INTERNATIONAL STANDARD

ISO 21007-1

First edition
2005-07-15

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

Part 1: Reference architecture and terminology

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

Partie 1: Architecture de référence et terminologie

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

Reference number
ISO 21007-1:2005(E)

© ISO 2005

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

 © ISO 2005 – All rights reserved

Contents

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

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 21007-1 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

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.*

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

Introduction

Throughout industry and in commerce, trade and the domestic sector, the employment of gas cylinders 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 may provide complex gas mixes for medical, industrial or research use.

The cylinders are made and used in a wide variety of shapes and sizes. All are controlled by international, regional or national regulations in respect of safety, and all require clear marking, and periodic safety checks and maintenance under the provisions of regulations for pressure testing. The requirements for testing will vary according to the design of the cylinder and its contents.

Although manufactured to a specific design for a specific content, the life of such cylinders may be long, often exceeding 50 years. During that lifetime, the cylinders may be used to contain different materials at different fill pressures. As a consequence, the amount of material contained in the cylinders may also vary. It is possible that during this lifetime the regulatory framework permitting and controlling their use may also change.

As the cylinders may contain a wide variety of gases, identification is of paramount importance. It is often 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 may 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 of cylinder characteristics through stamp marking (for information, see ISO 13769); paint (for information, see ISO 32), paper (for information, see ISO 7225), card, metal, and plastic labelling; colour code identification; bar coding and, in some circumstances, other means 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 signal is returned in a modified form to the reader/interrogator and the data are decoded. The data component in a gas cylinder's environment provides the basis for unambiguous identification of the transponder and may also provide a medium for a bi-directional interactive exchange of data between the host and transponder. The signal may be modulated or unmodulated according to the 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 may 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 is expandable from the simplest low-cost cylinder identification system to the 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) from ISO/IEC 8824 and ISO/IEC 8825 as a data identifier structure 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 container identification in that it

— enables and uses existing standard codings,

— is adaptable and expandable,

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

— has a minimum of overhead in storage and transmission.

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

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

Part 1:
Reference architecture and terminology

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

1 Scope

This part of ISO 21007 establishes a common framework for data structure for unambiguous identification of single or manifolded gas cylinders and for other common data elements in this sector. It also serves as a terminology document in the area of radio frequency identification (RFID) technology.

The scheme and reference model architecture proposed is designed to be an enabling structure to allow some harmonization between different commercial systems and not prescriptive in determining any one system. It is not frequency or air interface protocol specific, provides maximum interoperability, has a high population capability and provides the possibility of upwards migration to more capable systems.

This part of ISO 21007 provides a reference structure within which the key core elements of the data structure form an unambiguous identification that may be used to identify the message as a message from a gas cylinder within an electronic data interchange (EDI) environment and provides an application reference identifying that different data structure is contained in the message. A wide variety of such systems can be supported within the structure determined in this part of ISO 21007 such as identification of specialty gases and different gas applications. Each such system may range from individual simple identification to identification of such factors as content, fill date, history of use, etc.

This part of ISO 21007 does not include the air interface or any aspect of the equipment, solely the data element structure. Subsequent parts of ISO 21007 will define the data structures for gas cylinders and for specific sectors of application.

The numbering scheme views the Identification (ID) as a data element, and the common basic data structure is defined as a data identifier code. The adoption of the Abstract Syntax Notification (ASN.1) structure in a form to meet the requirements of this and subsequent subordinate parts of ISO 21007 enables the ISO 21007 series of standards to meet its objectives of

— being adaptable and expandable,

— providing a migration path to enhancement and future developments,

— avoiding carrying unnecessary information for irrelevant applications in any data construct,

— using existing standard codings wherever possible, and

— carrying a minimum of overhead in storage and transmission.

© ISO 2005 – All rights reserved

2 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

2.1
address
character or sequence of characters designating the originating source or destination of data being transmitted

2.2
air interface
conductor-free medium, usually air, between a transponder and the reader/interrogator through which the linking of the transponder to the reader/interrogator is achieved by means of a signal of radio, microwave or inductive frequencies

2.3
antenna
structure for transmitting/receiving electromagnetic or radio signals

2.4
ASCII
American Standard Code for Information Exchange
standard form of bit encoding providing the identification of 128 standard keyboard characters

NOTE The standard ASCII character set is of 7 bits separated by 1 or 2 stop bits.

cf. **extended ASCII**

2.5
ASN.1
Abstract Syntax Notation One
International Standard for representing data types and structures

NOTE CCITT published the first version of the standard as x.409 in 1984. A newer version of ASN.1 resulting from a cooperative venture of CCITT and ISO was specified in x.208 (1988) of CCITT and ISO/IEC :1990. The latest version is specified in ISO/IEC 8824-1:2002 to ISO/IEC 8824-4:2002.

2.6
automatic equipment identification
system of identification for equipment that uses the surface transportation infrastructures by means of transponders and interrogators combined with the unambiguous data structure defined in this part of ISO 21007

2.7
automatic identification system
system for achieving accurate and unambiguous identification of a data bearing label, tag, transponder or a natural/prescribed feature, the data or feature being interrogated by means of a system-appropriate source

2.8
bit
binary digit, which can take the value 0 or 1

2.9
bits per second
bps
measure of the information transfer rate of a data channel

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.10
byte
sequential series of bits comprising one character and handled as one unit

NOTE A byte is comprised of 8-data bits plus a parity bit and represents either one alphabetic or special character, two decimal digits or eight binary bits. It is usually encoded in the ASCII format.

2.11
carrier signal
electromagnetic signal, usually a high-frequency sinusoid that can be modulated to carry lower frequency encoded information across an air interface

2.12
coding scheme identifier
CSI
prescribed list of reference identifiers that relate to prescribed coding schemes determined in this and subordinate standards and/or issued by the authorized numbering scheme administrator

2.13
CCITT
International Consultative Committee on Telephony and Telegraphy
part of the International Telecommunications Union, an agency of the United Nations

NOTE The principal members of CCITT are the world's public communications authorities (PTTs). CCITT issues recommendations that are not binding on its members, but in practice most PTTs, manufacturers and users accept and endorse CCITT standards.

2.14
compatibility
capability of two or more items or components of equipment or materiel to exist or function in the same system without modification, adaption or mutual interference

2.15
cyclic redundancy check
CRC
check sequence that is computed using each data bit in a block a number of times and is usually added to the end of the block, providing a method of detecting data transmission errors

2.16
data element structure
framework comprising a number of data elements in a prescribed form

2.17
data substitution
incorrect substitution of one legitimate character in place of another

2.18
duplex
method of communication capable of transmitting data in both directions

cf. **full duplex, half duplex** and **simplex**

2.19
electronic data interchange
EDI
passing of a data message or series of messages between computers and/or between different software systems

NOTE Within this context, an EDI message is normally compatible with the form specified in ISO 9897.

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.20
electronic data transfer
EDT
passing of data sets comprising an entire message from one computer to another or from one software system to another

2.21
environmental parameters
used to describe different environmental component properties/specifications

2.22
effective radiated power
ERP
product of the transmitter power in watts and the relative gain of a directional antenna as compared with a standard half-wave dipole

NOTE A transmitter producing 10 watts of power connected to an antenna with a gain factor of 9 has an effective radiated power of 90 watts. In a given direction, the relative gain of a transmitting antenna with respect to the maximum directivity of a half-wave dipole is multiplied by the net power accepted by the antenna from the connected transmitter.

2.23
extended ASCII
EBCDIC
standard form of bit encodation providing the identification of 256 characters; the first 128 of which are the standard **ASCII** character set with an eighth bit providing a further 128 characters that are user definable

NOTE The character set is of 8 bits separated by 1 stop bit.

2.24
fixed RFID equipment
equipment required to interrogate, receive and interpret the data in the on-board equipment (on-board transponders) in order to present the identification

2.25
full duplex
method of communication capable of transmitting data in both directions at the same time

2.26
function block
grouping of functional characteristics of a (sub)system

2.27
half duplex
method of communication capable of transmitting data in both directions but only in one direction at any time

2.28
hertz
measure of frequency equal to one cycle per second

2.29
interchangeability
condition that exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability and are capable of being exchanged without alteration of the items themselves or of adjoining items, and without selection for fit and performance

2.30
interoperability
ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.31
incorrect read
failure to read correctly all or part of a data set

2.32
inductive signals
electromagnetic signals, usually below 30 MHz, characterized by the use made of the magnetic component of the signals to couple a transponder to a reader by electromagnetic induction

2.33
interrogator
device that performs the functions of a **reader**, but in addition has the ability to write new data into the transponder via an air interface

2.34
issuer
body, recognized by an approved international or national regulatory body, whose identity is recognizable within the code structures by a unique "issuer identifier" data element, and which is assigned the issue and management of the subordinate data elements within the data construct

NOTE Issuers are likely to be bodies such as industrial gas bottlers and distributors.

2.35
local area network
LAN
network that spans a limited geographical area (usually within one building or site) and interconnects a variety of computers and terminals, usually at very high data rates

NOTE Because it uses physical media (wires or co-axial cables) owned by the operator and does not normally cross public roads, it is excluded from regulations of bodies such as the local PTT.

2.36
major application identifier
first octet of a data element construct which is passed by a system to its host computer and which identifies that the message is a gas cylinder message

2.37
management system
software, firmware or hardware designed to receive and manage data from an RFID system, usually within a host computer

2.38
manufacturer
manufacturer of transponders for use within the applications defined in ISO 21007

2.39
microwave frequencies
electromagnetic energy emissions having frequencies of above 1 GHz

2.40
minor application identifier
second octet of a data element construct which is passed by the system to its host computer and which identifies the gas cylinder coding scheme to which it conforms

2.41
operational parameter
one of the different operational component properties or specifications

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.42
operator
owner and/or commercial operator of a gas cylinder system that uses transponders for the purposes defined in ISO 21007

2.43
open systems interconnection
OSI
internationally accepted framework of International Standards for communication between two systems made by different vendors

NOTE The OSI model is a seven layer hierarchical reference structure in which groups of protocols or rules for communicating are arranged in layers. Each layer performs a specific data communications function. The first three are the physical, data link and network layers, all concerned with routing and transmission. The last three – session, presentation and applications – focus on user applications. The fourth layer offers an interface between the first and last three layers.

2.44
one-time programmable
OTP
kind of storage device like an erasable programmable read-only memory (EPROM) but with no quartz glass window in the package for erasing the contents

cf. **programmable**

NOTE This reduces the packaging cost but means the device cannot be erased with ultraviolet light and so can only be written once.

2.45
point of identification
point in time and physical location at which identification is made

2.46
polling
method of controlling multiple sources of data (e.g. multiple transponders in a read zone) where each is interrogated in turn by the host system and where an action is initiated (usually by the host system) to avoid duplication or contention of signals

2.47
primitive identifier
identification as a stand-alone identity that does not require any qualifier such as expiration date

NOTE All construct identifiers are built from groups of primitive identifiers.

2.48
programmable
⟨transponder⟩ capable of having an operator-determined “read only” code programmed into the memory

2.49
radio frequencies
electromagnetic energy emissions having frequencies below 1 GHz

2.50
radio frequency identification system
automatic identification system comprising one or more reader/interrogators and one or more transponders in which communication and data transfer are achieved by means of electromagnetic energy of inductive, radio or microwave frequency

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.51
read cycle
complete sequence of interaction by the reader/interrogator in which the transponder is unambiguously identified via the air interface and its data read in its entirety

2.52
reader
device that can transmit an electromagnetic signal at inductive, radio or microwave frequencies as a means of initiating a response in or data transfer to a compatible tag or transponder, receive the data-modulated electromagnetic response and decode the signal

NOTE Readers can also use handshaking routines to control data transfer to and from the transponder and to the host computer via the system interface and remove foreign signals and interference.

2.53
read only
data mode corresponding to a transponder whose data content is encoded prior to use and which cannot be changed by the reader/interrogator

2.54
read/write
data mode corresponding to a transponder in which data content can be changed by means of a compatible interrogator via the air interface

2.55
read/write cycle
complete sequence of interaction by the reader/interrogator in which the transponder is unambiguously identified and new data, comprising either whole or part of the full data set, are written onto the tag by means of the air interface

2.56
redundancy checking
technique of error detection involving the transmission of additional data related in such a way that the receiving terminal can determine with a certain degree of probability whether an error has occurred in transmission

2.57
simplex
method of communication in one direction only

cf. **duplex**

2.58
tag
see **transponder**

NOTE Readers need to be aware that within the detail of ISO/IEC 8824 and ISO/IEC 8825 the word tag has a different meaning and does not relate to a transponder.

2.59
technical solution
detailed technical description of a system that has been demonstrated to work to the performance requirements of ISO 21007

NOTE The technical solution is to give more detail of all aspects including the air interface.

2.60
transponder
device that comprises an antenna and electronic circuitry to recognize, modify and reflect a signal back to the reader/interrogator

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved

2.61
transponder/reader protocol
sequence and etiquette of handshaking and transfer of the unambiguous identification and data content between tag and reader

2.62
write
see **read/write cycle**

3 Reference model architecture

3.1 General

The reference model architecture determined in this part of ISO 21007-1 provides an "enabling" structure. It is designed to accommodate, within the framework, a reference model for a wide and diverse variety of gas cylinder applications, from simple identification to more complex transactions with a wide variety of uses.

The data element construct architecture allows combinations of data elements to be used in composite data constructs. This and subsequent supporting parts of ISO 21007 are designed to allow as much interoperability of the data elements within an EDI/EDT environment as is possible so that otherwise incompatible structures can be supported in an effective and efficient manner, and the structure provides a capability for a significant expansion of the number of gas cylinder applications in the future.

This part of ISO 21007 takes cognizance of and accommodates the operation of systems of different capability 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 may be used accurately and effectively within an EDI/EDT environment.

The data element structure defined in this part of ISO 21007 is a "tree and branch" or "cascade" structure with the ability to build complex data element constructs.

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

By adopting the ISO/IEC 8824 and ISO/IEC 8825 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 (ISO 21007-1) is itself given a migration path so that as technological developments occur further capabilities are allowed. Subsequent parts of ISO 21007 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.

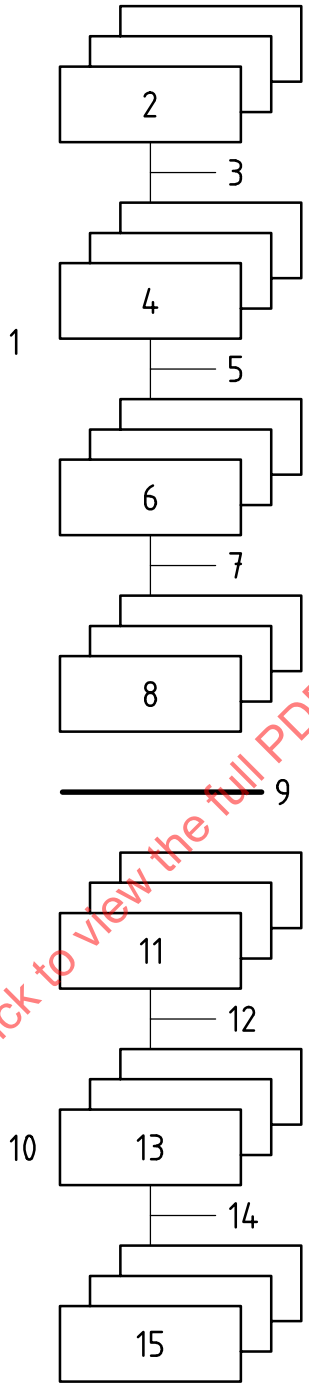
3.2 Example architecture

3.2.1 Generic system architecture

Figure 1 shows a generic system architecture. It maps the communication system as a number of function boxes, and labels the interfaces between these function boxes as reference points. It is important to be aware that functions and reference points do not necessarily fit into discrete physical boxes or interfaces, but are used to define the part of a system that is being described. Taken together, the reference points provide a functional description of a flexible reference model architecture relevant to most gas cylinder environments that involve data exchanges between cylinders, mounted transponders and reader/interrogators, which may be portable or permanently mounted.

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved



STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

Key

1	equipment not on cylinder (computer-interrogator)	6	communication control	11	media adaption
2	central system	7	gamma	12	epsilon
3	alpha	8	media adaption	13	communication control
4	local system	9	air interface - radio	14	zeta
5	beta	10	equipment on cylinders (transponder)	15	Memory Management Process (MMP)

Figure 1 — Reference model architecture

© ISO 2005 – All rights reserved

It is also important to be aware that reference architecture and the data construct schemes described in supporting parts of ISO 21007 need to provide a platform for a wide range of media (low frequency/inductive, below 1 GHz radio, microwave, etc.) so that ISO 21007 will remain valid both for existing and future technologies and to avoid contention with other RFID systems.

The system is described as a balanced communication system with special emphasis on the air interface. Portable equipment and ground equipment are the two major segments in this system.

3.2.2 Function blocks

Function blocks consist of the following.

a) Central system: the block containing all centralized functions of gas cylinder applications.

b) Local system: the local function block that handles the “real-time” and non-distributed parts of the gas cylinder application.

c) Communication control: the communication block that handles the media-independent part of the communication link.

d) Media adaption: the media-dependent function block.

e) Memory Management Process (MMP): the last function block symbolizing several specific applications, of which gas cylinder identification may be one read-only application.

3.2.3 Reference points

Reference points consist of the following.

a) Alpha (α): a network interface.

b) Beta (β): the reference point where data are passed from the communication subsystem to the local system functions and vice versa.

c) Gamma (γ): between communication control and media adaption.

d) Delta (δ): between transponder and interrogator. This air interface is usually in the nature of dedicated short-range communication.

e) Epsilon (ε): between media adaption and on communication control on the cylinder.

f) Zeta (ζ): reference for connecting MMP to the communication link.

3.2.4 Reference point Delta (cylinder to reader/interrogator link)

In this context, the cylinder-to-wayside link is a communication link between transponders and the interrogator. Simple identification systems should not be contentious with transactional or fully interactive data carrying systems.

3.2.5 Reference point Beta (reader/interrogator to application host link)

The fixed interface is needed for application communication with the application system. This part of ISO 21007 describes the interface as seen from an identification angle, but not the form of the link itself.

The guiding principle is to standardize on an interface so service providers can choose what link system they consider most appropriate for their purposes, and so they can freely mix several links and have them interoperate (as long as they do not interfere/contend with each other). In this case, the local processing block

STANDARDSISO.COM : Click to view the full PDF of ISO 21007-1:2005

© ISO 2005 – All rights reserved