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Information and documentation — RFID in libraries

Part 3: Fixed length encoding

National foreword

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Part 3: Fixed length encoding

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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ISO 28560-3 was prepared by Technical Committee ISO/TC 46, *Information and documentation*, Subcommittee SC 4, *Technical interoperability*.

ISO 28560 consists of the following parts, under the general title *Information and documentation — RFID in libraries*:

— *Part 1: Data elements and general guidelines for implementation*

— *Part 2: Encoding of RFID data elements based on rules from ISO/IEC 15962*

— *Part 3: Fixed length encoding*

Introduction

Libraries are implementing RFID (radio frequency identification) as item identification to replace bar codes. RFID streamlines applications like user self-service, security, and materials handling. A standard data model for encoding information on RFID tags could increase the cost-effectiveness of the technology within libraries particularly through greater interoperability of RFID tags and equipment, and enhance support for resource sharing between libraries.

Several countries have undertaken preliminary work on standardization. The Netherlands developed a data model for public libraries and in Denmark “RFID Data Model for Libraries” has been published (DS/INF 163-1). Finland has adopted the Danish model, but with a few changes. There is a French data model that differs from the Danish and Dutch models. Other libraries in different parts of the world have installations based on various proprietary systems offered by technology and library system suppliers. All of these constitute the installed base of RFID systems, but only account for a small minority of the total of libraries globally.

There is an opportunity to develop a standard data model, taking into account the lessons learned from the national schemes and vendor solutions, and provide migration options for those libraries that have already invested in the technology. Because new items are continually being purchased, a number of migration options can be adopted based on factors relevant to each library.

This part of ISO 28560 deals with the encoding of a basic set of data elements in a fixed length format and the rest of the data elements in optional extension blocks. ISO 28560-1 defines the set of mandatory and optional data elements.

ISO 28560-2 and this part of ISO 28560 are mutually exclusive with respect to an RFID tag being applied to a loan item. In other words, the RFID tag is encoded according to the rules of this part of ISO 28560, or to the rules of ISO 28560-2, or to some proprietary rules. Depending on the technologies being used, and other features of tags that are claiming compliance with ISO 28560-2, the reading system might achieve a degree of interoperability.

ISO 28560 provides essential standards-based information about RFID in libraries. Ongoing advice needs to be provided because of the evolving nature of RFID technology, and the opportunities to migrate between different types of legacy system and encoding rules of ISO 28560.

INTERNATIONAL STANDARD **ISO 28560-3:2011(E)**

Information and documentation — RFID in libraries —

Part 3: Fixed length encoding

1 Scope

This part of ISO 28560 provides a data model and encoding rules for the use of radio frequency identification (RFID) tags for items appropriate for the needs of all types of libraries (including academic, public, corporate, special and school libraries).

This part of ISO 28560 specifies the rules for encoding

— a subset of data elements taken from the total set of data elements listed in ISO 28560-1 into a basic block, and

— other data elements into extension blocks

onto the RFID tag.

A source of additional information about implementation issues is provided in Annex A.

2 Normative references

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

ISO/IEC 10646, *Information technology — Universal Coded Character Set (UCS)*

ISO/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 18046-3, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance*

ISO/IEC TR 18047-3, *Information technology — Radio frequency identification device conformance test methods — Part 3: Test methods for air interface communications at 13,56 MHz*

ISO 28560-1, *Information and documentation — RFID in libraries — Data elements and general guidelines for implementation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 28560-1 and the following apply.

3.1
basic block
data block occupying the first 272 bits of the RFID tag

NOTE If the RFID tag is limited to 256 bits (i.e. 32 bytes), the basic block is truncated.

3.2
byte
8-bit byte
group of eight consecutive bits

NOTE A byte can represent one **character** (3.3) or be part of a representation of a character.

3.3
character
one or more **byte**s (3.2)

3.4
CRC
cyclic redundancy check
value calculated from the data on the tag

3.5
data block
container for encoding data elements, **CRC** (3.4), filler and end mark

3.6
end block
data block (3.5) containing the end mark terminating the information on the RFID tag

3.7
extension block
optional **data block** (3.5) following the **basic block** (3.1)

3.8
field
entry in a **data block** (3.5)

3.9
filler data block
optional **data block** (3.5) that may be inserted to align other data blocks on **page** (3.11) boundaries

3.10
fixed length field
field (3.8) of prescribed size in a **data block** (3.5)

3.11
page
minimum data unit that can be read from or written to a tag

NOTE This is measured in **byte**s (3.2).

3.12
string
sequence of **character**s (3.3)

3.13
unsigned integer
binary value of a number of consecutive bits

3.14
variable length field
field (3.8) of variable size in a **data block** (3.5)

4 Requirements

4.1 Data elements

The data elements shall be as defined and compliant with those listed in ISO 28560-1.

NOTE There is a degree of flexibility in using locally defined codes that enable enhancements and variations to be implemented whilst still complying with the basic set of data elements.

4.2 RFID air interface

4.2.1 Air interface conformance

The air interface for compliant tags shall be in accordance with the specification for Mode 1.

For migration purposes, additional non-compliant air interfaces used in legacy systems may be supported during a transition period, which is permitted to remain in place for years, as necessary.

The air interface conformance shall be tested in accordance with ISO/IEC TR 18047-3.

4.2.2 Tag performance

Where there are requirements for test tag performance, these shall be performed in accordance with ISO/IEC 18046-3.

4.3 Data protocol

The fixed length encoding described in this part of ISO 28560 does not require a separate data protocol.

5 General encoding rules

5.1 Distinguishing from other applications and encodings

The value of the application family identifier (AFI) is used to distinguish tags for library applications from other applications. The values of AFI for library applications are defined in ISO 28560-1.

ISO 28560-1 describes how the data storage format identifier (DSFID), if present in the system memory as a programmable register, is used to distinguish tags in the library application area, i.e. with the same AFI.

Tags encoded according to this part of ISO 28560 shall be programmed with the value $3E_{HEX}$ in the DSFID register if the tag contains a programmable DSFID register.

This part of ISO 28560 is not able to encode the DSFID if the tag does not contain a programmable DSFID register. In this case, ISO 28560-2 encodes the DSFID in the first byte of the working area of the tag. To take this situation into account, the content parameter (see Table 1) shall not take the value 6 on RFID tags encoded according to this part of ISO 28560.

If and only if the tag does not contain a programmable DSFID register, it is permissible to distinguish tags encoded according to this part of ISO 28560 from other encodings by verifying the cyclic redundancy check (CRC) encoded in the basic block (see 7.2).

5.2 Writing/reading direction

Data shall be written to and read from the tag as specified in ISO/IEC 18000-3, Mode 1, such that the first bit transmitted to or from the tag is the least significant bit of the first field of the basic block. This field contains the content parameter (see Table 1). From that starting point, bytes are transmitted to or from the tag in order from left to right, with byte 0 to the left of bytes 1, 2, and 3, as shown in the memory map in Annex B.

5.3 Memory area layout

5.3.1 Specifications

The memory area shall be encoded starting with a basic block with fixed length encoding of a basic set of data elements for use in the library.

If the size of the RFID tag is limited to 256 bits (32 bytes), the RFID tag can only contain a truncated basic block.

If the size of the RFID tag is greater than 256 bits, extension blocks (structured or unstructured) may be inserted after the basic block up to the capacity of the chip. If extension blocks are inserted, the order of these is optional. The length of an extension block is determined by the first byte of the block. The type of extension block is defined in the following two bytes.

Filler data blocks may be inserted between blocks to align to page boundaries.

An end block shall terminate the encoding, unless the basic block and possible extension blocks take up the whole space on the RFID tag, in which case an end block is not needed.

5.3.2 Layout for tags greater than 32 bytes

The layout for tags greater than 32 bytes (256 bits) shall be as follows:

<basic block>[(<filler data block>)*<extension block>]*(<filler data block>)*(<end block>)

The end block is mandatory if the tag is not full (see 5.3.1). Basic block, filler data block, structured extension blocks, unstructured extension blocks and end block are specified in Clause 7.

An example is given in Annex B.

5.3.3 Layout for 32-byte tags

The layout for 32-byte tags shall be as follows:

<truncated basic block>

The truncated basic block is specified in Clause 7.

An example is given in Annex B.

5.4 Strings and integers

5.4.1 String encoding

All strings shall be encoded in UTF-8 in accordance with ISO/IEC 10646 with the first character of the string stored in the lowest memory location. Note that UTF-8 encoding implies that a character can occupy more than one byte.

The end of a string can be defined in different ways:

— with one byte 00_{HEX};

— with the length of a fixed length field;

— with the end of a structured extension block.

For fixed length fields all unused bytes shall be 00_{HEX}.

For variable length fields, one byte 00_{HEX} shall be used between each field.

5.4.2 Integer encoding

Integer-encoded fields shall use 4, 8 or 16 bits unsigned integers.

5.5 Writing the tag

5.5.1 Cyclic redundancy check (CRC)

For RFID tags with only 32 bytes (256 bits) user data space of the basic block is truncated two bytes, but the CRC shall be calculated for a full-length basic block with the two missing bytes assumed to be 00_{HEX}.

See 7.2 and Annex C for a description of CRC.

5.5.2 Unused space

Any unused space in blocks shall be filled with 00_{HEX}, i.e. a 6-byte primary item identifier encoded in the basic block (see 7.2) shall be written as the 6-byte primary item identifier followed by 10 bytes 00_{HEX}. It is very important for reading optimization that this rule be followed.

5.5.3 End of tag

If a data block ends on the last user byte of a tag no “end block” is required. The length specified in the last data block shall not indicate a size larger than the tag.

5.6 Reading optimization

Guidelines for reading optimization are given in Annex D.

5.7 Profiling

Guidelines for regional profiling are given in Annex E.

5.8 Locking

It is technically possible to lock parts of the tag, but this part of ISO 28560 does not prescribe any strategy for locking. Such a strategy is left for regional profiling.

5.9 Migration

The decision to migrate from a legacy implementation to a data model based on this part of ISO 28560 depends on economic and operational considerations that are beyond the scope of this part of ISO 28560.

6 Data elements

Table 1 shows for each data element defined in ISO 28560-1, the data block where it is encoded, how it is encoded and the values it may take. Note that some data elements can be encoded in different data blocks. The data blocks are described in Clause 7.

Table 1 — Data elements

N[a]	Name of data element[b]	Data block[c]	Encoding[d]	Values[e]	Requirements and remarks[f]
1	Primary item identifier	Basic block or library extension block	If the primary item identifier is maximum 16 bytes, it shall be encoded in the basic block as a string. Otherwise, it shall be encoded as a string in the library extension block.	Any string	If a primary identifier is not assigned yet the string is empty.
2	Content parameter	Basic block	4-bit unsigned integer	1 (14 values are reserved for future use: 0,2,3,4,5,7,8,9,10, 11,12,13,14,15. To be able to distinguish from tags encoded according to ISO 28560-2, the value 6 shall not be used.)	The value defines a version number. A new version number shall be applied if and only if it refers to a new version of this part of ISO 28560, which is not backward compatible.

Table 1 (*continued*)

N[a]	Name of data element[b]	Data block[c]	Encoding[d]	Values[e]	Requirements and remarks[f]
3	Owner institution (ISIL)	Basic block or library extension block	If the ISIL prefix is one or two characters and the ISIL unit identifier is less than 11 bytes (or 9 bytes for 32 bytes tags), the string may be encoded in the basic block. In this case the string shall be formed as the concatenation of the prefix and the unit identifier. If the prefix is only one character, a blank is added between the prefix and the unit identifier. If the prefix is more than two characters or the unit identifier is longer than 11 bytes, the string may be encoded in the library extension block. In this case the string shall be the ISIL code, including the hyphen.	If the tag is limited to 32 bytes, only ISIL codes with a prefix of max two characters and a unit identifier less than 9 bytes can be encoded. If the size of the tag is more than 32 bytes, any ISIL code can in theory be encoded.	The ISIL code is defined in ISO 15511 as <prefix><hyphen><unit identifier>, where <prefix> shall be either an alpha-2 country code (two upper-case letters), or another registered string (non-country code), and where <unit identifier> can be up to 11 characters long.
4	Set information	Basic block	Two 8-bit unsigned integers, the first specifying <number of parts in item> and the second <ordinal part number>	<numbers of parts in item> may take the values 0 to 255, where 0 indicates an unspecified number. <ordinal part number> may take the values 0 to 255, where 0 indicates the first item in a set, where not all items have an RFID tag.	Set information consists of two parts: <number of parts in item> and <ordinal part number> See examples in ISO 28560-1.
5	Type of usage	Basic block	4-bit unsigned integer	0: Acquisition item 1: Item for circulation 2: Item not for circulation 3 to 4: For local use 5: For future use 6: No information about usage on the tag 7: Discarded item 8: Patron card 9: Library equipment	The values correspond to the main qualifier in ISO 28560-1:—, Annex C.

Table 1 (*continued*)

N[a]	Name of data element[b]	Data block[c]	Encoding[d]	Values[e]	Requirements and remarks[f]
6	Shelf location	Library supplement block	String	Any string specifying the location of the item	See ISO 28560-1
7	ONIX media format	Library supplement block	String	ONIX media descriptor of two alphabetic characters	See ISO 28560-1
8	MARC media format	Library supplement block	String	MARC 21 category of material descriptor	See ISO 28560-1
9	Supplier identifier	Acquisition extension block	String	Any string identifying the supplier of the item	See ISO 28560-1
10	Order number	Acquisition extension block	String	Any string identifying the order containing the item	See ISO 28560-1
11	ILL borrowing institution (ISIL)	ILL block	String	Any ISIL code in the form <prefix> <hyphen><unit identifier>	The ISIL code is defined in ISO 15511.
12	ILL borrowing transaction number	ILL block	String	Any string identifying the borrowing transaction	See ISO 28560-1
13	GS1 product identifier	Acquisition extension block	String	Any GTIN-13 code	See ISO 28560-1
15	Local data A	Unstructured extension blocks	Locally defined	Locally defined	See ISO 28560-1
16	Local data B	Unstructured extension blocks	Locally defined	Locally defined	See ISO 28560-1
17	Title	Title block	String	Any string specifying the titles of the item	See ISO 28560-1
18	Product identifier local	Acquisition extension block	String	Any string specifying the product identifier of the item	See ISO 28560-1
19	Media format (other)	Library extension block	8-bit unsigned integer	0: Undefined 1: Book 2: CD/DVD 3: Magnetic tape 4: Other 5: Other, careful handling is required 6: Very small item, special handling is required	See ISO 28560-1
20	Supply chain stage	Acquisition extension block	8-bit unsigned integer	The set of code values are specified in ISO 28560-1	See ISO 28560-1

Table 1 (*continued*)

N[a]	Name of data element[b]	Data block[c]	Encoding[d]	Values[e]	Requirements and remarks[f]
21	Supplier invoice number	Acquisition extension block	String	Any string identifying the invoice containing the item	See ISO 28560-1
22	Alternative item identifier	Library extension block	String	Any string identifying the item	See ISO 28560-1
23	Alternative owner institution	Basic block or library extension block	If the non-ISIL code is less than 10 bytes (or 8 bytes for 32 bytes tags), it should be encoded as a string in the basic block Otherwise, it may be encoded as a string in the library extension block	Any string identifying the institution that owns the item, that is either a national standardized code not part of ISIL or a code that is neither part of ISIL nor a national standard	See ISO 28560-1
24	Subsidiary of an owner institution	Library supplement block	String	Any string defined by the institution that owns the item	See ISO 28560-1
25	Alternative ILL borrowing institution	ILL block	String	Any string identifying the institution that borrows the item	See ISO 28560-1
26	Local data C	Unstructured extension blocks	Locally defined	Locally defined	See ISO 28560-1

[a] This column specifies the data element number, i.e. the number identifying the data element in ISO 28560-1. Data elements 14, and 27 to 31 are reserved for future use, and therefore not listed in Table 1. When usage and type for these data elements are defined, a mapping should be considered and specified, and then published at the informational website in Annex A.

[b] This column specifies the data element name, i.e. the name identifying the data element in ISO 28560-1.

[c] This column specifies the names of the data blocks in which the data element is encoded.

[d] This column specifies how the data element is encoded. For encoding of strings and integers, see 5.4.1 and 5.4.2.

[e] This column specifies the values the data element may take.

[f] This column gives additional requirements and remarks.

7 Data blocks

7.1 Types of data blocks

The following types of data blocks exist:

— basic block;

— special blocks;

— structured extension blocks;

— unstructured extension blocks.

The rules for encoding these different types of data blocks are given in 7.2 to 7.10.

7.2 Basic block

The basic block contains a number of fixed length data fields. The basic block occupies the first 34 bytes (272 bits) on the tag. If the tag has only 32 bytes (256 bits), the layout for the truncated basic block shall be used. In this case, no other data can be stored on the tag.

Table 2 and Table 3 specify the usage and layout of the basic block and the truncated basic block.

Table 2 — Usage and layout of the basic block

Position[a]	Length[b]	Content of field[c]
0 (0)	4 bits	Content parameter (data element 2)
0 (4)	4 bits	Type of usage (data element 5)
1	2 bytes	Set information (data element 4) <numbers of parts in item> and <ordinal part number>, the first stored in the low byte and the second in the next byte.
3	16 bytes	This field may contain the empty string or the primary item identifier (data element 1) if it is maximum 16 bytes. Otherwise, the first byte shall be 01_{HEX}, and the primary item identifier shall be encoded in the library extension block.
19	2 bytes	This field shall contain the CRC, which is not a data element, but a value calculated as part of the encoding. The purpose is to detect reading and writing errors. CRC-16-CCITT shall be used with $x^{16} + x^{12} + x^5 + 1$ polynomial and FFFF as start value. The CRC shall be calculated starting from the lowest address and skipping the two CRC bytes.
21	13 bytes	This field may contain the empty string or the owner institution (ISIL) (data element 3), in which case the first two bytes shall be a two-character country code or a one-letter non-country code followed by a blank. The following bytes shall be the unit identifier. The country code, the non-country code and the unit identifier are defined in ISO 15511. The hyphen specified in ISO 15511 shall not be encoded. If the third byte is 01_{HEX}, the owner institution (ISIL) (data element 3) shall be encoded in the library extension block; in this case the value of the other bytes in the field is undefined. If the third byte is 02_{HEX} or $03_{HEX,}$ the string starting from byte 4 shall be the alternative owner institution (data element 23); in this case the value of the first two bytes in the field is undefined. 02_{HEX} shall indicate a national standardized code not part of ISIL and 03_{HEX} shall indicate an institution code that is neither part of ISIL nor a national standard. Use of ISIL is highly recommended. The escape options should only be used in a transition period or if ISIL is irrelevant.

[a] Start position of field given as byte number with bit number in parentheses. If bit number is not given, 0 is assumed.

[b] Length of field.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4.

Table 3 — Usage and layout of the truncated basic block

Position[a]	Length[b]	Content of field[c]
0 (0)	4 bits	Content parameter (data element 2)
0 (4)	4 bits	Type of usage (data element 5)
1	2 bytes	Set information (data element 4) <numbers of parts in item> and <ordinal part number>, the first stored in the low byte and the second in the next byte
3	16 bytes	This field may contain the empty string or the primary item identifier (data element 1) if it is maximum 16 bytes. Otherwise, the first byte is 01_{HEX}, and the primary item identifier shall be encoded in the library extension block.
19	2 bytes	This field shall contain the CRC, which is not a data element, but a value calculated as part of the encoding. The purpose is to detect reading and writing errors. CRC-16-CCITT shall be used with $x^{16} + x^{12} + x^5 + 1$ polynomial and FFFF as start value. The CRC shall be calculated starting from the lowest address and skipping the two CRC bytes. See special remark in the following field.
21	11 bytes	This field may contain the empty string or the owner institution (ISIL) (data element 3), in which case the first two bytes shall be a two-character country code or a one-letter non-country code followed by a blank. The following bytes shall be the unit identifier. The country code, the non-country code and the unit identifier are defined in ISO 15511. The hyphen specified in ISO 15511 shall not be encoded. If the third byte is 01_{HEX}, the owner institution (ISIL) (data element 3) shall be encoded in the library extension block; in this case the value of the other bytes in the field is undefined. If the third byte is 02_{HEX} or 03_{HEX}, the string starting from byte 4 shall be the alternative owner institution (data element 23); in this case the value of the first two bytes in the field is undefined. 02_{HEX} shall indicate a national standardized code not part of ISIL and 03_{HEX} shall indicate an institution code that is neither part of ISIL nor a national standard. Use of ISIL is highly recommended. The escape option should only be used in a transition period or if ISIL is irrelevant. Special remark: For CRC calculation this field shall be viewed as being 13 bytes long, i.e. the CRC calculation algorithm shall add two bytes 00_{HEX} to the end of the field.

[a] Start position of field given as byte number with bit number in parentheses. If bit number is not given, 0 is assumed.

[b] Length of field measured in bytes or bits.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4.

7.3 Special blocks

The layout specified in 5.3 operates with two special blocks, each 1 byte of size.

Table 4 specifies the usage and layout of these special blocks.

Table 4 — Usage and layout of the special blocks

Block name	Description	Encoding
End block	If there is room left on the tag, this block shall be added to signal the end of the data.	1 byte = 00_{HEX}
Filler data block	The block may be used to align other data blocks on page boundaries. If necessary multiple instances may be used.	1 byte = 01_{HEX}

7.4 Structured extension blocks

7.4.1 Usage of structured extension blocks

Structured extension blocks are used as a supplement to the basic block to encode the full set of data elements specified in ISO 28560-1.

It is permissible to have two or more structured extension blocks of the same type (i.e. with same data block ID).

7.4.2 Format of structured extension blocks

Structured extension blocks use a frame structure of 4 bytes to specify length, type and checksum. The general structure of the extension blocks is:

<length ><data block ID><XOR checksum>(<data field><end block>)*

Data fields have to occur in the order specified for the specific structured extension block. A data field may be empty. In this case, it shall be filled with 00_{HEX}.

It is permissible to limit the structured extension block size by any length, in which case data fields that reach beyond this limit can be truncated or omitted. If so the missing data is assumed to be bytes with value 00_{HEX}.

It is also permissible to specify a larger size than the data field requires. If so, the redundant part of the structured extension block is filled with 00_{HEX}.

7.4.3 Length

The length specifies the number of bytes of the extension block. The value shall be greater than 4 and shall specify all bytes in the extension block, including the length byte itself.

The length is encoded as an 8-bit unsigned integer.

7.4.4 Data block ID

The data block ID identifies the structured extension block.

The data block ID is encoded as a 16-bit unsigned integer with least significant byte (lsb) stored at the lowest memory location.

Values:

1: Library extension block

2: Acquisition extension block

3: Library supplement block

4: Title block

5: ILL block

6 to 100: Other structured extension blocks (for future use)

7.4.5 Checksum

7.4.5.1 General

The checksum is a value calculated from the bytes in the extension block and used to verify the encoding.

7.4.5.2 Calculating the checksum

Set the checksum field to 00_{HEX}, then calculate the XOR for all bytes including length, ID and checksum. Store this value in the checksum field.

7.4.5.3 Verifying the checksum

Calculate the XOR for all bytes including length, id and checksum field. The result shall be 00_{HEX}.

7.5 Library extension block

This block contains three data fields. It may be used as a supplement to the basic block for specification of media format and for item and institution identification.

Table 5 specifies the usage and layout of the library extension block.

Table 5 — Usage and layout of the library extension block

Position[a]	Length[b]	Content of field[c]
0	1	Length
1	2	Data block ID (=1)
3	1	XOR checksum
4	1	Media format (other) (data element 19).
5	Variable	This field may be empty or it may contain the primary item identifier (data element 1), or the alternative item identifier (data element 22). Please note that the primary item identifier should be stored in the basic block if possible.
First free byte[d]	Variable	This field may be empty or it may contain the owner institution (ISIL) (data element 3), or the alternative owner institution (data element 23). Please note that these data elements should be stored in the basic block if possible. The owner institution (ISIL) shall be encoded as a string according to ISO 15511 (ISIL), i.e. <prefix><hyphen><unit identifier> The alternative owner institution shall be encoded as a string preceded by 02_{HEX} (specifying a national standardized code not part of ISIL) or 03_{HEX} (specifying a code that is neither part of ISIL nor a national standard).

[a] Start position of field given as byte number.

[b] Length of field measured in bytes.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4. Note that for variable length fields, one byte 00_{HEX} shall be inserted between each field.

[d] First byte after the terminating 00_{HEX} of the preceding variable length field.

7.6 Acquisition extension block

This block contains six data fields. It may be used to hold information relevant for the acquisition phase.

Table 6 specifies the usage and layout of the acquisition extension block.

Table 6 — Usage and layout of the acquisition extension block

Position[a]	Length[b]	Content of field[c]
0	1	Length
1	2	Data block ID (=2)
3	1	XOR checksum
4	Variable	This field may be empty or it may contain the supplier identifier (data element 9).
First free byte[d]	Variable	This field may be empty or it may contain the product identifier local (data element 18).
First free byte[d]	Variable	This field may be empty or it may contain the order number (data element 10).
First free byte[d]	Variable	This field may be empty or it may contain the supplier invoice number (data element 21).
First free byte[d]	Variable	This field may be empty or it may contain the GS1 product identifier (data element 13).
First free byte[d]	1	Supply chain stage (data element 20).

[a] Start position of field given as byte number.

[b] Length of field measured in bytes.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4. Note that for variable length fields, one byte 00_{HEX} shall be inserted between each field.

[d] First byte after the terminating 00_{HEX} of the preceding variable length field.

7.7 Library supplement block

This block contains four data fields. It may be used to hold additional information on an item.

Table 7 specifies the usage and layout of the library supplement block.

Table 7 — Usage and layout of the library supplement block

Position[a]	Length[b]	Content of field[c]
0	1	Length
1	2	Data block ID (=3)
3	1	XOR checksum
4	Variable	This field may be empty or it may contain the shelf location (data element 6).
First free byte[d]	Variable	This field may be empty or it may contain the MARC media format (data element 8).
First free byte[d]	Variable	This field may be empty or it may contain the ONIX media format (data element 7).
First free byte[d]	Variable	This field may be empty or it may contain the subsidiary of an owner institution (data element 24).

[a] Start position of field given as byte number.

[b] Length of field measured in bytes.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4. Note that for variable length fields, one byte 00_{HEX} shall be inserted between each field.

[d] First byte after the terminating 00_{HEX} of the preceding variable length field.

7.8 Title block

This block contains one data field. It may be used to hold title information to an item.

Table 8 specifies the usage and layout of the title block.

Table 8 — Usage and layout of the title block

Position[a]	Length[b]	Content of field[c]
0	1	Length
1	2	Data block ID (=4)
3	1	XOR checksum
4	Variable	This field may be empty or it may contain the title (data element 17).

[a] Start position of field given as byte number.

[b] Length of field measured in bytes.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4. Note that for variable length fields, one byte 00_{HEX} shall be inserted between each field.

7.9 ILL block

This block contains three data fields. It may be used to hold information relevant for interlibrary loan.

Table 9 specifies the usage and layout of the ILL block.

Table 9 — Usage and layout of the ILL block

Position[a]	Length[b]	Content of field[c]
0	1	Length
1	2	Data block ID (=5)
3	1	XOR checksum
4	Variable	This field may be empty or it may contain the ILL borrowing institution (ISIL) (data element 11). The ILL borrowing institution (ISIL) shall be encoded as a string according to ISO 15511 (ISIL), i.e. <prefix><hyphen><unit identifier>
First free byte[d]	Variable	This field may be empty or it may contain the ILL borrowing transaction number (data element 12).
First free byte[d]	Variable	This field may be empty or it may contain the alternative ILL borrowing institution (data element 25). The alternative ILL borrowing institution shall be encoded as a string preceded by 02_{HEX} (specifying a national standardized code not part of ISIL) or 03_{HEX} (specifying a code that is neither part of ISIL nor a national standard).

[a] Start position of field given as byte number.

[b] Length of field measured in bytes.

[c] Content of field. For data elements, refer to Table 1 and for string and integer encoding, refer to 5.4. Note that for variable length fields, one byte 00_{HEX} shall be inserted between each field.

[d] First byte after the terminating 00_{HEX} of the preceding variable length field.

7.10 Unstructured extension blocks

7.10.1 Usage of unstructured extension blocks

For these blocks it is up to the local or national level to profile the selection and order of local data elements and other data elements.

Local data elements from ISO 28560-1:

Local data A

Local data B

Local data C

Other data elements not part of ISO 28560-1 may be specified on a local or national level.

7.10.2 Format of unstructured extension blocks

An unstructured extension block shall be identified by a unique data block id greater than 100 to distinguish the blocks from the structured extension blocks (see 7.4.4).

Encoding is defined on a local or national level.

Annex A
(informative)

Information about ISO 28560 RFID in libraries

A.1 Informational website

The Danish Agency for Libraries and Media is hosting a website with additional information about ISO 28560:

http://biblstandard.dk/rfid

Danish Agency for Libraries and Media
Digital Development and Infrastructure
Copenhagen,
Denmark

Email: rfid@bs.dk

A.2 Types of support information

At the time of publication of ISO 28560, two items of information have been identified. These are listed below, together with the URL of the continually updated material.

— RFID in libraries. Links to external materials
http://biblstandard.dk/rfid/docs/RFID-in-libraries-Links-external

— RFID in libraries. Q&A http://biblstandard.dk/rfid/docs/RFID-in-libraries-q-and-a

Other material may be published in future, and this may be publicized and made available from the URL in A.1.

Annex B
(informative)

Encoding examples

B.1 Example 1, encoding of truncated basic block

Table B.1 gives an example of encoding of a truncated basic block (see 7.2).

The truncated mode is used for tags with only 256 bits (32 bytes).

Table B.1 gives an example with specific values of a set of data elements to be encoded in a truncated basic block. The data elements and the indexes in the content column refer to Table 1. The length and the encoding columns indicate the space occupied by and the hexadecimal value of the data elements for the given value.

Table B.1 — Example 1, data elements to be encoded

Content	Length	Value	Encoding (hex value)
2. Content parameter	4 bits	1	1
5. Type of usage	4 bits	1 (item for circulation)	1
4. Set information	2 bytes	Item 1 of 1	0101
1. Primary item identifier	16 bytes	1000000056	31303030303030303536000000000000
CRC	2 bytes		98A4
3. Owner institution (ISIL)	13 bytes	DK-718500	444B37313835303000000000

The example given in Table B.1 results in the memory map for the encoded tag, shown in the shaded area in Table B.2.

The page number column identifies the given page of the tag. The byte number column identifies the byte location on the tag. The dump column shows a graphical representation of the byte values.

Table B.2 — Example 1, memory map

Page number	Byte number	Byte value hex	Byte value hex	Byte value hex	Byte value hex	Dump
0	0 to 3	11	01	01	31	. . . 1
1	4 to 7	30	30	30	30	0 0 0 0
2	8 to 11	30	30	30	35	0 0 0 5
3	12 to 15	36	00	00	00	6 . . .
4	16 to19	00	00	00	98	. . . ˜
5	20 to 23	A4	44	4B	37	¤ D K 7
6	24 to 27	31	38	35	30	1 8 5 0
7	28 to 31	30	00	00	00	0 . . .

B.2 Example 2, encoding of basic block and structured extension blocks

The example shows encoding of a basic block, a library extension block and an acquisition extension block on a tag.

The basic block is described in 7.2. Structured extension blocks are described in 7.4.

Table B.3 gives an example with specific values of a set of data elements to be encoded in a truncated basic block and two extension blocks. The data elements and the indexes in the content column refer to Table 1. The length and the encoding columns indicate the space occupied by and the hexadecimal value of the data elements for the given value.

The example requires a tag with at least 608 bits (76 bytes). In this case the basic block is 272 bits (34 bytes).

Table B.3 — Example 2: data elements to be encoded

Content	Length	Value	Encoding (hex value)
2. Content parameter	4 bits	1	1
5. Type of usage	4 bits	1 (item for circulation)	1
4. Set information	2 bytes	Item 1 of 1	0101
1. Primary item identifier	16 bytes	1000000136	31303030303030313336000000000000
CRC	2 bytes		3615
3. Owner institution (ISIL)	13 bytes	DK-718500	444B37313835303000000000
Length	1 byte	5 bytes	05
Data block ID	2 bytes	1 (library ext. block)	01 00
XOR checksum	1 byte		05
19. Media format (other)	1 byte	1 (book)	01
Length	1 byte	34 bytes	22
Data block ID	2 bytes	2 (acquisition ext. block)	02 00
XOR checksum	1 byte		71
9. Supplier identifier	10 bytes	Bogvognen	426F67766F676E656E00
18. Product identifier local	11 bytes	1234567890	3132333435363738393000
10. Order number	1 byte	Empty	00
21. Supplier invoice number	9 bytes	a789656c	613738393635366300
The shading of the table indicates the block type: basic block library extension block acquisition extension block			

The example given in Table B.3 results in the memory map for the encoded tag shown in the shaded area in Table B.4.

The page number column identifies the given page of the tag. The byte number column identifies the byte location on the tag. The dump column shows a graphical representation of the byte values.

Table B.4 — Example 2: memory map

Page number	Byte number	Byte value hex	Byte value hex	Byte value hex	Byte value hex	Dump
0	0 to 3	11	01	01	31	. . . 1
1	4 to 7	30	30	30	30	0 0 0 0
2	8 to 11	30	30	31	33	0 0 1 3
3	12 to 15	36	00	00	00	6 . . .
4	16 to 19	00	00	00	36	. . . 6
5	20 to 23	15	44	4B	37	. D K 7
6	24 to 27	31	38	35	30	1 8 5 0
7	28 to 31	30	00	00	00	0 . . .
8	32 to 35	00	00	05	01	. . . .
9	36 to 39	00	05	01	22	. . . "
10	40 to 43	02	00	71	42	. . q B
11	44 to 47	6F	67	76	6F	o g v o
12	48 to 51	67	6E	65	6E	g n e n
13	52 to 55	00	31	32	33	. 1 2 3
14	56 to 59	34	35	36	37	4 5 6 7
15	60 to 63	38	39	30	00	8 9 0 .
16	64 to 67	00	61	37	38	. a 7 8
17	68 to 71	39	36	35	36	9 6 5 6
18	72 to 75	63	00	00	00	c . . .

Annex C
(normative)

Cyclic redundancy check (CRC)

C.1 Specification

The CRC-16-CCITT shall be used.

C.2 Example

The string “RFID tag data model” gives the CRC value 1AEE, that shall be encoded with EE at the lowest memory location and 1A at the next memory location.

C.3 Example code

```
const int crc_poly=0x1021;
int crc_sum;
void update_crc(int c)
{
int i;
bool xor_flag;
c<<=8;
for(i=0; i<8; i++)   {
      xor_flag=((crc_sum ^ c) & 0x8000)!=0;
      crc_sum = crc_sum << 1;
      if (xor_flag) crc_sum = crc_sum ^ crc_poly;
      c = c << 1;
      }
crc_sum&=0xffff;
}
…
crc_sum=0xffff;
call “update_crc(byte);” for each data byte
```

Annex D
(informative)

Reading optimization

D.1 General

Any application should be capable of reading any tag conforming to this part of ISO 28560.

D.2 Fast reading

When the “primary item identifier” is 12 bytes or less, it is possible to make a faster but less reliable reading. Read the first 16 bytes and verify that the last byte is 00_{HEX}.

This way of reading the RFID tag cannot verify the CRC as defined in this part of ISO 28560. It is also not possible to verify if the item belongs to the library or if it is a non-library tag.

D.3 Optimized reading

When the owner institution (ISIL) data element is 10 bytes or less, the full basic block header can be read and checked by reading 32 bytes. In this case, it should be verified that the last byte is 00_{HEX}.

D.4 Structured or unstructured extensions

Any application should normally be able to handle any item by just reading the basic block. However, an increased speed or service level may be provided if the correct extensions are present.

Annex E
(informative)

Guidelines for regional profiling

Regional profiles may specify:

— that certain structured data blocks be used;

— that certain structured data blocks not be used;

— that certain optional data elements in the basic block or in structured extension blocks be used;

— that certain optional data elements in the basic block or in structured extension blocks not be used;

— that unstructured extension blocks be used;

— that certain data elements require write protection.

Bibliography

[1] DS/INF 163-1, *RFID-datamodel i biblioteker — RFID Data Model for Libraries*

[2] ISO 15511 *Information and documentation — International standard identifier for libraries and related organizations (ISIL)*

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