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Gas cylinders — Identification and marking using radio frequency identification technology —

Part 2: Numbering schemes for radio frequency identification

Bouteilles à gaz — Identification et marquage à l'aide de la technologie d'identification par radiofréquences —

Partie 2: Schémas de numérotage pour identification par radiofréquences

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Foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This third edition cancels and replaces the second edition (ISO 21007-2:2013), which has been technically revised with the following changes:

— a new registration body has been added to Annex B;

— a new Annex E has been added;

— the former Annex C, which provided a list of RFID codes, as well as marks for gas cylinder manufacturers, has been removed from this part of ISO 21007 and will be published in a separate document, ISO/TR 17329.

ISO 21007 consists of the following parts, under the general title *Gas cylinders — Identification and marking using radio frequency identification technology*:

— *Part 1: Reference architecture and terminology*

— *Part 2: Numbering schemes for radio frequency identification*

Introduction

Cylinders can contain a wide variety of gases, and identification is of paramount importance. It could be desirable to identify not only the type of gas or liquid contained in the GC, but also such details as the filling station where the cylinder was filled, the batch of cylinders filled and the date the cylinder was filled.

Various methods and technologies such as physical identification through indentation; paper, card, metal and plastic labelling; colour code identification; bar coding and, in some circumstances, vision systems are already used to make or assist such identifications.

The technology of radio frequency identification (RFID) involves a reader/interrogator station that transmits a predetermined signal of inductive, radio or microwave energy to one or many transponders located within a read zone. The transponder returns the signal in a modified form to the reader/interrogator and the data are decoded. The data component in a portable gas or liquid cylinder environment provides the basis for unambiguous identification of the transponder and also can provide a medium for a bi-directional interactive exchange of data between the reader/interrogator and transponder. The signal can be modulated or unmodulated according to architecture of the system.

Recently, RFID has started using new, higher frequencies called ultra high frequency (UHF). These higher frequencies facilitate a faster reading and writing process and deliver longer reading/writing distances. Therefore, the UHF band frequency has been included in this part of ISO 21007. The aim of this part of ISO 21007 is to provide the data structure respectively suitable for all frequency bands including UHF.

In many cases, it is necessary or desirable to use one air carrier frequency and protocol; however, this will not always be the case. Within a global market, different applications could require different solutions for the carrier frequency (e.g. reading distance and velocity) and protocols (e.g. security, company rule).

However, there is benefit in using a standard common core data structure that is capable of upwards integration and expandable from the simplest low-cost cylinder identification system to more complex functions. Such a structure will have to be flexible and enabling rather than prescriptive, thus enabling different systems degrees of interoperability within and between their host systems.

The use of Abstract Syntax Notation One (ASN.1, as defined in the ISO/IEC 8824 series) from ISO/IEC 8824-1 as a notation to specify data and its associated Packed Encoding Rules (PER) from ISO/IEC 8825-2 is widely used and gaining popularity. Its usage will provide maximum interoperability and conformance to existing standards and will meet the specifically defined requirements for a generic standard model for gas cylinder identification in that it

— enables and uses existing standard coding,

— is adaptable and expandable,

— does not include unnecessary information for a specific application, and

— has a minimum of overhead in storage and transmission.

RFID standards other than ASN.1, for definition of frequencies and protocols, have been developed within recent years [see ISO/IEC 18000 (all parts)].

ISO 21007-1 provides a framework reference architecture for such systems. This part of ISO 21007 is a supporting part to ISO 21007-1 and provides a standardized yet flexible and interoperable framework for numbering schemes. This part of ISO 21007 details individual numbering schemes within the framework for the automatic identification of gas cylinders.

Central to the effective use of many of the constructs is a structure to provide unambiguous identification. This part of ISO 21007 provides a standardized data element construct for the automatic identification of gas cylinders.

The inconvenience of such a flexible concept is that a large storage memory is needed, particularly if a large amount of information has to be stored and read directly from the RFID tag.

The following two alternatives could be used to address this issue:

— limit the information directly accessible on the RFID tag and obtain the additional information from the host (ERP system);

— use a fixed data structure and length as shown in Annex E, as this can minimize the storage demand.

This part of ISO 21007 is intended to be used under a variety of national regulatory regimes, but has been written so that it is suitable for the application of the UN Model Regulations.[1] Attention is drawn to requirements in the relevant national regulations of the country (countries) where the cylinders are intended to be used that might override the requirements given in this part of ISO 21007. Where there is any conflict between this part of ISO 21007 and any applicable regulation, the regulation always takes precedence.

Gas cylinders — Identification and marking using radio frequency identification technology —

Part 2: Numbering schemes for radio frequency identification

1 Scope

This part of ISO 21007 establishes a common flexible framework for data structure to enable the unambiguous identification in gas cylinder (GC) applications and for other common data elements in this sector.

This part of ISO 21007 enables a structure to allow some harmonization between different systems. However, it does not prescribe any one system and has been written in a non-mandatory style so as not to make it obsolete as technology changes.

The main body of this part of ISO 21007 excludes any data elements that form any part of transmission or storage protocols such as headers and checksums.

For details on cylinder/tag operations, see Annex A.

2 Normative references

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

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 13769, *Gas cylinders — Stamp marking*

ISO/TR 17329, *Gas cylinders — Identification of gas cylinder manufacturer marks and their assigned radio frequency identification (RFID) codes*

ISO 21007-1:2005, *Gas cylinders — Identification and marking using radio frequency identification technology — Part 1: Reference architecture and terminology*

ISO/IEC 8824-1:2008, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Part 1*

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*

ISO/IEC 18000-6, *Information technology — Radio frequency identification for item management — Part 6: Parameters for air interface communications at 860 MHz to 960 MHz General*

3 Terms, definitions and numerical notations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21007-1 and the following apply.

3.1.1
bit rates
number of bits per second, independent of the data coding

3.1.2
carrier frequency
centre frequency of the downlink/uplink band

3.1.3
construct
one or more primitive constructs to form an ASN.1 message

3.1.4
data coding
coding that determines the baseband signal presentation, i.e., a mapping of logical bits to physical signals

Note 1 to entry: Examples are bi-phase schemes (Manchester, Miller, FM0, FM1, differential Manchester), NRZ and NRZ1.

3.1.5
modulation
keying of the carrier wave by coded data described in accordance with commonly understood methodologies (amplitude shift keying, frequency shift keying)

3.1.6
octet
set of eight binary digits (bits)

3.1.7
power limits within communication zone
limits that determine the minimum and maximum values of incident power referred to a 0 dB antenna in front of the tag

Note 1 to entry: These two values also specify the dynamic range of the tag receiver. Power values are measured without any additional losses due to rain or misalignment.

3.1.8
registration body
organization entitled to issue and keep track of issuer identification

Note 1 to entry: For examples, see Annex B.

3.1.9
tolerance of carrier frequency
maximum deviation of the carrier frequency expressed as a percentage

3.2 Numerical notations

The numerical notations used in this part of ISO 21007 are as follows:

— decimal (“normal”) notation has no subscript, e.g. 127;

— hexadecimal numbers are noted by subscript 16, e.g. $7F_{16}$;

— binary numbers are noted by subscript 2, e.g. 01111111_2.

4 Data presentation

4.1 General requirements

The data element construct determined in this part of ISO 21007 is an “enabling” structure. It is designed to accommodate within its framework, data element constructs for a variety of GC applications, from simple GC identification to more complex transactions with a wide variety of uses, and to allow combinations of data elements to be used in a composite data construct. It is designed to allow as much interoperability of the data elements within an electronic data interchange/electronic data transfer (EDI/EDT) environment as is possible and has to provide a capability for a significant expansion of the number of GC applications in the future.

This part of ISO 21007 takes cognizance of and accommodates the operation of systems of different capabilities and will enable within its structure the interoperability of one transponder in any country, even though the operator systems themselves may be significantly different, so long as there is a common air interface (at reference point Delta) and protocol. Even where information has to be collected by a separate interrogator because air carrier compatibility does not exist, the data once collected is in a commonly interoperable format and so may be used accurately and effectively within an EDI/EDT environment.

The data element structure defined in this part of ISO 21007 specifies the general presentation rules for transfer of ASN.1 data schemes. It is also the purpose of this part of ISO 21007 to determine how ASN.1 will be used for data transmission in GC applications.

Excluding transfers in a predefined context, the first level of identification required in ASN.1 messages identifies the context of the message. This part of ISO 21007 determines that in GC applications this is achieved by using an object identifier that shall be determined in accordance with an arc determined in ISO/IEC 8824-1:2008, Annex B.

The objective of this part of ISO 21007 is therefore to establish a basis where the message can always be identified simply by reference to the relevant standard and without the requirement of central registration authorities (except where those are specifically required in the referred-to document).

4.2 ASN.1 messages

Where there is a simple message where no further subdivision according to ASN.1 rules is possible, the message is called an ASN.1 “primitive message”. Such messages will have only one identification and length statement. The GC identification structure defined in ISO 21007-1:2005, Clause 3 is an ASN.1 primitive message.

4.3 Message identification requirements

The data constructs shall conform to ISO/IEC 8824-1.

With the exception of transfers in a predetermined context (see 4.4):

— All GC standard ASN.1 messages shall commence with a unique object identifier that shall be determined in accordance with the arc 2 (joint ITU-T), followed by the object class indicating a standard arc 0, followed by the reference to the standard:

{ ITU-T)(2) standard(0) standardxxx(yyy) }

— Where the data content relates to standards produced by other identified organizations, they shall commence with a unique object identifier that shall be determined in accordance with the arc 2 (joint ITU-T), followed by the identification of an identified organization arc 3, followed by the identification of the identified organization (as provided in Annex B), followed by the object class indicating a standard arc 0, followed by the reference to the standard:

{ ITU-T(2) identified-organization (3) organization-identity(xxx) standard(0) standardxxx(zzz) }

4.4 Predetermined context and the use of packed encoding rules

Where the context of a transfer is known, the data constructs determined in this part of ISO 21007 may be assumed to be in accordance with the rules determined in ISO/IEC 8825-2.

In respect of any identification of an item using an ISO ASN.1 message, the data necessary for unambiguous identification shall reside on the on-board equipment associated with the item being identified.

4.5 Sample GC data structure constructs

The ISO complete ASN.1 format is as follows:

octet 0	octet 1	octet 2	octet 3–4	octet 5-xx
02_{16}	20_{16}	00_{16}	ISO standard reference	GC identification structure

The predetermined GC context follows:

octet 0-yy
GC identification structure

5 Gas cylinder identification structure (variable)

5.1 General requirements

The general requirement of the structure proposed shall be that it is constructed from one or more data elements to form an ASN.1 message.

Each of these data elements shall be preceded by 2 octets that identify

a) the data scheme identifier (also referred to as DSI), and

b) the length of the data field.

Data scheme identifier (1 octet)	Length of data field (1 octet)	Data field

This part of ISO 21007 has been designed by adopting the principles of ISO/IEC 8824-1 and ISO/IEC 8825-2, which utilize octets (bytes) of data elements to provide an application identifier, a coding identifier and a length/use identifier in an “abstract syntax notation” for “open systems interconnection”.

By adopting the ISO/IEC 8824-1 and ISO/IEC 8825-2 abstract syntax notation with the inclusion of a data element length indicator, the flexibility is provided for data elements of any length to be supported. This data structure standard is itself given a migration path so that as technological developments allow further capabilities, subsequent standards may provide additional data fields for use in all or some sector-specific applications while maintaining the upwards compatibility from and to this part of ISO 21007.

The structure enables the chaining of multiple data elements from different application sectors to build complex data element constructs. For example, a GC identification shall be followed by an ISO country code, or perhaps a GC identification followed by a transient data set of the current contents, fill date and location followed by a country identifier, etc.

It is expected that several data element structures will start with a GC identification data element.

5.2 Data structure construct

5.2.1 General

The data structure construct is as follows:

Data scheme identifier	Length of data field	Data field	Data scheme identifier	Length of data field	Data field

5.2.2 Data scheme identifier (DSI)

The octet used for the data scheme identifier shall be used to identify to which of the standardized GC coding scheme data formats the data element construct conforms.

Each number issued shall be supported by an ISO format standard detailing the data scheme that is to be used within that format.

NOTE Clause 6 details the initial list of primitive data scheme allocations.

5.2.3 Length

The length octet shall determine the number of octets in the subsequent data fields. It shall be a length indicator as defined in ISO/IEC 8825-2.

For coding, this field will be kept to less than 127, i.e. 1-byte length is expected. For constructs, the extension bit may be used to signify a 3-byte length indicator.

5.2.4 Data field

The data field shall follow the number of octets of data that comprises the data field as determined in the previous octet.

The data structure of the data field shall be defined in a series of standard data formats issued and published by the gas cylinder data scheme issuing authority and forming subordinate standards in support of this part of ISO 21007.

This field may also contain constructs of primitives as defined in ISO/IEC 8824-1 and ISO/IEC 8825-2.

6 Gas cylinder identification data schemes (variable)

6.1 General requirements

The essence of the general requirement of GC systems is constructed around a basic core unambiguous identification. This GC identification numbering scheme provides a “fixed” core unambiguous identification element.

It is envisaged that this core element of unambiguous identification will form the first data set of one or many data sets in a GC environment using data structures that comply with the structure established in ISO 21007-1.

Either data scheme “01” or data scheme “02” shall be used in accordance with 6.2 or 6.3, respectively. In addition, data schemes “10”, “11”, “12”, etc., may optionally be used (see Table 1).

This data structure is designed to be used not only as a form for simple GC identification, but to form the GC identification element of all standard GC messages where GC identification is a component. To this extent, while this part of ISO 21007 has been primarily designed for use in a transponder/interrogator environment, it is expected that other GC systems, while they use different transmission media and effect similar data exchanges, shall adopt this standard numbering scheme.

Table 1 — GC primitive data scheme identifiers

Data scheme number	Data scheme identifier	GC data scheme
0	40_{16}	Non-standard scheme
01	41_{16}	GC numbering scheme (binary)
02	42_{16}	GC numbering scheme (ASCII)
10	$4A_{16}$	GC manufacturer information
11	$4B_{16}$	GC approval information
12	$4C_{16}$	GC package information
13	$4D_{16}$	GC content information
14	$4E_{16}$	GC commercial product information
15	$4F_{16}$	GC production lot information
16	50_{16}	GC accessories information
20	54_{16}	GC acetylene specifics

This compact numbering data scheme can be replaced or combined with a more versatile identification scheme allowing the use of existing non-numeric gas cylinder identifications. This alternate unambiguous identification data set will be given the DSI appellation: data scheme "02".

Other data schemes concerning the package and content of gas cylinders proposed in 6.4 to 6.11 provide capability for other applications that simplify GC identification.

The data scheme identifier (DSI) is described in Table 1; the length is the number of bits of the information field. 6.2 to 6.11 give some examples for the content of these data schemes. 6.2 and 6.3 describe the minimum definition for the unique identification number of a GC. The choice is between a binary (6.2) and an ASCII (6.3) version. All other definitions in 6.4 to 6.11 are optional.

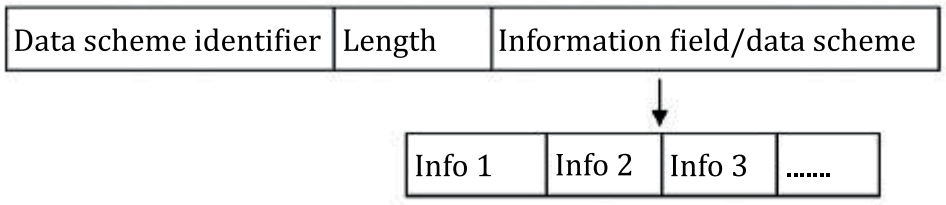

Figure 1 — Flow chart for principles of 6.2 to 6.11

6.2 Data scheme "01": numbering (binary)

6.2.1 General

If data scheme "01" is used, the unique number shall be coded in binary format as indicated below.

The format provides a transponder code mandatory field providing specific adaptation to the requirements for GC identification in the GC environment.

The code length is 64 bits or more and will be preceded by 2 octets that identify, respectively, the GC DSI (i.e. 41_{16} primitive) and the code length in octets (i.e. 08_{16} or more).

The data scheme “01” structure is as follows:

Data scheme identifier	Length	Unique number data field
41_{16}	08_{16} or more	

The third field contains the GC unambiguous identification number.

The following structure details the elements and content of the unambiguous data structure and is to be read in conjunction with the notes shown following the structure.

To allow a large number of unique cylinder numbers, the unique number data field shall have the following structure:

ISO 3166-1 issuer country code	Registration body	Issuer identifier	Service number/unique number

6.2.2 Issuer country code

The issuer country code as specified by ISO 3166-1 is as follows:

	Bits	Variables	Type
(binary 0–4 095)	12	4 096	Binary

e.g., 276 for Germany.

6.2.3 Registration body

The registration body is as follows:

	Bits	Variables	Type
(binary 0–15)	4	16	Binary

e.g., 02 for EIGA (see Annex B).

6.2.4 Issuer identifier

The issuer identifier is as follows:

	Bits	Variables	Type
(binary 0–16 772 215)	24	16 772 216	Binary

e.g., 123 for gas supplier 123.

6.2.5 Unique number

A unique number within each country specified by ISO 3166-1 shall be allocated by a registration body (see Annex B).

	Bits	Variables	Type
(binary 0–16 772 215 or more)	24	16 772 216 or more	Binary

e.g., 12345678.

6.2.6 Conclusion

In the above example, the minimum information for the gas cylinder would be:

2760212312345678.