
**Coding for radio frequency
identification (RFID) tyre tags**

*Codage de tags d'identification des pneumatiques par radio
fréquence (RFID)*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes data construction best practices, processes and methods for tyre identification, verification, traceability and product characteristics. An extensive effort has been undertaken to make data interchangeable between 2D (e.g. Data Matrix/QR Code) optical symbols and electronic media like RFID to permit the user to select the appropriate technology with a minimum impact on information technologies (IT) infrastructures. These technologies complement each other and may be used jointly or separately as the application can require. This document is focused on the application of RFID to achieve these ends.

The provisions in this document are intended to express the minimum requirements for passive RFID tags and are not intended to limit the development of the technology in the future.

This document also provides guidance to tyre manufacturers on using RFID tags for tyre identification during the manufacturing process or in the aftermarket (i.e. RFID patch application) in tyres, service life and for other purposes. Tyre dealers and retreaders may also use RFID tags for inventory and retread control of tyres, and fleets may use them for tyre record keeping, tyre performance analysis, maintenance and inventory control.

The use of an RFID tag in tyre application follows strict rules in order that the data format can be used globally within the tyre and transportation industries.

This standardization will allow for interoperability and the use of interchangeable hardware and software from multiple suppliers resulting in greater efficiencies.

This document:

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- specifies the air interface standards required between the RFID interrogator (also known as a reader) and RFID tag;
 - specifies the use of industry recognized GS1 codes;
 - clarifies the role of the company prefix;
 - specifies the semantics and data syntax to be used in the data construction for MB01;
 - provides a unique item identifier for traceability (UII, stored in MB01);
 - provides information on the use of the UII in MB01 as the link to database infrastructures;
 - specifies the option for user memory bank (MB11).

This document is based on the requirements in the following:

- technology: only passive ultra high frequency (UHF) RFID tags are used;
- global interface: the air interface protocol is ISO/IEC 18000-63, which is equivalent to GS1 EPC Gen2 V2.0.1.

A unique item identifier (UII) is not the same as a part number, a DOT tire identification number (TIN), a CCC code, a branded ID, or other names for tyres. Foremost in making an ideal UII is to know who made the part. Because of this, the UII is often referred to as the “birth record”. A constraint with internally-derived numbering schemes is that they are only unique to the domain owner; they may have duplicates within the “world”, and rarely communicate intelligently who the owner actually is (outside of their domain). In order to clearly identify who, there must be a globally recognized register of companies. That is where GS1 play a key role.

The international role of the GS1 is to register companies and issue assigned company prefixes, much the same way that cell phones have assigned company IDs as provided by international telecommunications agencies.

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Coding for radio frequency identification (RFID) tyre tags

1 Scope

This document specifies the terms and definitions, general requirements and data structure for coding radio frequency identification (RFID) tyre tags.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 18000-63, *Information technology — Radio frequency identification for item management — Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C*

ISO/IEC 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO 20909, *Radio Frequency Identification (RFID) tyre tags*

GS1 EPC™ Tag Data Standard¹⁾

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 and ISO 20909 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

memory bank

MB

designated name of a segmented memory structure

Note 1 to entry: ISO/IEC 18000-63 compliant tags have 4 (four) individually usable memory banks, numbered Memory Bank 00(MB00), Memory Bank 01(MB01), Memory Bank 10(MB10), Memory Bank 11(MB11). See [Table 1](#).

3.2

company prefix

CP

number code of the tyre manufacturer provided by GS1 and encoded in SGTIN

1) This standard defines the Electronic Product Code™, and also specifies the memory contents of Gen 2 RFID Tags. In more detail, the Tag Data Standard covers two broad areas: the specification of the Electronic Product Code, including its representation at various levels of the EPC global Architecture and its correspondence to GS1 keys and other existing codes, and the specification of data that is carried on Gen 2 RFID tags, including the EPC, “user memory” data, control information, and tag manufacture information.

3.3
global trade item number
GTIN

unique identifier for trade items used to look up product information in a database

3.4
serial number

number indicating place in a series and used as one of the components of the *unique item identifier* (3.6)

3.5
serialized global trade item number
SGTIN

electronic product code (3.7) including *GTIN* (3.3) and *serial number* (3.4) of a single trade item

3.6
unique item identifier
UII

birth record

unique identifier for a physical item that in this case is a tyre

Note 1 to entry: It refers to the unique identifier written into MB01 of the tyre RFID in this document.

Note 2 to entry: Item refers to products, transportation units, recyclable assets and services.

3.7
electronic product code
EPC

globally unique *serial number* (3.4) that identifies an object in the supply chain

Note 1 to entry: EPCs are administered by GS1.

3.8
lock
locking

ability of the tag protocol to cause:

- the reserved *memory bank* (3.1) MB00 to be read and write protected,
- the UII memory bank MB01 to be write protected,
- the user memory bank MB11 to be write protected

Note 1 to entry: Once “locked,” that memory bank can only be changed back to “readable / writable” by using the access password.

3.9
permalock

ability of the tag protocol to cause a *memory bank* (3.1) to be locked permanently

Note 1 to entry: Once “permalocked,” that memory bank cannot be unlocked whatever the access password.

3.10
Tag ID
TID

globally unique serialized identification of the individual silicon chip programmed and locked by the silicon manufacturer

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4 General requirements

4.1 Memory banks and data structure organization

This clause defines details for tyre application.

Data structure organization shall conform to protocol ISO/IEC 18000-63.

Data structure organization divides the tag memory storage into (four) memory banks (see [Table 1](#)) which are represented in [Annex A](#).

Table 1 — Memory bank use

Binary	Memory bank	Use
00	RESERVED	This memory bank is the password management memory bank and contains access password and kill password.
10	TID	TID is unique part and serial number of the RFID tag and permanently locked by the chip manufacturer. This memory bank is not used by tyre manufacturers and is locked by chip manufacturer. It is not described in this document.
01	UII	The unique item identifier is written within this memory bank under the responsibility of the tyre manufacturer.
11	User memory	The user memory is optional. Whenever available, stakeholders can use it under their own responsibility.

4.2 UII memory bank (MB01)

For tyre applications, UII shall be coded using SGTIN-96 (96 bits - serialized global trade item number) as per GS1 EPC Tag Data Standard.

The size of MB01 is limited and its purpose is to contain the name (UII, birth record) by which the Tag (and the tyre to which it is associated) is known.

The UII in MB01 is programmed one time when the tag is commissioned and then the content of MB01 is permalocked. This is the information used for asset identification, control and tracking purposes and accessibility to authorized databases remotely or on a local device.

It is the responsibility of the tyre manufacturer installing and programming the tag's birth record (the process is known as "commissioning") to properly follow the rules for "naming" the tyre and placing that information into the UII section of MB01.

Once commissioned, the UII shall remain unchanged within the tag.

4.3 RFID technical specification

4.3.1 UII memory bank MB01 size

For tyre application, the minimum size of the UII memory bank MB01 shall allow 96 bit SGTIN encoding.

4.3.2 Security/Locking data (Permalock command)

The kill function shall be disabled before leaving the tyre manufacturer facilities in accordance with ISO/IEC 18000-63. Kill password has to be set to 00000000h and permalocked.

Once the UII data has been written into MB01, this memory bank shall be permalocked.

The access password can be either:

- unlocked (readable), or
- locked or permalocked (unreadable).

The latter may mean that there is additional information regarding the product in the user memory bank (MB11) or in a database. In that case, UII (SGTIN 96) only refers to the original casing of the product and might not be directly decoded as the product identity anymore.

In the case of retreaded tyres, the retreader can lock (or permalock) the access password (if this has not already been done by another stakeholder). This should make the reader aware that additional information (about the retreader) can be found in a database. The content of UII memory bank MB01 (encoded with SGTIN 96), that only refers to the original casing of the product, might not be directly decoded as the product identity anymore.

4.3.3 Numbering system identifier

Bit 17_h of the stored PC shall be set to 0 in order to conform to GS1 EPC Global requirements.

5 Memory banks

5.1 MB00 (Reserved memory bank)

MB00 is the password management memory bank that contains:

- access password,
- kill password.

5.2 MB01 (UII memory bank)

MB01 is UII memory bank, which contains the following data:

- CRC: calculated 16 bits checksum on the tag for data verification on the air interface from address 00_h to $0F_h$;
- stored PC, a 16 bits protocol control word which contains several data fields, including:
 - L: length of the UII stored in 10_h – 14_h ,
 - T (numbering system identifier toggle, bit 17_h): bit 17_h has to be set to 0_2 as per GS1 EPCglobal™²⁾ application and PC bits 18_h – $1F_h$ shall be as defined in this protocol,
 - UII field: contains the UII starting at address 20_h .

5.3 MB10 (TID memory bank)

TID is a unique part and serial number of the RFID tag and is permanently locked by the chip manufacturer.

5.4 MB11 (User memory bank)

The MB11 is optional. Whenever available, stakeholders can use it under their own responsibility.

2) This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

6 Data structure for unique item identifier (UII)

The minimal data elements to meet item identification shall follow the GS1 EPC Global Coding Scheme for Item Identification (SGTIN-96) (see [Table 2](#) and [Table 3](#)); Identification of the tagged object is accomplished via the UII.

A 96-bit UII (SGTIN-96) shall be used and permalocked after commissioning.

Table 2 — Data structure in MB01

EPC GS1 SGTIN-96	UII					
	Header	Filter value	Partition	Company prefix	Item reference	Serial number
Length (bits)	8	3	3	20 to 40	24 to 4	38
Example						
Value (binary)	0011 0000	000	010 (for 34 bits GS1 Company prefix and 10 bits item reference)	010...01 (34 bits)	010...01 (10 bits)	010...01 (38 bits)

The SGTIN-96 format consists of the following data fields and has an overall length of 96 bits:

- header (8 bits): definition of the coding scheme, in which the structure and length of the actual EPC identifier are defined (e.g., SGTIN-96, global returnable asset identifier (GRAI), etc.). SGTIN-96 header value shall be 0011 0000₂;
- filter value (3 bits): provides a fast filtering to determine the item basic category. In this document, the filter value is 000₂ since tyre belongs to “other item” category;
- partition field (3 bits): contains a code that indicates the number of bits in the GS1 company prefix field and the indicator/item reference field;
- company prefix (20 – 40 bits): assigned by GS1 to a managing entity. The company prefix is the same as the company prefix digits within a GS1 GTIN in binary code;
- item reference (24 – 4 bits): assigned by the managing entity to a particular object class. The item reference for the purposes of EPC encoding is derived from the GTIN by concatenating (i.e. linking) the indicator digit of the GTIN and the item reference digits and treating the result as a single integer;
- serial number (38 bits): assigned by the managing entity to an individual object as a single integer.

UII (EPC) coding scheme for item based on GS1 SGTIN-96 is shown in [Table 3](#) (IAC is GS1).

NOTE The structure of [Table 3](#) follows GS1 EPC Gen2 V 2.0.1 and it is up to the entity applying this document to verify the compliance with the latest version of GS1 EPC UHF Gen2 Air Interface Protocol.