8.22.13 Fields 22.200-900: 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.

8.22.14 Field 22.902: 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.**

8.22.15 Field 22.903: Device unique identifier / DUI

This is an optional field describing the device used to capture the image. See **Section 7.7.1.1** for details. All characters marked "A", "N" or "S" in **Table 128 Character encoding set values** are allowed.

8.22.16 Field 22.904: Make/model/serial number / MMS

This is an optional field to describe the device used to capture the image. See **Section**

7.7.1.2 for details.

8.22.17 Field 22.992: Type-2 Record cross reference / T2C

This is an optional field. When used, it contains the **IDC** value of the **Type-2** record that contains relevant biographic information and other data concerning the subject of this instance of the record, who may be different from the subject of the transaction. See **Section 7.3.1.1 Type-2 Record cross reference / T2C.**

8.22.18 Field 22.993: 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 22.004: Source agency / SRC**.

8.22.19 Field 22.994: 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 medical image files. If this field is used, **Field 22.999: Imagery data block / 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 2014:1468 Orthodontic Cast".

8.22.20 Field 22.995: Associated context / ASC

This optional field refers to one or more Records **Type-21** with the same **ACN**. See **Section 7.3.3.** Record T**ype-21** contains images that are NOT used to derive the biometric data in **Field 22.999: Imagery data block / 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.

8.22.21 Field 22.996: Hash / HAS

This optional field shall contain the hash value of the digital data in **Field 22.994: External file reference / EFR** or **Field 22.999: Imagery data block / DATA** of this record, calculated using SHA-256. See **Section 7.5.2**.

8.22.22 Field 22.997: Source representation / SOR

This optional field refers to a representation in Record **Type-20** with the same **SRN**.

8.22.23 Field 22.998: 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**.

8.22.24 Field 22.999: Imagery data block / DATA

This field shall contain the imagery data if conveyed in the transaction. If the data is stored externally, **Field 22.994: External file reference / EFR** is used. Only one of these two fields may be present in a single record. See **Section 7.2** for details on the Data field entry. [<2013d]

[2015a>] Either DATA or EFR fields shall be present in all instances of this record type. [<2015a]

8.23 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 125 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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
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: 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
98.007-98.199		**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	12 [319]	*	[2015a>] comma-separated values [<2015a]	1	1
	AGT	agent	M↑	U	1	200	none	1	1
	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

[319] [2015n>] Minimum value lowered to 12 from 15 and maximum made unlimited. [<2015n]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
98.994-999		RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL	Not to be used						

8.23.1 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**.

8.23.2 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.**

8.23.3 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 table 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).

8.23.4 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.**

8.23.5 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.

8.23.6 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.

8.23.7 Field 98.200-899: User-defined fields / UDF

These fields are user-definable fields. Their size and content shall be defined by the user in **Field 98.005: IA data format type / DFT** [2013a>] and be in accordance with the receiving agency. [<2013a]

8.23.8 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 [2015a>] with up to 200 Unicode characters [<2015a] .

- **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

  [2015n>] For repeating pairs of information items, the repeat count of the information item may follow the mnemonic. This value is also used to specify an item in a list. This position need not be filled with NA if it is not relevant.

  Third repeating pair example for the first element of the pair (HPO):

  - 5,10.033,1,HPO,3

Example for the fifteenth item in the list (MARC)

- 29,12.011,1,MARC,15

Note that for Record **Type-1** the IDC value is NA. [<2015n]

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

[2015n>] If two records of the same type have the same IDC, then the IDC value can be suffixed by an indicator of the sequence of the affected record with the transaction. For example, if there were two **Type-14** records with the same IDC (indicating that it is the same image – for instance one RAW and the other losslessly compressed as explained in Section **7.3.1 Information designation character / IDC**), the second one within the transaction sequentially would be referenced as 7-2 for the IDC. A reference of 7 is equivalent to 7-1. [<2015n]

- **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**. [2015a>] Up to 200 Unicode characters are allowed[<2015a].

- **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**).

8.23.9 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**.

8.23.10 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**.

8.24 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 126 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 ≤ IDC ≤ 99 integer	1	1

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
99.003		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
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						
99.100	**HDV**	**CBEFF HEADER VERSION**	M	N	T=4 X=3 [320]	4	HDV = 0101	1	1
99.101	**BTY**	**BIOMETRIC TYPE**	M	H [321]	T=8 X=1 [320]	8	value From **Table 127**	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

[320] Traditional encoding (T) requires a leading zero. XML encoding (X) does not. See **Section 8**.

[321] [2013e>] This had been listed as numeric; but it is hex per http://csrc.nist.gov/publications/nistir/NISTIR6529A.pdf [<2013e]

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
99.105-99.199		**RESERVED FOR FUTURE USE ONLY BY ANSI/NIST-ITL**	Not to be used						
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**	1	1
	NAV	processing algorithm name / version	M↑	U	1	*	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 any character with type A, N or S in **Table 128 Character encoding set values**	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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min#	Max#		Min#	Max#
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
		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

Field Number	Mnemonic	Content Description	Cond Code	Character			Value Constraints	Occurrence	
				Type	Min #	Max #		Min #	Max #
	LTS	latitude second value	D	NS	1	8	0 ≤ LTS < 60 [322]	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 [322]	0	1
	ELE	elevation	O	NS	1	8	-422.000≤ ELE ≤ 8848.000 real number [322]	0	1
	GDC	geodetic datum code	O	AN	3	6	value from Table 7	0	1
	GCM	geographic coordinate universal transverse Mercator zone	D [323]	AN	2	3	one or two digits 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

8.24.1 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**.

[322] [2013e>] corrected typographical error: < → ≤ [<2013e]

[323] [2013a>] GCM, GCE and GCN are treated as a group, but the group itself is optional. In 2011, this concept was presented with listing GCM as O, and GCE and GCN as D. Some users felt, however, that it was clearer to also list GCM as D. [<2013a]

8.24.2 Field 99.002: Information designation character / IDC

This mandatory field shall contain the **IDC** assigned to this **Type-99** record as listed in the information item **IDC** for this record in **Field 1.003: Transaction content / CNT.** See **Section 7.3.1.**

8.24.3 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.**

8.24.4 Field 99.005: Biometric capture date / BCD

This is a mandatory field. See **Section 7.7.2.2** for details.

8.24.5 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.

8.24.6 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 127** lists the current biometric type codes for modalities not covered in this standard with specific Record Types assigned to them.[324] See **Section 8** for information concerning leading zeros.

Table 127 CBEFF biometric type

Biometric Type Name	Biometric TypeCode
No Information Given	'00000000'
Multiple Biometrics Used	'00000001'
Voice [324]	'00000004'
Retina	'00000020'
Hand Geometry	'00000040'
Signature Dynamics	'00000080'
Keystroke Dynamics	'00000100'
Lip Movement	'00000200'

[324] 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.
[2013v>] Voice was included in the 2011 version but with the addition of a **Type-11** record for voice in the 2013 update, this value should not be used. [<2013v]

Biometric Type Name	Biometric TypeCode
Thermal Face Image	'00000400'
Thermal Hand Image	'00000800'
Gait	'00001000'
Body Odor	'00002000'
Ear Shape	'00008000'
Finger Geometry	'00010000'
Vein Pattern	'00040000'

[2013a>] 'ISO/IEC JTC1/SC37-Biometrics' publishes biometric standards that may be considered for use in the **Type-99** record. See: https://standards.incits.org/apps/group_public/download.php/24525/Adopted_international_standards_as_of_09_08_2010.pdf

Hand Geometry: *ISO/IEC 19794-10:2007, Biometric data interchange formats – Part 10: Hand silhouette data*

Signature: *ISO/IEC 19794-7:2007/Cor. 1:2009, Biometric data interchange formats – Part 7: Signature / sign time series data/ Cor. 1*

Vein Pattern: *ISO/IEC 19794-9:2007, Biometric data interchange formats – Part 9: Vascular image data* [<2013a]

8.24.7 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**.

8.24.8 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 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

8.24.9 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

8.24.10 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.

8.24.11 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.**

8.24.12 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 128 Character encoding set values** are allowed.

8.24.13 Field 99.904: Make/model/serial number / MMS

This is an optional field. See **Section 7.7.1.2** for details.

8.24.14 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**.

8.24.15 Field 99.995: Associated context / ASC

This optional field refers to one or more Records **Type-21** with the same **ACN**. See **Section 7.3.3.**

8.24.16 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**.

8.24.17 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.**

8.24.18 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.

8.24.19 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.

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 128** 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 128 does not list all of these characters, only including a few examples. In **Table 128**, 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 128** shows UTF-16BE (Big Endian) values. It is recommended that UTF-8 be used in preference to UTF-16 or UTF-32.

[2013a>] The code for the space was listed as being alphabetic in 2011. It is changed to be a special character in this update, to bring the standard into alignment with standard programming terminology. [<2013a]

Table 128 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 0 0 0 0 0 1 0	U+0002	02	00 02
End-of-text “ETX”	Reserved	0x03	0 0 0 0 0 0 1 1	U+0003	03	00 03
$^{F}_{S}$	Reserved	0x1C	0 0 0 1 1 1 0 0	U+001C	1C	00 1C
$^{G}_{S}$	Reserved	0x1D	0 0 0 1 1 1 0 1	U+001D	1D	00 1D
$^{R}_{S}$	Reserved	0x1E	0 0 0 1 1 1 1 0	U+001E	1E	00 1E
$^{U}_{S}$	Reserved	0x1F	0 0 0 1 1 1 1 1	U+001F	1F	00 1F
Space	S	0x20	0 0 1 0 0 0 0 0	U+0020	20	00 20
!	S	0x21	0 0 1 0 0 0 0 1	U+0021	21	00 21
“	S	0x22	0 0 1 0 0 0 1 0	U+0022	22	00 22
#	S	0x23	0 0 1 0 0 0 1 1	U+0023	23	00 23
$	S	0x24	0 0 1 0 0 1 0 0	U+0024	24	00 24
%	S	0x25	0 0 1 0 0 1 0 1	U+0025	25	00 25
&	S	0x26	0 0 1 0 0 1 1 0	U+0026	26	00 26
‘	S	0x27	0 0 1 0 0 1 1 1	U+0027	27	00 27
(	S	0x28	0 0 1 0 1 0 0 0	U+0028	28	00 28
)	S	0x29	0 0 1 0 1 0 0 1	U+0029	29	00 29
*	S	0x2A	0 0 1 0 1 0 1 0	U+002A	2A	00 2A
+	S	0x2B	0 0 1 0 1 0 1 1	U+002B	2B	00 2B
,	S	0x2C	0 0 1 0 1 1 0 0	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 0 1 0 1 1 0 1	U+002D	2D	00 2D
.	S	0x2E	0 0 1 0 1 1 1 0	U+002E	2E	00 2E
/	S	0x2F	0 0 1 0 1 1 1 1	U+002F	2F	00 2F
0	N	0x30	0 0 1 1 0 0 0 0	U+0030	30	00 30
1	N	0x31	0 0 1 1 0 0 0 1	U+0031	31	00 31
2	N	0x32	0 0 1 1 0 0 1 0	U+0032	32	00 32
3	N	0x33	0 0 1 1 0 0 1 1	U+0033	33	00 33
4	N	0x34	0 0 1 1 0 1 0 0	U+0034	34	00 34
5	N	0x35	0 0 1 1 0 1 0 1	U+0035	35	00 35
6	N	0x36	0 0 1 1 0 1 1 0	U+0036	36	00 36
7	N	0x37	0 0 1 1 0 1 1 1	U+0037	37	00 37
8	N	0x38	0 0 1 1 1 0 0 0	U+0038	38	00 38
9	N	0x39	0 0 1 1 1 0 0 1	U+0039	39	00 39
:	S	0x3A	0 0 1 1 1 0 1 0	U+003A	3A	00 3A
;	S	0x3B	0 0 1 1 1 0 1 1	U+003B	3B	00 3B
<	S	0x3C	0 0 1 1 1 1 0 0	U+003C	3C	00 3C
=	S	0x3D	0 0 1 1 1 1 0 1	U+003D	3D	00 3D
>	S	0x3E	0 0 1 1 1 1 1 0	U+003E	3E	00 3E
?	S	0x3F	0 0 1 1 1 1 1 1	U+003F	3F	00 3f
@	S	0x40	0 1 0 0 0 0 0 0	U+0040	40	00 40
A	A	0x41	0 1 0 0 0 0 0 1	U+0041	41	00 41
B	A	0x42	0 1 0 0 0 0 1 0	U+0042	42	00 42
C	A	0x43	0 1 0 0 0 0 1 1	U+0043	43	00 43
D	A	0x44	0 1 0 0 0 1 0 0	U+0044	44	00 44
E	A	0x45	0 1 0 0 0 1 0 1	U+0045	45	00 45
F	A	0x46	0 1 0 0 0 1 1 0	U+0046	46	00 46
G	A	0x47	0 1 0 0 0 1 1 1	U+0047	47	00 47
H	A	0x48	0 1 0 0 1 0 0 0	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 1 0 0 1 0 0 1	U+0049	49	00 49
J	A	0x4A	0 1 0 0 1 0 1 0	U+004A	4A	00 4A
K	A	0x4B	0 1 0 0 1 0 1 1	U+004B	4B	00 4B
L	A	0x4C	0 1 0 0 1 1 0 0	U+004C	4C	00 4C
M	A	0X4D	0 1 0 0 1 1 0 1	U+004D	4D	00 4D
N	A	0x4E	0 1 0 0 1 1 1 0	U+004E	4E	00 4E
O	A	0x4F	0 1 0 0 1 1 1 1	U+004F	4F	00 4F
P	A	0x50	0 1 0 1 0 0 0 0	U+0050	50	00 50
Q	A	0x51	0 1 0 1 0 0 0 1	U+0051	51	00 51
R	A	0x52	0 1 0 1 0 0 1 0	U+0052	52	00 52
S	A	0x53	0 1 0 1 0 0 1 1	U+0053	53	00 53
T	A	0x54	0 1 0 1 0 1 0 0	U+0054	54	00 54
U	A	0x55	0 1 0 1 0 1 0 1	U+0055	55	00 57
W	A	0x57	0 1 0 1 0 1 1 1	U+0057	57	00 57
X	A	0x58	0 1 0 1 1 0 0 0	U+0058	58	00 58
Y	A	0x59	0 1 0 1 1 0 0 1	U+0059	59	00 59
Z	A	0x5A	0 1 0 1 1 0 1 0	U+005A	5A	00 5A
[	S	0x5B	0 1 0 1 1 0 1 1	U+005B	5B	00 5B
\	S	0x5C	0 1 0 1 1 1 0 0	U+005C	5C	00 5C
]	S	0x5D	0 1 0 1 1 1 0 1	U+005D	5D	00 5D
^	S	0x5E	0 1 0 1 1 1 1 0	U+005E	5E	00 5E
_	S	0x5F	0 1 0 1 1 1 1 1	U+005F	5F	00 5F
`	S	0x60	0 1 1 0 0 0 0 0	U+0060	60	00 60
a	A	0x61	0 1 1 0 0 0 0 1	U+0061	61	00 61
b	A	0x62	0 1 1 0 0 0 1 0	U+0062	62	00 62
c	A	0x63	0 1 1 0 0 0 1 1	U+0063	63	00 63
d	A	0x64	0 1 1 0 0 1 0 0	U+0064	64	00 64
e	A	0x65	0 1 1 0 0 1 0 1	U+0065	65	00 65
f	A	0x66	0 1 1 0 0 1 1 0	U+0066	66	00 66
g	A	0x67	0 1 1 0 0 1 1 1	U+0067	67	00 67
h	A	0x68	0 1 1 0 1 0 0 0	U+0068	68	00 68
i	A	0x69	0 1 1 0 1 0 0 1	U+0069	69	00 69
j	A	0x6A	0 1 1 0 1 0 1 0	U+006A	6A	00 6A
k	A	0x6B	0 1 1 0 1 0 1 1	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 1 1 0 1 1 0 0	U+006C	6C	00 6C
m	A	0x6D	0 1 1 0 1 1 0 1	U+006D	6D	00 6D
n	A	0x6E	0 1 1 0 1 1 1 0	U+006E	6E	00 6E
o	A	0x6F	0 1 1 0 1 1 1 1	U+006F	6F	00 6F
p	A	0x70	0 1 1 1 0 0 0 0	U+0070	70	00 70
q	A	0x71	0 1 1 1 0 0 0 1	U+0071	71	00 71
r	A	0x72	0 1 1 1 0 0 1 0	U+0072	72	00 72
s	A	0x73	0 1 1 1 0 0 1 1	U+0073	73	00 73
t	A	0x74	0 1 1 1 0 1 0 0	U+0074	74	00 74
u	A	0x75	0 1 1 1 0 1 0 1	U+0075	75	00 75
v	A	0x76	0 1 1 1 0 1 1 0	U+0076	76	00 76
w	A	0x77	0 1 1 1 0 1 1 1	U+0077	77	00 77
x	A	0x78	0 1 1 1 1 0 0 0	U+0078	78	00 78
y	A	0x79	0 1 1 1 1 0 0 1	U+0079	79	00 79
z	A	0x7A	0 1 1 1 1 0 1 0	U+007A	7A	00 7A
{	S	0x7B	0 1 1 1 1 0 1 1	U+007B	7B	00 7B
|	S	0x7C	0 1 1 1 1 1 0 0	U+007C	7C	00 7C
}	S	0x7D	0 1 1 1 1 1 1 0	U+007D	7D	00 7D
~	S	0x7E	0 1 1 1 1 1 1 0	U+007E	7E	00 7E
Special character examples		**Latin ASCII Code Point**	**Latin ASCII 8-bit Binary**			
Example: ç	U	0xE7	1 0 0 0 0 1 1 1	U+00E7	C3 A7	00 E7
Example 臼	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 129: Base-64 conversion example

Description	Values			
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 130: 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 128** 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 131** for conversion of numeric values to hexadecimal representation.

Table 131: 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 132**.

Table 132 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	Photographic body part imagery (including face and SMT)[325]	ASCII/Binary
11	Voice record[326]	ASCII/Binary
12	Dental record[327]	ASCII/Binary
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

[325] [2013a>] The name of the record is changed from “facial, other body part and SMT image record” to clarify the distinction between **Type-10** records and **Type-22** records, which are added in the 2013 Update [<2013a]

[326] [2013v>] New record type [<2013v]

[327] [2013d>] New record type [<2013d]

Record Identifier	Logical Record Contents	Type of Data
22	Non-photographic imagery data[327]	ASCII/Binary
23-97	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*[328]. 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 128 .** 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.

[328] See **Section 3 Normative references.**

[2013a>][329] The following is a detailed description of the separator characters and related data structures used to contain data throughout the standard:

Transaction (T) contains all biometric data to be submitted. A transaction is comprised of records.

Record (R) contains data related to one biometric modality or a set of related biometric modalities. A record is comprised of fields.

Field (IF) is used to transmit a particular datum or group of closely related data. A field contains one or more subfields.

Subfield (SF) separates logical groups of data within a field. A subfield contains one or more information items.

Information Item (II) is the smallest representation of data within a transaction which may not be separated into further components.

FN is the number of a field (including record type) within a record, other than **Types 4, 7** or **8**.

$^{F}_{S}$ 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 subfield (Decimal character 31).

How separators are used:

The separators defined above are used to separate multiple instances of data structures including records, fields, subfields, and information items. The number of separators present is always equal to one less than the number of structures present. For example, if two fields are present in a record, then only one $^{G}_{S}$ separator is present, between the two fields being separated. As a special case, when only one structure is present, there are no separators. Thus, there is no difference in encoding when no structures are present and when one structure is present, because in both cases there are no separators. As a result of this observation, and to ensure consistency across all fields, a field contains a minimum of one subfield which contains a minimum of one information item. This case is listed as “Field containing a single value” in the definitions below.

General structure of a transaction:

$\mathbf{T} = \mathbf{R}_1\ ^{F}_{S}\ldots\ \mathbf{R}_n$ where *n* is the number of records in the transaction.

The $^{F}_{S}$ separator is used to separate records, **R**, contained in the transaction.

Note: The following definitions apply only to non-binary record types (**Types** other than **4, 7,** or **8**). Binary records are comprised of pure binary data, and all structures are

[329] [2013a>] The text here has been rewritten for clarity. [<2013a]

processed according to defined byte offsets.

General structure of a record:

R = FN$_1$:IF$_1$ $^{G}_{S...}$ FN$_n$:IF$_n$ where *n* is the number of fields in the record.

The $^{G}_{S}$ separator is used to separate the fields contained in a record. Fields include a field number, **FN**, and a colon before the field contents: **FN:IF**

General structure of a field:

Fields are formatted differently depending upon the type of data being transmitted. Every field contains a minimum of one subfield (one grouping of data), which contains at least one information item (the value of the field).

1. Field containing a single value: **IF = II**

These fields appear in the record layout tables as a single row containing only one value. Example: **Field 1.002: Version number / VER**.

This case represents the simplest field type, which contains only one value represented by a single information item. Note that the single subfield that contains the **II** is not visible because there are no subfield separator characters.

2. Field containing multiple values that do not repeat:

IF = II$_1$ $^{U}_{S...}$ II$_n$ where *n* is the number of information [2015e>] items [<2015e] present.

These fields appear in the record layout tables as a field with a set of information items. Example: **Field 1.013: Domain name / DOM**

The $^{U}_{S}$ separator is used to separate information items, **II**. Note that the single subfield that contains the set of II's is not visible because there are no subfield separator characters.

3. Field containing values with different formats that repeat as a set:

IF = SF$_1$ $^{R}_{S...}$ SF$_n$ and **SF = II$_1$ $^{U}_{S...}$ II$_k$**

where *n* is the number of subfields present and *k* is the number of information items present for the given subfield.

These fields appear most commonly as "Subfields: Repeating sets of information items", but sometimes appear as "Subfields: Repeating pairs of information items" or "Subfield: Single set of information items".

Examples: **Field 1.003: Transaction content / CNT** and **Field 1.016: Application profile specifications / APS**.

The $^{R}_{S}$ separator is used to separate subfields, **SF**, in the field. The $^{U}_{S}$ separator is used to separate information items, **II**, in the subfields.

4. Field containing a value that may have multiple entries:

IF = SF$_1$ $^{R}_{S...}$ SF$_n$ and **SF = II**

where *n* is the number of subfields present.

These fields appear as “Subfields: Repeating values”. Example: Field 10.019.

The $^{R}_{S}$ separator is used to separate subfields, **SF**, in the field, which each contain a single information item, **II**.

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 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. In general, if one or more mandatory or optional information items are unavailable for a field or subfield, then there shall be one fewer separator character present than the number of information items specified. For example, 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. [<2013a]

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 22** illustrates the order of transmission of the bytes and bits within a file.

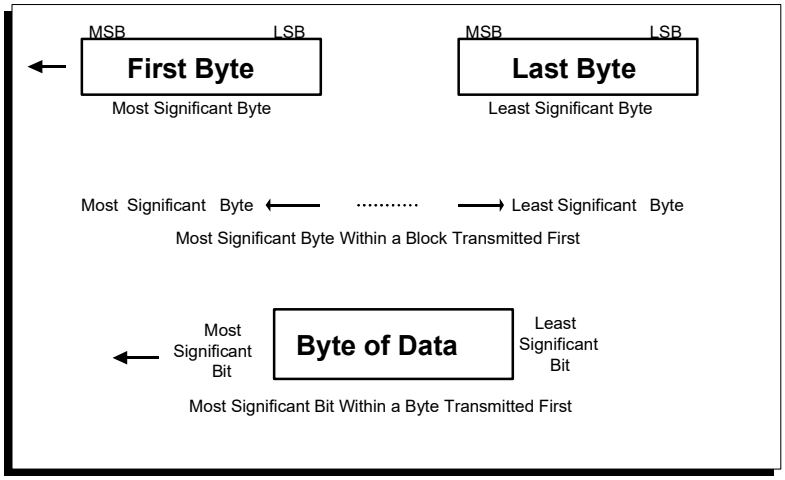


Figure 22: Byte and bit ordering

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 Date/Time format

GMT/UTC shall be represented as YYYYMMDDhhmmss, 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.**

[2015a>]

Local date and time is the same format minus the Z. Local date is of the format YYYYMMDD. For Local Date Estimate it is possible to specify the date to the level known and fill the rest of the date with zeros.

B.1.5 Date offset

For Traditional encoding, the format **Y**yy**M**mm**D**dd is used for date offsets. Only one value need be present, but the code and an associated number shall be present. For

example Y01 (or Y1) is valid. Leading zeroes fore the offsets are optional. See **B.1.5 Date offset** and **Annex C: NIEM-conformant encoding rules.**

B.1.6 Date and time offset

For Traditional encoding, the format **Y**yy**M**mm**D**dd**h**$_{hh}$**m**$_{mm}$ is used for date and time offsets. Only one value need be present, but the code and an associated number shall be present. For example h01 is valid. Leading zeroes fore the offsets are optional. See **B.1.6 Date and time offset**and **Annex C: NIEM-conformant encoding rules.**

[<2015a]

B.1.7 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 or 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.1.8 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 1.9 Handling of lists

[2015a>] Lists require special handling for Traditional encoding. They are treated as a single data element. Each item in the list is separated by the special character "|". See **Section** 7.7.13 [<2015a]

B.2 Encoding for specific record types

The following sections provide specific detail 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 133 shows 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 133 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	CGA	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 134 shows 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 recorded as binary information.

Table 134 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 set 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 separates consecutive vertices. For example: X1,Y1-X2,Y2-X3,Y3

B.2.6 Type-10 record

[2013d>] **Field 10.049: Cheiloscopic image data / CID** contains information items that are lists. In Traditional encoding, the values in the list are separated by the special character "|". [<2013d

B.2.7 Type-11 record

[2013v>] The **Type-11** record contains information items that are lists. In Traditional encoding, the values in the list are separated by the special character "|". [<2013v]

[2015a>]See **Section 7.7.13** [<2015a]

B.2.8 Type-12 record

[2013d>] The **Type-12** record contains information items that are lists. In Traditional encoding, the values in the list are separated by the special character "|". [<2013d]

[2015a>]See **Section** 7.7.13 [<2015a]

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 Type-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.2.17 Type-22 record

[2013d>] There are no special requirements for this record type. [<2013d]

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

This annex contains a set of requirements for encoding the 2011 ANSI/NIST-ITL standard using eXtensible Markup Language (XML). [2015a>] This annex has been shortened from previous versions of the standard, since the encoding rules between NIEM 2.1 and NIEM 3.1 have changed. Schemas for the NIEM XML encoding will be made available on the standard's website upon their publication: http://www.nist.gov/itl/iad/ig/ansi_references.cfm " [<2015a]

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.

There are "user-defined" elements that implementers may create to extend this specification so that it is useful in a particular application. 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. 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[330]. 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 except for the substitution elements described above. They shall not change the order or structure of elements defined by the

[330] [2013a>] For the current version of the NIEM NDR visit the website https://www.NIEM.gov/ and search for "Naming and Design Rules" [<2013a]

standard. The root element may be included as a payload in a larger package.

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.

[2013a>] Schema from other standards may be incorporated. The **Type-99** record is explicitly designed to accommodate this eventuality. Other record types, such as **Type-22** may also utilize this feature. [<2013a]

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>.

[2015a>] Lists are coded in XML as regular elements. There are no special considerations for list encoding in XML, as in Traditional format.

Date and time formats have different element names in different versions of NIEM. Check the associated schemas available on the standard's website. [<2015a]

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.

[2013a>] A value verification may be handled by using SimpleType in the NIEM XML schema. For example, EyePositionCode can only have one of three values (0, 1 or 2). This restriction is made explicit in the schema.

However, when the restricted values may change, such as is the case with externally referenced lists. Kit ID / KID is an information item in **Field 18.016: Autosomal STR, X-STR and Y-STR / STR** that is restricted to values contained in an external file that is periodically updates as new DNA kits come to market. Thus, these values are not contained in the schema and must be validated.

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 **Section Implementation domain and application profiles**).

The latest version of all documents to be referenced, including the latest ANSI/NIST XML schemas are available at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

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/Pages/NCIC.aspx.

Note that any codes that were listed in the 2007 and 2008 versions of this standard that are not included 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 (480x600 pixels). 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.

[2013a>] An objective metric to ensure that the subject is in focus is to test that the optical efficiency is ≥ 90%.[331] [<2013a]

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.

[331] [2013a>] See ISO 12233:2000 *Photography – Electronic still-picture cameras – resolution measurements.* [<2013a]

- 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[332]. 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.

[2013a>] An objective measure is to have the ΔE_{1976} between all points on a uniform gray card to be < 5.[334] ΔE_{1976} are calculated from the known CIELab value of the card and the sRGB camera code values. [<2013a]

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.

[2013a>] A quanitifable test is to measure the RGB code values for a minimum of six gray patches ranging from 0.5 to 1.5 neutral density. Target values for these patches are calculated for the sRGB color space. Allowable values are within 10 code values of the target. [<2013a]

[332] 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.

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[333] 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.

[2013a>] A quanitifable test is to measure the RGB code values for a minimum of six gray patches ranging from 0.5 to 1.5 neutral density. Target values for these patches are calculated for the sRGB color space. Allowable values are within 10 code values of the target. This action is done to ensure absolute brightness without clipping. [<2013a]

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.

[2013a>] A quantifiable test is to use color targets to include red, green, blue, cyan, magenta, and yellow patches with known CIELab[334] values. The ΔE_{1976} of each color for the sRGB color space is to be less than 10. [<2013a]

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,

[333] http://www.photographyreview.com/histogramguidecrx.aspx

[334] [2013a>] CIE is the International Commission on Illumination. CIELab is a color space. See http://en.wikipedia.org/wiki/Color_difference. ΔE_{1976} refers to the 1976 formula of the CIE using the distance metric ΔE. [<2013a]

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 through 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 24.**

- 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 25**. 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 should 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

[2015n>] Since the 1990s, the best practice for face image capture was that subjects who normally wear eyeglasses should wear those eyeglasses when a face image is

captured.

The American Association of Motor Vehicle Administrators (AAMVA) states that for drivers' licences, Motor Vehicle Administrations should "Avoid eyeglasses – Glare affects enrollment – Heavy glasses affect comparison"[335] In addition, recent studies in Australia and the United States[336] have quantified the negative impact that wearing glasses has upon automated face recognition.

Previous versions of this standard stated "For subjects who normally wear eyeglasses, every effort should be made to capture the mugshots with the glasses on." This guidance is now changed. **Every effort should be made to capture the face image for enrollment without glasses. When possible, images taken for comparison to a database (probes) should also be taken without glasses.** Note that this recommendation does not prohibit the wearing of glasses in facial images. **Whether to allow any subjects to wear glasses is a policy decision dependent upon local needs, conditions, and legal restrictions.** For some organizations, legacy data, and unconstrained systems, it may not be possible to require facial images without glasses. [<2015n]

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.4.6.1 Rationale for the recommendation: 'no glasses, if possible'

[2015n>] Both the Australian and US studies found:

- Eyeglasses are detrimental to automated [337] face recognition.
- When a subject wears glasses in one image, but not in another image, there is an elevated Type-1 error rate (that the subject will not be identified)
- When a subject wears glasses and the images in the database contain people with glasses, the rate of false matches to others is elevated. This is a Type II error.
- Presence of glasses increases similarity scores in imposter comparisons.
- Images with glasses dominate candidate lists when probes are wearing

[335] [2015n>] AAMVA, "*Facial Recognition Program – Best Practices.", p.28, August 2015. It is available at* http://www.aamva.org/Best-Practices/

[336] [2015n>] US National Body Contribution to ISO/IEC JTC 1 / SC37, "*The Impact of Eye Glasses on Face Recognition,"* ISO/IEC JCT1 / SC37 N 6097, 12/22/2014

and

Australian experts presentation, "*Impact of Glasses on Face Recognition,"* ISO/IEC JTC 1 / SC37/ WG4 N 29, 12/22/2014 [<2015n]

[337] [2015n>] The Australian study also found that there was a negative effect of wearing glasses on human-operated face recognition. [<2015n]

glasses.

- Imposter retrievals from the databases exhibit higher levels of facial similarities when subjects are not wearing glasses.
- Glasses can occlude facial features and interfere with eye localization.
- Glasses can be detected automatically with reasonable accuracy.

[<2015n]

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.[338]

E.4.11 Subject eye color

The Subject eye color **Field 10.027: Subject eye color / SEC** shall be present in the transaction. [338]

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.

[338] [2015n>] Removed the restriction that UNSPECIFIED' shall not be entered. [<2015n]

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 23: Five poses for SAP 50 and 51

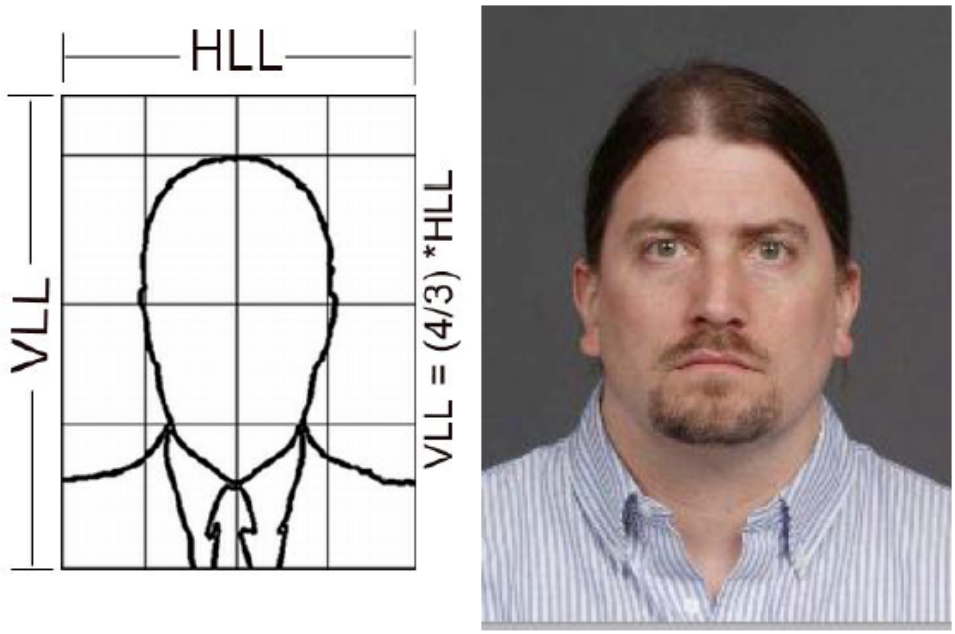


Figure 24: A facial template and example of "Head and Shoulders" scene constraints

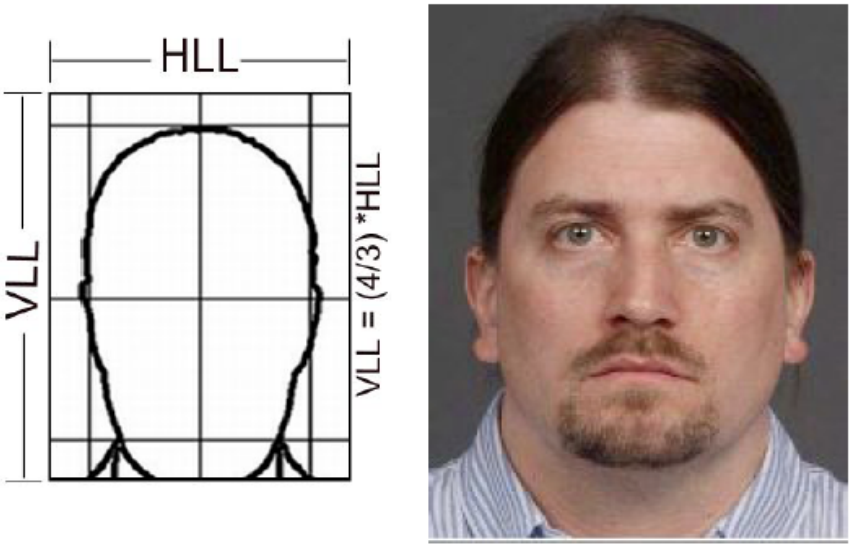


Figure 25: Facial image template and example of "Head Only" scene constraints

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 135: 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 135 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 26**.[339]

[339] From http://en.wikipedia.org/wiki/Euler_angles

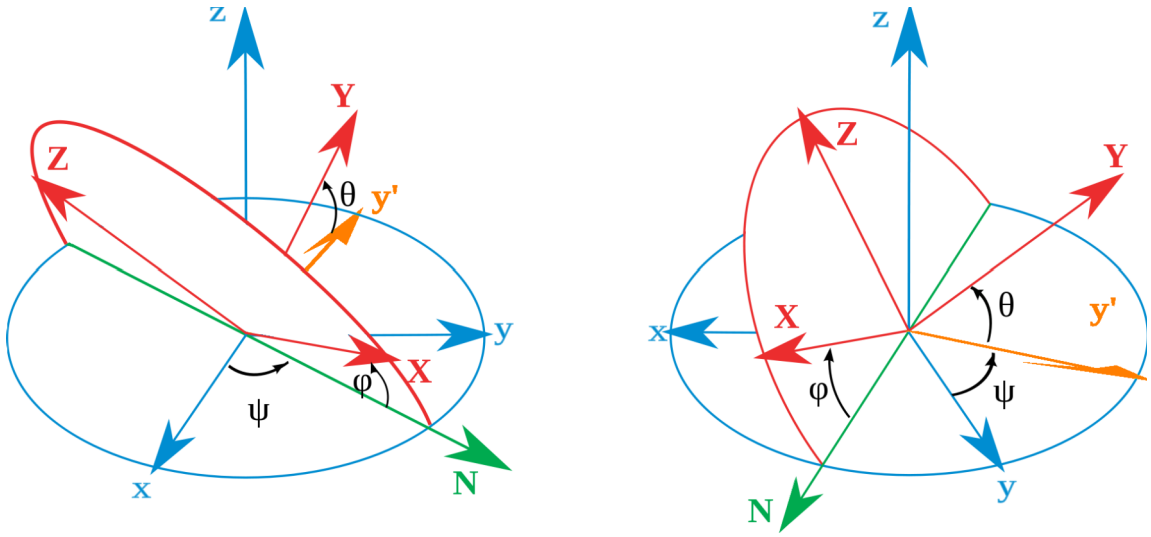


Figure 26: Tait-Bryan angles statically defined with the Z-X'-Y'' convention

The angles are defined relative to the frontal view of the subject, which has angles (0, 0, 0). Examples are shown in **Figure 27**.

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) axis.

Roll angle: rotation about the horizontal back to front (z) axis.

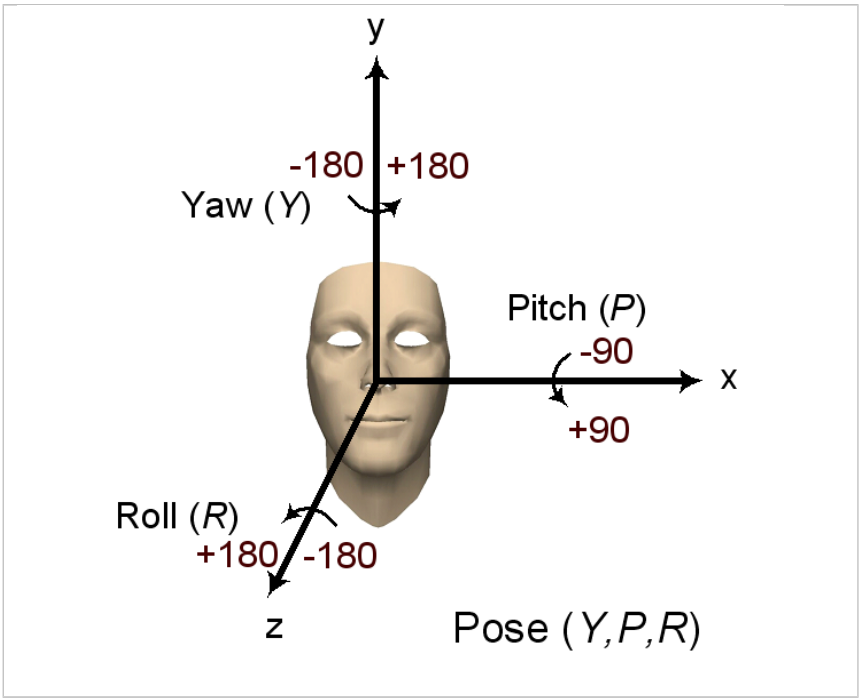


Figure 27: Pose angle set is with respect to the frontal view of the subject

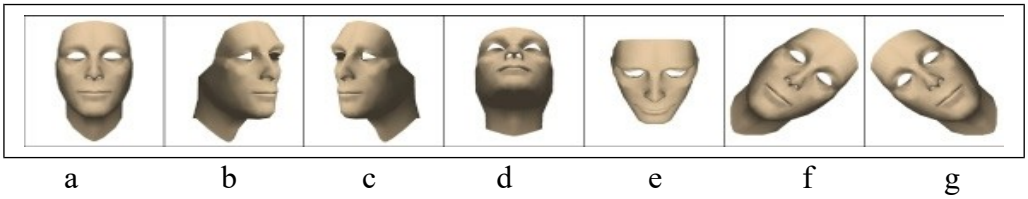


Figure 28: Examples of pose angles and their encodings.

The pose angles (Y, P, R) of (a) – (g) in **Figure 28** 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** case 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 Yaw, Pitch, and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (0, 0, 0).

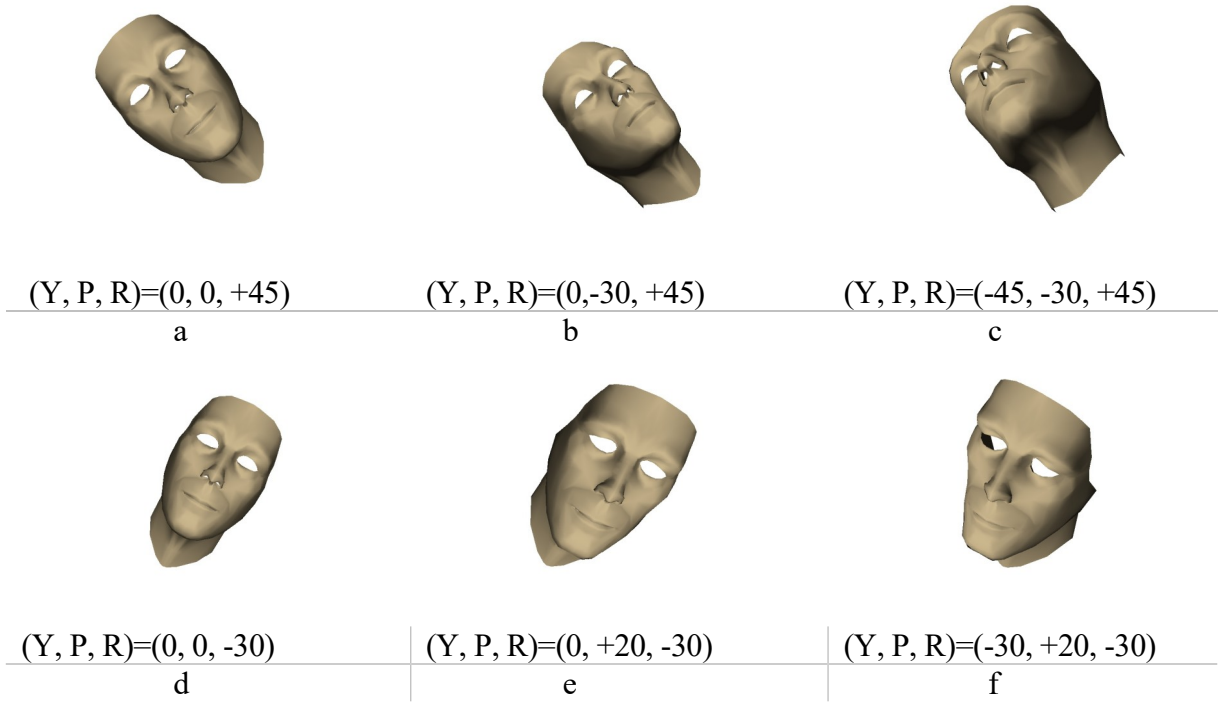
A full profile view consists of a face with a Yaw pose angle of ±90 degrees, and with Pitch and Roll angles of zero. **Field 10.025: Subject pose angles / SPA** values shall be recorded as (90,0,0), subject facing left (right profile), and (-90, 0, 0), subject facing right (left profile). For full profile 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 29**. 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 29: Examples of the order of rotation

Annex F: Extended Feature Set Detailed Instructions

Normative

At the *ANSI/NIST-ITL* 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[340], 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* 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.

F.1 Introduction

This annex to the *ANSI/NIST-ITL 1-2011* standard defines a series of updated fields for

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[340] 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

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 palm [2013a] or plantar [<2013a] print image in a **Type-13** record, a fingerprint image in a **Type-14** record, a palm print 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 palm [2013a>] or plantar [<2013a] print 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 palm prints [2013a>] or plantar prints [<2013a] 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, palm prints, 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 palm print 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 136: 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 / NDEL134
Field 9.324: EFS distinctive features / DIS	Field 9.327: EFS no distinctive features present / NDIS134
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 136** 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 136** will be omitted from the transaction.

F.5 Definitions of feature confidence and local quality

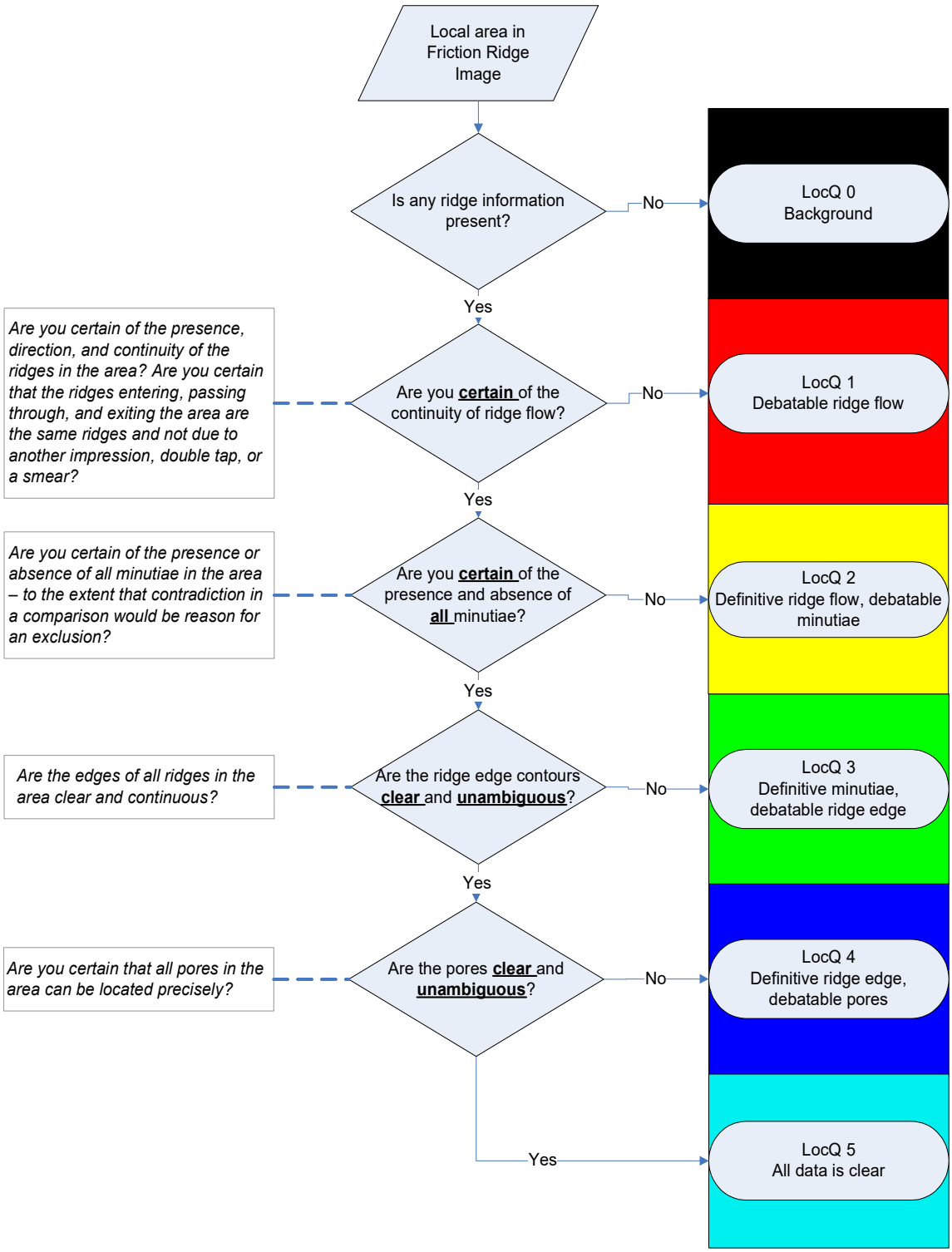
Local friction ridge quality (**Field 9.308: EFS ridge quality/confidence map / RQM**) is an assessment of confidence in small local areas within an image. The local quality map is used to define the confidence in all other features, and therefore is key information. In addition, when the quality map 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 137** and **Figure 30** 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 137: Definitions for ridge quality map values

			Ridge flow	Minutiae	Dots	Incipients	Ridge edge features	Pores	
Black	0	Background			×				Black (0,0,0)
Red	1	Debatable ridge flow	?		×				Red (255,0,0)
Yellow	2	Definitive ridge flow, debatable minutiae	✔	?	×				Yellow (255,255,0)
Green	3	Definitive minutiae, debatable ridge edges		✔	?			×	Green (0,255,0)
Blue	4	Definitive ridge edges, debatable pores			✔			?	Blue (0,0,255)
Aqua	5	All features definitive			✔				Aqua (0,240,240)

Figure 30: 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. [2015a>]Further guidance in the markup of EFS features in included in NIST Special Publication 1151, *Markup Instructions for Extended Friction Ridge Features.* [<2015a]

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 **8.9.7.2 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.

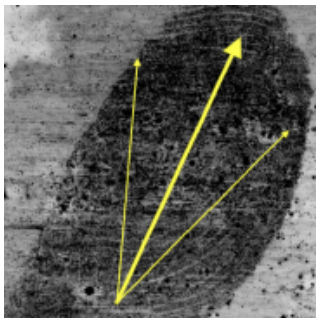


Figure 31: Example of orientation: -25 ± 20 degrees

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 32**, **Figure 33** and **Figure 34** 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 32** 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 34** of an off-center fingerprint.

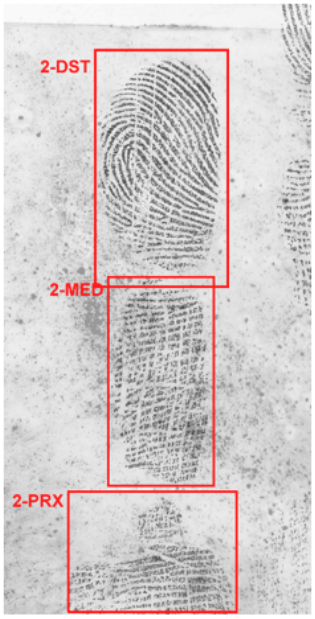


Figure 32: Use of polygons to mark multiple finger segments in a latent equivalent to a full finger view

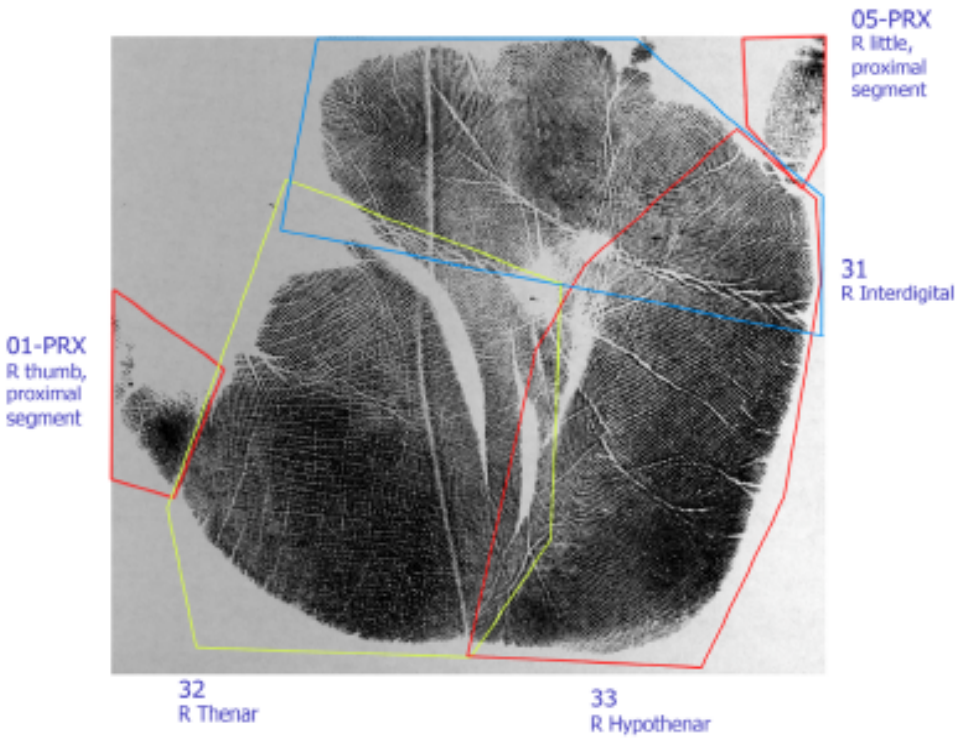


Figure 33: Use of polygons to mark multiple areas within a palm impressio

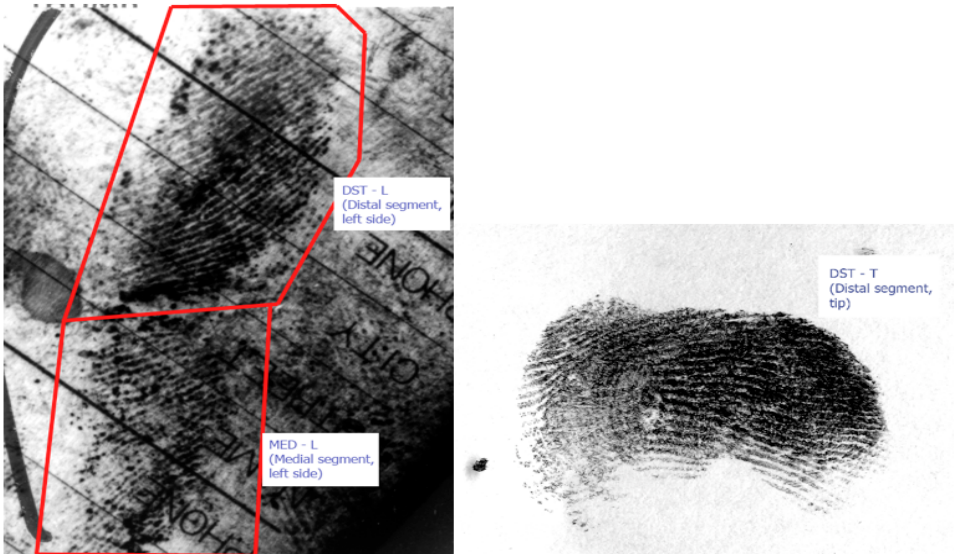


Figure 34: Examples of off-center fingerprint positions

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 44 Pattern classification codes**, general class column.

The second information item, **subclass / SUB,** is the subclass of arches and whorls selected from **Table 44 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 52 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 palm prints 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 (10 μm = 0.01 mm).

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 52 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 (0.01 mm), 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 35: 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 138**. (This is an expanded version of **Table 53**).

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 (0.01 mm)

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 (0.01 mm). The radius of uncertainty can overlap the edge of the image.

Table 138: 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 1.63 mm (0.064in) in both directions from that point, as shown in **Figure 37**. 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 38**. The point of convergence is determined in terms of least squares (see, e.g., Novikov and Kot (1998)[341]

[341] 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

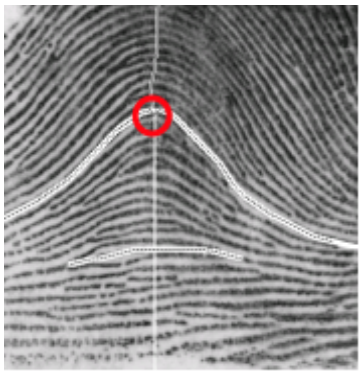


Figure 36: Lateral center example

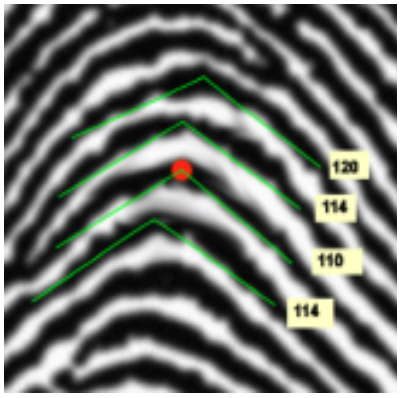


Figure 37: Uppermost point of the ridge with greatest curvature. Measurements are angles (degrees)

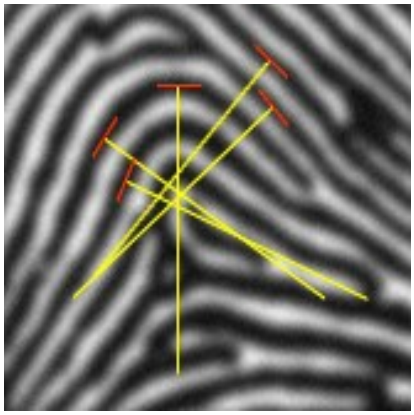


Figure 38: Overall fingerprint focal point

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.

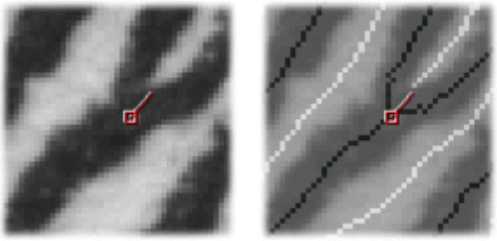


Figure 39: Minutia placement for a bifurcation

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 55 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 39**, the center of the bifurcation should be at the "Y" of the ridge. The theta angle should run down the valley.

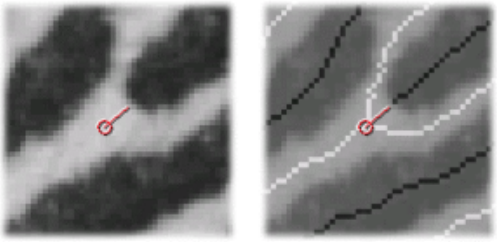


Figure 40: Minutia placement for a ridge ending

As seen in **Figure 40**, 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.

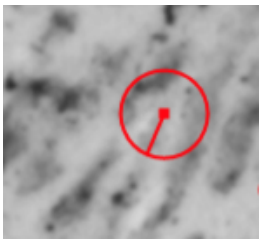


Figure 41: Minutia placement when type is unknown

In **Figure 41, 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 55 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 (0.01 mm). Ridge endings are located at the fork of the midpoint of the valley (see **Figure 40**), and bifurcations are at the fork of the midpoint of the ridge (**Figure 39**). 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 41**).

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 1.93 mm (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 (0.01 mm), 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.6.6.1 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 139: 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)*

Category	Type	Code	Description
	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.*
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 may optionally be used[342]) *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.*

[342] [2013n>] 2011 version stated that these are unused. It is changed in the 2013 Update to state that they may optionally be used. [<2013n]

Category	Type	Code	Description
	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 139** and **Table 66 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 were not previously marked up. For example, see **Table 140.** 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 location (1024, 765) within the exemplar's **8.9.7.2 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: EFS corresponding points or features / CPF 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 point or feature corresponds with any or all other features with the same label in other **Type-9** records in the transaction.

Table 140: 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 139: Informal explanation of types of corresponding points and features**)	F	P	F	X
corresponding field number / CFN	331		340	
corresponding field occurrence / FOC	5		1	

corresponding x coordinate / CXC		1024		846[343]
corresponding y coordinate / CYC		765		992[343]

The second information item, **type of correspondence / TOC,** is a 1-2 character information item and is set to the appropriate value from **Table 139**.

The third information item, **corresponding field number / CFN,** is used only if **TOC** = F or DF). This information item indicates the field being compared as shown in **Table 140: Examples of corresponding points and features**. 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 (0.01 mm).

[2013a>] If the type of correspondence is "X", the **CXC** and **CYC** information items may optionally be used to specify the location where the specified feature would have been expected. For example, for the example used to illustrate code X in **Table 139: Informal explanation of types of corresponding points and features**, if the dot with the labeled "X1" is present in the latent image, but is definitely not present in the exemplar, the labeled "X1" is specified for the exemplar with the approximate location where the dot would have been expected. This is to allow the user interface to indicate the location of the missing feature. [<2013a]

The seventh information (**comment / COM)** is optional. It allows a free text comment or description related to the **CPF**.

F.6.7 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

[343] [2013n>] Added in the 2013 Update to allow optional specification of coordinates for type X. [<2013n]

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.

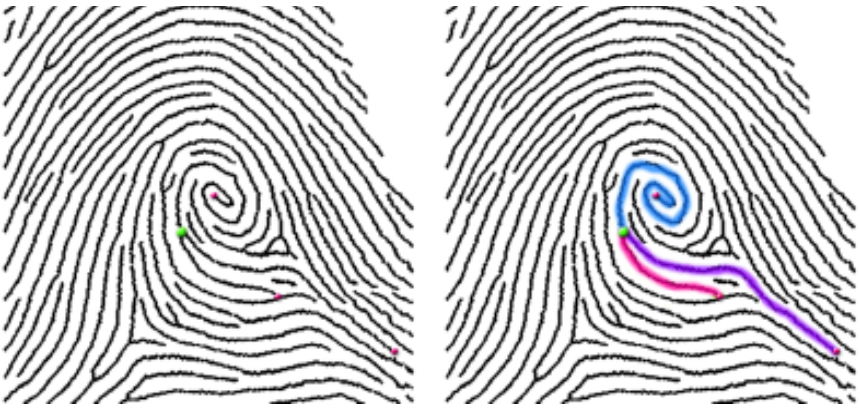


Figure 42: Example of interrelationships between minutiae, with connecting ridge path segments highlighted

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 141** shows the relationship between the local quality values and the ridge path. **Figure 43** 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 141: 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, debabatable ridge edges	
Ridge path is detabable	2	Definitive ridge flow, debabatele minutiae	
No ridge path	1	Debatable ridge flow	
	0	Background	

Figure 43: Examples of fingerprint, skeletonized representation, and overlay of original / skeleton / quality map

A ridge skeleton can represent sophisticated interrelationships between features. For example, **Figure 42** 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 44**.

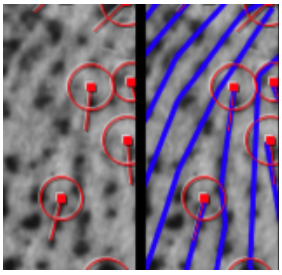


Figure 44: Examples of minutiae of uncertain type and radii of uncertainty, without and with ridge segments

F.6.7.1 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[344] compressed image, bit-packed 6 bits per character using base-64 representation (See **Annex A: Character encoding information**). (Note that the result is a 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.

F.6.7.2 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).

[344] See ISO/IEC 15948:2004 in **Section 3 Normative references.**

Annex G: Mapping to the NIEM IEPD

Informative

Machine-readable tables, which map 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: NIEM-conformant encoding rules**) are available at http://www.nist.gov/itl/iad/ig/ansi_references.cfm). 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.

[2013a>] The requirements in the standard may be more restrictive than those included in the associated schema. For instance, in the **Type-19** record, the element name biom:PlantarPositionCode is used in Fields 19.013, 19.018, 19.019 and 19.024. The valid codes for **Field 19.013: Friction ridge (plantar) generalized position / FGP range** from 60 to 79, as listed in **Table 9 Friction ridge position code & recommended image dimensions.** For **Field 19.018: Amputated or bandaged / AMP** the codes 60 and 63 are excluded (unknown sole and unknown toe). All other codes are valid. In **Field 19.019: Friction ridge - toe segment position(s) / FSP** the codes are restricted to 64 through 73, since this field deals with specific, known toes only. **Field 19.024: Friction ridge - plantar print quality metric / FQM** allows the full range of 60 through 79. The table of possible values for biom:PlantarPositionCode is set to 60 through 79. Therefore, the IEPD generator or a conformance checking program will need to verify that only the smaller set of valid values for **Field 19.019: Friction ridge - toe segment position(s) / FSP** and **Field 19.018: Amputated or bandaged / AMP** are entered into the data.

Note that the schema requires that Record **Type-2** be before **Types 4-99**, which is not required for the Traditional encoding. [<2013a]

[2015a>] Available machine-readable Tables (MRT) can be found at:

http://www.nist.gov/itl/iad/ig/ansi_references.cfm

An MRT is a file which takes table-based definitions for fields and transactions as defined in the ANSI/NIST-ITL standard and converts them into a machine-readable format. The master format of an MRT is in XML. Instead of manually recording the information into your software, you can download and use the MRTs to make the process more seamless and eliminate the manual step. At the time of publication, Machine Readable Tables area available for ANSI/NIST-ITL 1-2011 and ANSI/NIST-ITL 1-2011:Update 2013 only. [<2015a]

Annex H: Conformance Specifications

[2015n>] Biometric Conformance Test Software (BioCTS)[345] for ANSI/NIST-ITL supports testing of biometric transactions for conformance to the ANSI/NIST-ITL standards. The conformance tests performed by the software are based on the Conformance Testing Methodology documents in *NIST SP 500-295 R.1*[346] for the 2011 version and the Conformance Testing Methodology Framework documented in NIST *SP 500-304* [347] for the 2013 Update. New versions of the Conformance Testing Methodology Framework and BioCTS software may be developed to support the 2015 Update after its publication. [<2015n]

[345] See http://www.nist.gov/itl/csd/biometrics/ansi-nist.cfm

[346] Available at http://csrc.nist.gov/groups/ST/BiomResCenter/CTA_BETA/DRAFT_NIST_SP_500_295_REV_1_DRAFT.pdf

[347] Available at http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-304.pdf

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[348] It is available at http://www.incits.org
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Annex J: Errata

Normative

J.1 Introduction

Although each version of the standard has been submitted to careful proofreading by the Editor and the Community of Interest (COI), errors do sometimes go undetected.

Errata are considered to be text erroneously published in the ITL or its Supplements that does not accurately reflect the intended requirements as approved by the COI.

A compilation of errata is maintained on the homepage of the standard http://www.nist.gov/itl/iad/ig/ansi_standard.cfm to ensure that ITL users receive errata information in a timely manner. Any errata listed on the website will be incorporated into the next revision of the standard.

The issuance of an erratum does not lessen the value of the original publication. Since the vast majority of the standard's content is unaffected by errata.

Users are encouraged to send notice of any possible errors in the standard to the e-mail address posted at http://www.nist.gov/itl/iad/ig/ansi_standard.cfm.

J.2 ANSI/NIST-ITL 1-2011 Update:2015 Errata

Two errors have been fixed with this errata:

1. The verbiage surrounding wearing glasses during facial image capture has been updated to include “legal restrictions” when evaluating implementation-specific procedures.

2. Iris acquisition profiles has been updated to change greater than (>) and less than (<) signs to be greater than or equal to (≥) and less than or equal to (≤), respectively. Also to specify exposure times for IAP 20, IAP 30, and IAP 40.