INTERNATIONAL STANDARD

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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

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 21007-2 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This second edition cancels and replaces the first edition (ISO 21007-2:2005). Only Annex C has been revised.

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

Throughout industry and in commerce, trade and the domestic sector, the employment of gas cylinders (referred to as GC in this part of ISO 21007) to enable the local consumption and use of gases and liquids, without the need for in-situ high cost permanent pressure vessel installations, is an important part of modern practice.

Such cylinders provide complex gas mixes for medical, industrial or research use.

As the cylinders can contain a wide variety of gases, identification is of paramount importance. It is mandatory to be able to uniquely identify each cylinder. As many contents are of limited life, and for product quality and liability tracking and tracing, in some circumstances it could be necessary or desirable to identify not only the type of gas or liquid, but also such details as filling station, batch and date of fill.

Various methods and technologies such as physical identification through indentation; paper, card, metal, and plastic labeling; 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 is 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 host and transponder. The signal can be modulated or unmodulated according to architecture of the system.

In many cases it will be necessary or desirable to use one air carrier frequency and protocol, but this will not always be possible or even desirable in all situations, and it could be useful to separate fundamentally different cylinders by the response frequency.

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 portable 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.

ISO 21007-1 provides a framework reference architecture for such systems. This part of ISO 21007 is a supporting part of 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.

Where there is any conflict between this International Standard 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 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 of 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 21007-1, *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*

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

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 A.

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 Annex B of ISO/IEC 8824-1:2008.

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 Clause 3 of ISO 21007-1:2005 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

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

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. can 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}	Nonstandard scheme
01	41_{16}	GC numbering scheme (binary)
02	42_{16}	GC numbering scheme (ASCII)

Data scheme number	Data scheme identifier	GC data scheme
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. Clauses 6.2 to 6.11 give some examples for the content of these data schemes. Clauses 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.

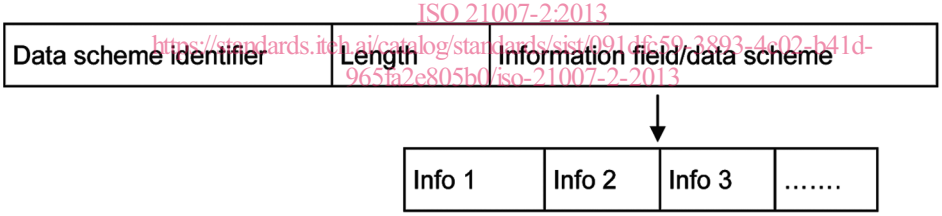

Figure 1 — Flow chart for principles of 6.2 to 6.11

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.

Unique number data field:

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	4096	Binary

6.2.3 Registration body

The registration body is as follows:

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

6.2.4 Issuer identifier

The issuer identifier is as follows:

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

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

6.3 Data scheme 02: numbering (ASCII)

6.3.1 General

If Data scheme 02 is used, the unique number shall be coded in ASCII 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 40 bits plus unique string length and will be preceded by 2 octets that identify, respectively, the GC DSI (i.e. 42_{16} primitive) and the code length in octets (i.e. 05_{16} plus string length).

The Data scheme 02 structure is as follows:

Data scheme identifier	Length	Unique number data field
42_{16}	05_{16} + string length	

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 following the structure.

The Unique number data field is as follows:

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

6.3.2 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

6.3.3 Registration body

The registration body is as follows:

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

6.3.4 Issuer identifier

The issuer identifier is as follows:

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

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

6.3.5 Unique string

A unique string provides a unique service/number issued by the operator. Strings should include alphanumeric characters only, excluding accented characters or special symbols such as " - " or blank (i.e. 26 roman uppercase alphabetic letters (A-Z) plus 10 (0-9) numeric characters) and shall be as follows:

	Bits	Variables	Type
(8 bit characters ASCII string)	48	2 176 782 336 or more	ASCII

6.4 Data scheme 10: cylinder manufacturer information (optional)

6.4.1 General

Data scheme 10 determines the form of the data field content, for GC identification for DSI 10 of ISO 27001-1. The Data scheme 10 structure is as follows:

Data scheme identifier	Length	Cylinder manufacturer information data field
$4A_{16}$	40_{16} or more	

The third field contains the cylinder manufacturer identification number and the manufacturing serial number of the cylinder.

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

The cylinder manufacturer information data field is as follows:

Manufacturer code	Manufacturer serial number

6.4.2 Manufacturer code

The manufacturer code is as follows:

	Bits	Variables	Type
(binary 0-65 535)	16	65 536	Binary

See Annex C.

6.4.3 Manufacturer serial number

The manufacturer serial number is an alphanumeric field allocated by the manufacturer and readable on the cylinder in accordance with ISO 13769.

	Bits	Variables	Type
(8 bit characters ASCII string)	4 8 or more	2 176 782 336 or more	ASCII

Strings should include alphanumeric characters only, excluding accented characters or special symbols such as " - " or blank. (i.e. 26 roman uppercase alphabetic letters (A-Z) plus 10 (0-9) numeric characters).

The recommended length of this DSI unique data element is 64 bits (with a 6-character manufacturer serial number) or more.