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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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Contents

Page

Foreword

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

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.

Data scheme identifier	Length	Information field/data scheme

Info 1	Info 2	Info 3	…….

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.

6.5 Data scheme 11: cylinder approval information (optional)

6.5.1 General

Data scheme 11 determines the form of the data field content for GC identification for DSI 11 of ISO 27001-1.

The Data scheme 11 structure is as follows:

Data scheme identifier	Length	Cylinder approval information data field
$4B_{16}$	10_{16}	

The third field contains information about the countries where the cylinder is approved.

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 approval information data field is as follows:

ISO 3166-1 country code

6.5.2 Country code

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

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

This field contains the code for the country where the cylinder is approved. ISO 3166-1 provides the 900 to 999 codes range for private uses. In the context of this standard, 900_{10} is reserved to indicate a European approval, 901_{10} to 999_{10} can be used to build private groups of countries, for cylinders having several approval stamps and not a European approval.

The recommended length of this DSI unique data element is 16 bits.

6.6 Data scheme 12: cylinder package information (optional)

6.6.1 General

Data scheme 12 determines the form of the data field content for GC identification for DSI 12 of ISO 27001-1.

The Data scheme 12 structure is as follows:

Data scheme identifier	Length	Cylinder package information data field
$4C_{16}$	44_{16}	

The third field contains the water capacity, working pressure, tare weight and last test date 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 package information data field is as follows:

Water capacity	Working pressure	Tare weight	Last test date

6.6.2 Water capacity (l)

The water capacity is a numeric field indicating the water capacity in litres in accordance with ISO 13769 in a specific compact decimal floating point coding:

	Bits	Variables	Type
	(float)	12	Real

Numbers are noted as $x \times 10^y$ with x ranging from 0 to 255 and y ranging from −7 to +7. The 12-bit field is coded as follows.

The 8 most significant bits (0 to 7) are used for the mantissa (x) coded in binary, bit 8 is used for the sign of the exponent (0 = +, 1= -), and the 3 least significant digits are used for the exponent y (power of 10).

EXAMPLE

1	0	0	1	0	1	1	1	1	0	0	1
			x					$\pm$		y	

represents 151×10^{-1}, or 15,1 in decimal ($10010111_2 = 151_{10}$)

6.6.3 Working pressure (bar)

The working pressure is a numeric field indicating the working pressure in bar in accordance with ISO 13769:

	Bits	Variables	Type
	(float)	12	Real

6.6.4 Tare weight (kg)

The tare weight is a numeric field indicating the tare weight in kilograms.

	Bits	Variables	Type
	(float)	12	Real

6.6.5 Last test date

The last test date is a numeric field indicating the last test date of the cylinder:

	Bits	Variables	Type
	(date)	24	Date

The date is coded as YYYYMMDD, on a 24 bit data structure. Bits 19-23 (5 least significant bits) are used to code the day number in binary (1 to 31), bits 15-18 are used to code the month number in binary (1 to 12), bits 0-14 are used to code the year in binary.

EXAMPLE

0	0	0	0	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	1	0	0
Year : 1999																Month : 07					Day : 28			

represents the 28th of July 1999.

The length of this DSI data element is 60 bits ($3C_{16}$).

6.7 Data scheme 13: cylinder content information (optional)

6.7.1 General

Data scheme 13 determines the form of the data field content, for GC identification for DSI 13 of ISO 27001-1.

Data scheme 13 structure is as follows:

Data scheme identifier	Length	Cylinder content information data field
$4D_{16}$	28_{16}	

The third field contains the content UN number code and the fill date 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 content information data field is as follows:

Content code (UN number)	Fill date

6.7.2 Content code

The content code is an alphanumeric field containing the UN number code for the content of the cylinder:

	Bits	Variables	Type
(binary 0-65 535)	16 or more	65 636 or more	Binary

6.7.3 Fill date

The fill date is a date field indicating the date the cylinder was filled (see 6.6.5 for date coding):

	Bits	Variables	Type
	(date)	24	Date

The length of this DSI data element is 40 bits (28_{16}) or more.

6.8 Data scheme 14: commercial product information (optional)

6.8.1 General

Data scheme 14 determines the form of the data field content, for GC identification for DSI 14 of ISO 27001-1.

The Data scheme 14 structure is as follows:

Data scheme identifier	Length	Commercial product information data field
$4E_{16}$	48_{16} or more	

The third field contains the commercial product ID and, optionally, lot number and expiration date.

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 commercial product information data field is as follows:

Quantity	Quantity unit	Product ID

6.8.2 Quantity

Quantity is a numeric field containing the quantity of product (gas) sold with the cylinder:

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

6.8.3 Quantity unit code

Quantity unit code is a numeric field indicating the engineering unit used for the previous quantity (see Annex D):

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

6.8.4 Product ID

Product ID is an alphanumeric field (5 characters or more) referencing the commercial product sold with the cylinder:

	Bits	Variables	Type
(8 bit characters ASCII string)	40 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 length of this DSI data element is 64 bits (40_{16} or more).

6.9 Data scheme 15: production lot information (optional)

6.9.1 General

This sub-clause determines the form of the data field content, for GC identification for DSI 15 of ISO 27001-1.

The data scheme 15 structure is as follows:

Data scheme identifier	Length	Lot information data field
$4F_{16}$	48_{16} or more	

The third field contains the commercial product ID and, optionally, lot number and expiration date.

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 lot information data field is as follows:

Expiration date	Lot ID

6.9.2 Expiration date

Expiration date is a numeric field containing the expiration date of the cylinder (see 6.6.5 for date coding):

	Bits	Variables	Type
	(date)	24	Date

6.9.3 Lot ID

Lot ID is an alphanumeric field (6 characters or more) referencing the cylinder filling lot identifier:

	Bits	Variables	Type
(8 bit characters ASCII string)	48 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 length of this DSI data element is 72 bits (48_{16}) or more.

6.10 Data scheme 16: accessories information (optional)

This data scheme will contain information about accessories with which the cylinder is equipped (valve, connector, fittings).

6.11 Data scheme 20: acetylene specifics (optional)

6.11.1 General

Data scheme 20 determines the form of the data field content, for GC identification for DSI 20 of ISO 27001-1.

The Data scheme 20 structure is as follows:

Data scheme identifier	Length	Acetylene specifics
54_{16}	8_{16}	

The third field contains information about the porous mass for acetylene cylinders.

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

Acetylene specifics are as follows:

Porous mass characteristics

6.11.2 Porous mass characteristics

Porous mass characteristics is a numeric field providing characteristics of the porous mass:

	Bits	Variables	Type
(binary 0-255)	8	256	binary

Bit 0 (most significant bit) is used to define a monolithic/nonmonolithic attribute of the porous mass. Bit 0 = 0: nonmonolithic, bit 0 = 1: monolithic.

The length of this DSI data element is 8 bits (8_{16}).

7 Air interface specifications

7.1 Technical requirements

RFID systems used in the GC sector use different frequencies. GC RFID application standards specify the use of a limited number of air interfaces.

However, where the same frequency is used, the standard air interface parameters are defined in 7.3 to ensure minimum physical interoperability.

Other parameters listed in 7.3 shall be fully documented.

Standard parameters correspond to layer 1 (physical communication layer) in the OSI convention. Conformance will allow communication between a standard interrogator and multiple tag/transponders, provided that the interrogator is driven by appropriate software. However, OSI communication layers 2 and above shall be fully documented for each standard tag/transponder technology.

7.2 Downlink and uplink

Communication for information from reader/interrogator to tag is considered as "downlink".

Communication for information from tag to reader/interrogator is considered as "uplink".

7.3   Standard downlink/uplink parameters

Standard PGC parameter sets are as follows:

Carrier frequency	125 kHz	13,56 MHz
Tolerance of carrier frequency	$\pm$ 0,01 % (downlink) $\pm$ 3 % (uplink)	$\pm$ 0,01 % (downlink) $\pm$ 1,6 % (uplink)
Modulation	ASK	ASK
Data coding	Manchester	Miller
Power limits within communication zone	67 dBµA/m @ 10 m or 77 dBµA/m @ 3 m	42 dBµA/m @ 10 m or 52 dBµA/m @ 3 m
Bit rate	$\leqslant$ 8 kbit/s	26 kbit/s

8   Transponder memory addressing

8.1   General requirements

Beyond conformance to the air interface specification of this part of ISO 21007 enabling physical communication at OSI layer 1 to achieve interoperability, RFID systems used in the GC sector should adopt common rules for accessing standard GC data sets. A specific concern is transponder/tag memory addressing. Different transponders/tags include different features such as passwords, control zones and transponder/tag serial numbers. Application addressable memory areas thus have different address limits, making it inappropriate to adopt a fixed address for PGC data sets.

The situation is the same whether using predetermined context rules or not (see 4.3 and 4.4). The ISO/IEC 8824-1 notion of "message" cannot directly be extracted from actual transponder memory mappings.

It is proposed, therefore, that interoperability is achieved at interrogator level by software features (reference point Zeta).

The communication protocol between host and interrogator shall include a layer of "virtual transponder/tag addressing" that will be transponder/tag independent.

The GC data sets will be accessed at fixed virtual addresses using that protocol. The interrogator will translate or offset these fixed virtual address access requests into transponder/tag dependent requests at point Delta after identification of the actual transponder/tag technology. This protocol shall be fully documented by interrogator vendors. Fixed virtual addresses shall be allocated by an issuing authority appointed by the standardization authority and will form subordinate standards in support of this part of ISO 21007.

8.2   MODBUS/JBUS implementation

Annex E gives an example of a framework for implementing a virtual tag addressing area when using the *de facto* standard MODBUS protocol between the interrogator and a host.

In such a context, it is proposed that for read-only tags standard GC data sets start at virtual address 0000h, and for read/write tags standard GC data sets start at address 0040h, leaving room for communication control headers such as checksums, tag mapping version control, etc.

Annex A
(normative)

Technical solution

Companies need to develop their own operational standard when dealing with tagged cylinders.

The following are given as examples of some operational concerns.

— The tag could be located on the cylinder shoulder, neck ring, valve guard or any other suitable location.

— The choice of technology and location can have an influence on the performance of the tag.

— The tag and its protection (if relevant) shall be compatible with the intended service conditions, e.g. temperature (including during maintenance if relevant), mechanical impact and load, corrosion, etc.

— Care shall be taken that a damaged tag does not result in some illegible data.

17

Annex B
(informative)

List of codes for registration bodies

Name	Code
EAN	01
EIGA	02
KGS	03

NOTE   Any body can apply to ISO/TC 58/SC 4 to be included in this list.

Annex C
(informative)

List of codes for gas cylinder manufacturers

The columns entitled "Code" designate the RFID code for a manufacturer.

The columns entitled "Manufacturer Name" designate the official name of the gas cylinder manufacturer. It should be noted that the name may have changed over time.

The information provided in the columns entitled "Location of Manufacturing Plant/Facility" designates the plant/facility responsible for manufacturing and to which the cylinder type approval is assigned.

The information provided in the columns entitled "Year(s) of Manufacture" designates the years for which the manufacturers' marks were used, if known. For example, "→ 1927" means the mark was used inclusive of 1927; "1927 → 1961" means the mark was used from some time in 1927 to some time during 1961; and "2002 →" means the mark has been used starting some time during 2002 to present.

The last columns entitled "Manufacturer's mark" provide the official manufacturer's identification that is stamped on the shoulder of a cylinder as required by ISO 13769 (see item 3 in Table 1).

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	ALGERIA
			Year(s) of Manufacture	Manufacturer's mark
012 01	F.E.R.A.P. (Fabrication et entretien de récipients à pression)	Algiers		☪

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	ARGENTINA
			Year(s) of Manufacture	Manufacturer's mark
032 01	L'Air Liquide	Buenos Aires		A
			1960 → 1985	
032 02	Drago	Buenos Aires	1938 →	M D
032 03	Fabricacion Militar			FM
032 04	Gas Carbonic Argentina			G.C.A.

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	ARGENTINA Manufacturer's mark
032 05	Gonzalez & Chiesa Changed to Inflex Argentoil S.A.	San Luis	1967 →	INFLEX
032 06	Pablo Casale		1958 → 1986	CASALE
032 07	Saravia Y Lopez	Buenos Aires	→ 1993	L̃S
032 08	Oxi – Luz			
032 09	Acetylene	Buenos Aires	1972 → 1992	
032 10	Miguel Balbona			M.R.B.
032 11	R. Batalles S.A.	Buenos Aires	1944 →	YUKON
032 12	Propulsora San Luis	San Luis		PISL
032 13	Luis Pasquinelli e Hijos	Buenos Aires	1947 →	LPH
032 14	Kioshi Compresion	Buenos Aires	2005 →	
032 15	Mozart	Buenos Aires	1995 →	
032 16	INPROCIL S.A.	Entre Rios	2007	
032 17	CIDEGAS S.A.	Buenos Aires	2004 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	AUSTRALIA Manufacturer's mark
036 01	Manchester Tank & Equipment CO	Echuca		MANCHESTER
036 02	CIG		→ 1996	CIG
036 03	Luxfer Australia		1997 → 2004	CIG

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	AUSTRIA
			Year(s) of Manufacture	Manufacturer's mark
040 01	Jos. Heiser Changed to Worthington Heiser Changed to Worthington Cylinders GmbH	Kienberg	→ 1927	
			1927 → 1961	
			1961 → 1976	
			1976 → 2001	HEISER
			2002 →	
040 02	iSi GmbH	Wien	1994 → (3 alternative symbols used)	ISI

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	BELGIUM
			Year(s) of Manufacture	Manufacturer's mark
056 01	S.A. Ateliers Belges Réunis (formerly S.A. des Ateliers de la Dyle)	La Dyle-Louvain	→ 1962	
056 02	Établissements Champy	Antwerp	→ 1940	
056 03	S.A. Comet	Mechelen	→ 1980	S.A.COMET.Malines
			→ 1980	C.M
056 04	S.A. Standard Van Leer (formerly S.A. Usines Standard)	Lierre		
056 05	S.A. Des Usines A Tubes de la Meuse	Flémalle-Haute (Liège)		
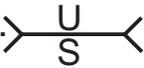
Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	BRAZIL
			Year(s) of Manufacture	Manufacturer's mark
076 01	Worthington Cylinders	Itu	2002 → 2003	08
076 02	Worthington Tank	Itu	2002 → 2003	09
076 03	MAT A/A	Sao Paulo		

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	CANADA
			Year(s) of Manufacture	Manufacturer's mark
124 01	Canadian Cylinder Company, Ltd	Brantford, Ontario		C
124 02	Engineering Products of Canada Ltd	Boucherville, Québec		EP
				E.P.C.L
124 03	Forges HPC Ltee	Cap-de-la-Madeleine Québec		FHPC
124 04	Hugh Canning Industries, Inc.	Toronto, Ontario		H.C.I.
124 05	Aircom Industries ('76) Ltd	Edmonton, Alberta		M4803
124 06	Bruin Engineered Parts, Inc.	Midland, Ontario		BRUIN
				M8802
124 07	Gas Cylinder Technologies	Tecumseh, Ontario		M9001
124 08	Kadet Engineering, Inc.	Mississauga, Ontario		KENG
124 09	Metal-Flo Corporation Canada Limited	Guelph, Ontario		MFCCL
124 10	Wolfedale Engineering, Ltd	Mississauga, Ontario	→ 2007	WENG or M8903
124 11	Steel Cylinder Manufacturing changed to Worthington Cylinders	Tilbury, Ontario	→ 1996	SCM or M8004
			1996 → 2002	M8004
			2002 →	M8004 or 07
124 12	Dynetek Industries Ltd.	Alberta, Canada	→ March 1, 2007	M5550
			March 1, 2007 →	M0501

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	CHINA
			Year(s) of Manufacture	Manufacturer's mark
156 01	Beijing Tianhai Industry Co., Ltd.	Beijing	1978 →	JP
156 02	Changzhou aircraft manufacture Co., Ltd.	Changzhou, Jiangsu Province	1980 →	CAF
156 03	Chengdu Great High Pressure Vessel Co., Ltd.	Chengdu, Sichuan Province	1978 →	CG
156 04	Chongqing Yifeng High-pressure Container Co., Ltd.	Chongqing	1987 →	YM
156 05	Juhua Group Corp-Engineering Co., Ltd.	Quzhou, Zhejiang Province	2002 →	JG
156 06	Ningbo Meike Acetylene Cylinders Co., Ltd.	Cicheng Town, Ningbo	1984 →	NB
156 07	Shanghai Ronghua High-Pressure Vessel Co., Ltd.	Shanghai	1979 →	HT
156 08	Shanghai Huasheng Enterprises (Group) Co., Ltd.	Shanghai	2002 →	SG
156 09	Tianjin Tianhai High Pressure Container Co., Ltd.	Tianjin	2003 →	JP1
156 10	Shanghai Tianhai Dekun Composite Cylinders Co., Ltd.	Shanghai	2005 →	JP2
156 11	Langfang Tianhai High Pressure Container Co., Ltd.	Langfang, Hebei Province	2008 →	JP3
156 12	Luxfer	Shanghai	2007 →	M-0713

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	CROATIA
			Year(s) of Manufacture	Manufacturer's mark
891 01	Djuro Djakovice Oour Changed to Cilinder Sistem D.o.o	Slavonski Brod	1972 → 2007	
			2007 →	CSC
891 02	Slavonski Partizan	Slavonski Brod	1956 → 1972	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	CZECH REPUBLIC Manufacturer's mark
203 01	Eisenwerke Podbrezová A.G.		1916 →	PODBREZOVÁ
203 02	Witkowitzer Bergbau und Eisenhütten-Gewerkschaft Changed to VÍTKOVICE CYLINDERS a.s.	Ostrava-Vítkovice	1925 → 1928	WITK
			1929 → 1938	
			1939 → 1991	
			1991 →	
203 03	Gastec, Changed to Worthington Gastec Changed to Worthington Cylinders a.s.	Hustopece	1992 → 1999	GTH
			1999 → 2001	WGH
			2002 →	11
203 04	Plynokov	Brno		JMP BRNO
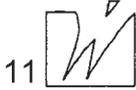
Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	DENMARK Manufacturer's mark
208 01	Brdr. Degn	Besser	→ 1973	BD
208 02	Cylindric Denmark A/S	Bieghusvej		Cy
208 03	Dalso Maskinfabrik A/S	Langedalsvej	→ 1973	DM
			→ 1973	Dalsø Maskinfabrik
208 04	Kosan Cylindric	Middelfart		CY
208 05	Metal Møller	Hadsten		

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	FINLAND Manufacturer's mark
246 01	Mekes Oy	Parkano	1964 → 1967	MEKES
246 02	Mkt – Tehtaat Oy	00700 – Helsinki 70	04/1958 →	
246 03	Oy Vähäsilta Ab	21530 – Paimio	1975 →	
246 04	Oy Wärtsilä Ab	Helsinki	13/08/1958 → 1973	WÄRTSILÄ

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	FRANCE Manufacturer's mark
250 01	Brunon Vallette & Cie	Rive-de-Gier	→ 1962	BV RIVE DE GIER
250 02	Établissements Freudenberg et Sté de Fabrication de Bouteilles	Region 75 – Paris	1945 → 1950	SFB
250 03	Établissements Pecquet-Tesson	Region 2 – Crouy		P.Tesson.Cie
250 04	Établissements Roth	Region 69 – Mions	1983 → 2007	ROTH-MIONS
		Region 59 – Wignehies		
		Region 92 – Colombes	1972 →	ROTH-COLOMBES
250 05	S.A. des Anciens Établissements Poulet	Region 93 – Pantin	1920 →	AP
250 06	Société d'Escaut et Meuse	Region 59 – Anzin		EM ANZIN
250 07	Société de Forgeage de Rive-de-Gier	Region 42 – Rive-de-Gier	1962 →	SFR
250 08	Société Lorraine-Escaut	Region 59 – Anzin		EM ANZIN
250 09	Société Louvroil – Montbard – Aulnoye	Region 21 – Montbard	→ 1945	
250 10	Société Métallurgique de Gerzat Changed to Luxfer Gas Cylinders, France	Region 63 – Gerzat	→ 1989	SMG
			→ 2005	S.M.GERZAT
			1989 → 2005	SMG
			2005 →	LUXFER
250 11	Société Olaer	Region 69 – Mions	1976 → 1983	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	FRANCE
			Year(s) of Manufacture	Manufacturer's mark
250 12	La Soudure Autogène Française	Region 60 – Pont-Ste-Maxence	1920 → 1940	**SAF**
250 13	Vallourec	Region 59 – Louvroil	1945 → 1963	LMA LOUVROIL
		Region 21 – Montbard	→ 1945	
		Region 59 – Aulnoye		
250 14	Schneider (GLI)	Region 67 - Bischwiller	1961 →	SCHNEIDER
			1991 →	
			1961→	**SCHNEIDER BISCH**
250 15	CB Moulins Chevalier Bertrand	Region 3 - Moulins	1990	**CB MOULINS**
250 16	Liotard	Region 37 - St Pierre des Corps	→ 1980	**SMLF**
			1980 →	LIOTARD

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	GERMANY
			Year(s) of Manufacture	Manufacturer's mark
276 01	Acieries et usines a tubes de la Sarre	Bous-s/Sarre	1918 → 1935	
276 02	August Thyssen Hütte	Dinslaken	1918 → 27/07/1919	
			28/07/19 → 5/07/28	
276 03	Berlin Seegefelder Industrie A.G.	Falkensee-bei Berlin	1937 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	GERMANY Manufacturer's mark
276 04	A. Borsig	Berlin-Tegel	1921 → 1936	
			1936 → 1941	
276 05	Carlshütte Maschinen und Stahlbau G.m.b.H	Waldenburg Altwasser	1936 →	
276 06	Deutsche Röhrenwerke A.G. (Poensgen)	Düsseldorf	1938 → 1948	
276 07	Deutsche Röhrenwerke A.G. (Thyssen)	Dinslaken	1934 → 1948	
276 08	Deutsche Waffen und Munitions Fabriken A.G.	Posen works (Karlsruhe)	1936 →	
276 09	Eschebach Werke A.G.	Radeberg-bei Dresden	1936 → 1941	
276 10	Flaschengeräte G.m.b.H.	Elterlein im Erzgebirge	1925 →	
276 11	Gelsenkirchner Bergwerks A.G.	Düsseldorf	1915 → 1922	
276 12	Gewerkschaft Deutscher Kaiser	Dinslaken	10/11/1911 → 12/02/1913	
			13/02/1913 → 1918	
276 13	Hager & Weidmann A.G.	Bergisch Gladbach bei Köln	08/1936 →	
276 14	Huldschinsky Werke	Gleiwitz	1904 →	SHS
276 15	Industrie Werke Karlsruhe Aktiengesellschaft	Karlsruhe		
276 16	Julius Pintsch K.G.	Berlin-Fürstenwalde	1936 → 1938	
			1938 → 06/1942	
			06/1942 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	GERMANY Manufacturer's mark
276 17	Mannesmann Stahlblechbau A.G.	Berlin Langschede (Ruhr)	1939 →	
276 18	Mannesmann Röhrenwerke Changed to Mannesmann Cylinder	Düsseldorf (Rath)	1923 →	
		Düsseldorf (Bous-a.d. Sarre)	→ 1918 1935 → 2000	
		Komotau	→ 1923	
			→ 1931	M–W
			1931 → 1945	
		Dinslaken	1970 → 2000 2000 → 2003	
276 19	Mauser K.G.	Waldeck	1937 →	
276 21	Oberschlesische Einsenbahnbedarf A.G.	Gleiwitz	1905 → 1925	OEB
				„O"
276 22	Phönix A.G. für Bergbau und Hüttenbetrieb	Duisburg	1907 → 1922	PHX
				SSAD°PHX
276 23	Phoenix-Rheinrohr A.G. Vereinigte Hütten-und Röhrenwerke	Düsseldorf Dinslaken	1955 → 1965	
276 24	Press-und Walzwerk A.G.	Düsseldorf-Reisholz		(PWR(
276 25	Rheinische Röhrenwerke A.G.	Düsseldorf Dinslaken	5/08/1948 → 1955	
276 26	Rheinmetall Borsig	Berlin-Tegel	1941 →	
276 27	Rheinmetall Borsig A.G.	Düsseldorf	15/01/1939 →	
276 28	Rheinmetall-Rheinische Metallwaren und Maschinen Fabrik	Düsseldorf	1898 → 1910	
			1910 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	GERMANY Manufacturer's mark
276 29	Sächsische Gussstahlwerke Döhlen A.G.	Freital in Sachsen (Saxe)	18/12/1908 →	
			10/11/1927	
276 30	Thyssen Röhrenwerke A.G.	Dinslaken	1965 1970	
276 31	Vereinigte Oberschlesische Hüttenwerke	Gleiwitz	1926 →	
276 32	Vereinigte Stahlwerke August Thyssen Hütte	Dinslaken	07/1928 → 1934	
276 33	Wilheim Siebel	Freudenberg	01/1936 →	
276 34	VEB Feuerlöschgerätewerk Apolda	Apolda	1956 → 1990	FWA
	Changed to Apoldaer Feuerlöschgeräte GmbH (1991)		1991 → 1995	AFG
	Changed to Apoldaer Stahlflashcen GmbH (1996)		1996 → 2001	AS
276 35	Changed to eurocylinders systems GmbH		2002 →	ecs
276 36	Hahn Metallbau GmbH	Stuttgart	1978 → 1995	
276 37	Welz Industrieprodukte GmbH	Stuttgart	1995 → 2003	
276 38	Welz Gas Cylinder GmbH	Rathenow	2003 →	
276 39	Basflaschen Werk Grünhain GmbH	Grünhain-Beierfeld	1990 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	GERMANY
			Year(s) of Manufacture	Manufacturer's mark
276 40	MCS International GmbH	Dinslaken	2003 →	
276 41	LBM Techno Gas GmbH	Langenfeld	01.07.1987 →	ЛБМ

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	GREECE
			Year(s) of Manufacture	Manufacturer's mark
300 01	Cylindric Hellas Ltd	Athens Artaki-Halkis (Isle of Euba)	1961 →	ΚΥΛΙΝΔΡΙΚΗ.Ε.Π.Ε
300 02	Viofial S.A.	Athens Petroupolis Athens	1962 →	ΒΙΟ Φ ΙΑΛ

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	HUNGARY
			Year(s) of Manufacture	Manufacturer's mark
348 01	Czepel			
348 02	Aluminiumárugyár Rt.	Budapest		ALUMINIUMÁRUGYÁR RT.

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	INDIA
			Year(s) of Manufacture	Manufacturer's mark
356 01	Rama Cylinders	Bhimasar	12/2005 →	RCL
356 02	Rama Cylinders	Kandla SEZ	9/2009 →	RCL K
356 03	Everest Kanto			EKC

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	ISRAEL
			Year(s) of Manufacture	Manufacturer's mark
376 01	Soda Club Israel			ILMAP

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	ITALY Manufacturer's mark
380 01	Acciaierie E Tubificio di Brescia	Brescia	1960 →	ĀTB ÃB ATB ATB ATB
380 02	Corpi Cavi	Milano	→ 1954	C.C.
380 03	Faber Industrie SpA	Cividale del Friuli (Udine) and Castelfranco Veneto	1972 →	FABER
380 04	Ghezzi Fratelli	Curnasco di Trevolio (Bergamo)		GHEZZI F. LLI
380 05	I.L.L. SpA	Pontedera (Pisa)	1981 →	O.B.P. I.L.L.
380 06	Incoge SpA	Milano		IG
380 07	Industria Metal-Meccanica Zane' I.M.Z. F.lli Illesi SpA Changed to CMV Srl Costruzioni Meccaniche Venete	Zane (VI)	→ 2006	IMZ
			2006 → (2 alternative symbols used)	CMV (logo)
380 08	Officine Meccaniche Italiane	Reggio Emilia	→ 1954	OMI
380 09	Simmel Changed to Faber	Castelfranco Veneto	1976 → end date not known	SIMMEL
380 10	Societa Tubi Mannesmann	Ora Dalmine		⟨⟩ ou STM
380 11	Stabilimenti Di Dalmine Changed to Tenaris Dalmine	Dalmine (Bergamo)	1906 → 1928	(logo)
			1928 → 1939	(logo)
			1940 → 1980	(logo)
			1981 → 2000	Dalmine D
			2001 → 2002	DALMINE
			2003 →	TDL

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	ITALY
			Year(s) of Manufacture	Manufacturer's mark
380 12	Tubi Togni	Brescia		
380 13	ISER			**ISER**

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	JAPAN
			Year(s) of Manufacture	Manufacturer's mark
392 01	Akamatsu Seisaku Sho	Osaka	1937 → 1938	
392 02	Asahi Seisakusho Company, Ltd	Saitama	1953 →	
392 03	Chugoku Kogyo Company, Ltd	Hiroshima/Kure	1955 →	
392 04	Dainihon Aga Gas Seizosho	Nagoya	1942 →	
392 05	Fuso Kinzoku Kogyo K.K. Kokan Seizo Sho	Osaka Amagasaki	1945 → 1952	
392 06	Fuso Kinzoku Kogyo	Osaka Amagasaki	1945 → 1949	
392 07	Honda Tekkosho (Tokai Koatsu Kiki.)	Gifu	1939 → 1950 / 1938 → 1939	
392 08	Ito Koatsu Yoki Seizo Sho	Tokyo	1936 → 1943	
392 09	Kanto Koatsu Yoki Mfg. Company, Ltd	Maebashi	1960 → 2000 / 2000 →	
392 10	Kawasaki Seitetsu K.K.	Kobe	1954 → 1961	
392 11	Kawatetsu Container K.K.	Itami	1961 →	
392 12	S.A. Kogyo K.K.	Tokyo	1941 → 1942	
392 13	Kyokukosha	Tokyo/Kawasaki	1952 → 1953	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	JAPAN Manufacturer's mark
392 14	Nichia Seiko K.K.	Tokyo/Amagasaki	1943 → 1944	
392 15	Nippon High Pressure Cylinders Company, Ltd		1979 → 2001	
392 16	Nihon Koatsu Gas Yoki K.K.	Osaka	1936 → 1942	
392 17	Nihon Koatsu Yoki Company, Ltd	Amagasaki	1953 → 1978	
392 18	Nihon Rikagaku Kogyo	Tokyo	1939 →	
392 19	Sakusabe Kogyo Sho	Tokyo	1941 → 1953	
			1936 →	
392 20	Sansen Tekko Sho	Osaka	1936 → 1942	
392 21	Shin Fuso Kinzoku Kogyo	Osaka/Amagasaki	1949 → 1952	
392 22	Shinko Koatsu Kiki K.K. Company, Ltd	Osaka/Yokohama	1938 → 1942	
			1939 → 1943	
392 23	HOKI SHINKO KOGYO KABUSHIKI KAISYA Changed to Shinko Kiki Kogyo Company, Ltd Changed to Shinko JFE Industrial Co., LTD Changed to Shinko Industrial Co., LTD	Kurayoshi	1961 → 1989	
			1989 →	
392 24	Showa Koatsu Kogyo Company, Ltd	Tsuchiura	1952 → 2001	
392 25	Sumikin Kiko Company, Ltd	Amagasaki	1964 →	
392 26	Sumitomo Kinzoku Kogyo	Osaka/Amagasaki	1952 → 1958	
392 27	Sumitomo Kinzoku Kogyo K.K. Kokan Seizo Sho	Osaka/Amagasaki	1958 → 1965	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	JAPAN Manufacturer's mark
392 28	Sumitomo Kinzoku Kogyo Ltd Kokan Seizosho	Osaka/Amagasaki	1931 → 1935	
392 29	Sumitomo Kinzoku Kogyo	Osaka	1935 → 1945	
392 30	Tohoku Denki Tekko	Sakata/Yamagata	1952 →	
392 31	Toyo Bombe Company, Ltd (Tokai Bombe Company, Ltd)	Kameyama/ Lameyama	1969 → 1978	
392 32	Totsuka Cylinder Corporation	Tokyo	1937 →	
392 33	Yamao Kinzoku Kogyo K.K.	Tokyo/Amagasaki	1938 → 1952	
392 34	Yamato Kinzoku Kogyo K.K.	Kawasaki	1943 → 1952	
392 35	Koatsu Showa Cylinders Company, Ltd	Kameyama and Tsutiura	2001 →	
392 36	CHUO SEIKI CO., LTD	Anjyoh	1961→	
392 37	HAGIO HIGH PRESSURE CONTAINERS CO., LTD	Niihama	1961→	
392 38	FUJIKOHKI CO., LTD	Nagoya	1977→	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	REPUBLIC OF KOREA Manufacturer's mark
410 01	Alloforge CO., LTD	Wanju		
410 02	CS CO., LTD	Gwangju		
410 03	Dae Hung Precision Industrial CO., LTD	Inchon		
410 04	Duck Jin Kiyoen CO., LTD	Inchon		
410 05	HanBee CO., LTD	Ulsan		
410 06	Han Kuk Fiber Glass CO., LTD	Milyang		FIBER-X
410 07	Korea Halon CO., LTD	Kimpo		

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	REPUBLIC OF KOREA
			Year(s) of Manufacture	Manufacturer's mark
410 08	Korea High Pressure Cylinder CO., LTD	Ichun		KHPC
410 09	Kyung Hee Steel CO., LTD	Taegu		
410 10	Nail CO., LTD	Hampyeong		
410 11	NGVI, INC	Chuncheon		
410 12	NK CO., LTD	Busan		NK
410 13	Sewang CO., LTD	Whasung		
410 14	Shin Heung Special Machinery Industry CO., LTD	Pyungtaek		SHINHEUNG
410 15	Shin Kwang Industrial NK CO., LTD	Chungju		
410 16	Sungshin Industrial CO., LTD	Pyungtaek		
410 17	Win Tech CO., LTD	Jincheon		

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	LEBANON
			Year(s) of Manufacture	Manufacturer's mark
422 01	Cie Industrielle du Gaz	Beyrouth		CIG

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	MEXICO
			Year(s) of Manufacture	Manufacturer's mark
484 01	Metalver			

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	MOROCCO
			Year(s) of Manufacture	Manufacturer's mark
504 01	Sté Chérifienne D'installations Ferroviaires (S.C.I.F.)	Casablanca		SCIF

35

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	MOROCCO
			Year(s) of Manufacture	Manufacturer's mark
504 02	Sté Chérifienne des Pétroles (S.C.P.)	Rabat Siki Kacem		**S.C.P.**
504 03	Métaghreb	Mohammedia		TISSIRGAZ

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	NORWAY
			Year(s) of Manufacture	Manufacturer's mark
578 01	RAGASCO AS	Raufoss	1990 →	RAGASCO

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country	POLAND
			Year(s) of Manufacture	Manufacturer's mark
616 06	GZWM (Grodkowskie Zaklady Wyrobow Metalowych)			GZWM
616 07	Towarzystwo Zakładów Metalowych B. Hantke Huta Aleksander	Sosnowiec	1882 → 1883	(M mark)
	Milowitzer Eisenwerk AG	Sosnowiec	1883 → 1911	
	Walcownia Milowice	Sosnowiec	1911 → 1925	
616 08	Zakłady Wyrobów Kutych „Huta Milowice"	Sosnowiec	1925 → 1939 1945 → 1950	(M mark)
			1950 → 1956	(M mark)
			1956 → 1971	(M mark)

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	POLAND Manufacturer's mark
616 09	Zakłady Przemysłu Precyzyjnego „Predom-Milmet"	Sosnowiec	1971 → 1975	
	Zakłady Przemysłu Precyzyjnego „Prema-Milmet"	Sosnowiec	1975 → 1981	
	Fabryka Łożysk Tocznych „Prema Milmet"	Sosnowiec	1981 → 1992	
	Fabryka Łożysk Tocznych „Prema Milmet" S.A.	Sosnowiec	1992 → 1996	
	Fabryka Butli Technicznych „Milmet" S.A.	Sosnowiec	1996 → 2008	
	Vitkovice Milmet S.A.	Sosnowiec	2008 →	

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	PORTUGAL Manufacturer's mark
620 01	Worthington Cylinders (formerly Progresso, Embalages Industriais de Gas)	Vale De Cambra	→ 1999	PROGRESSO
			1999	EIG
			late 1999 → 2001	WORTHINGTON
			2002 →	12
620 02	Alfa Changed to Amtrol‑Alfa Metalomecânica, S.A.	Guimarães – Portugal		ALFA / AMTROL-ALFA / AMTROL—ALFA / M9701
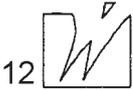
Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	SPAIN Manufacturer's mark
724 01	Fabio Murga	Valmaseda (Vizcaya)	1941 →	
724 02	Fabrica Nacional de Trubia	Trubia	1951 →	FABRICA DE TRUBIA
724 03	SEO			SEO
724 04	Société Babcock & Wilcox	Bilbao Gallinda-Sestao	1954 → 1988	B.W
724 05	Productos Tubulares	Bilbao	1988 → 2009	P T

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	SWEDEN Manufacturer's mark
752 01	Avesta Jernverks A B	Avesta	→ 1977	AVESTA
752 02	Primus-Sievert	Fien		PRIMUS
752 03	Composite Scandinavia AB	Piteå	1994 →	COMPOSITE SCANDINAVIA / composite SCANDINAVIA
752 04	ABB Power Technologies AB Plast	Piteå	1992 →	ABB

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	SWITZERLAND Manufacturer's mark
756 01	Aluminium Schweiss Werk A G Schlieren	Schlieren	→ 1971	A S S
756 02	Metallwaren Fabrik Zug	Zug	→ 1976	m Z

Code	Manufacturer Name	Location of Manufacturing Plant/Facility	Country Year(s) of Manufacture	TUNISIA Manufacturer's mark
788 01	Compagnie Générale de Metallurgie	Tunis		CGM
788 02	Société Générale Industrielle	Tunis		SGI