EuroData Council

AIDC Standards Report

Automatic Identification & Data Capture

2021/2022

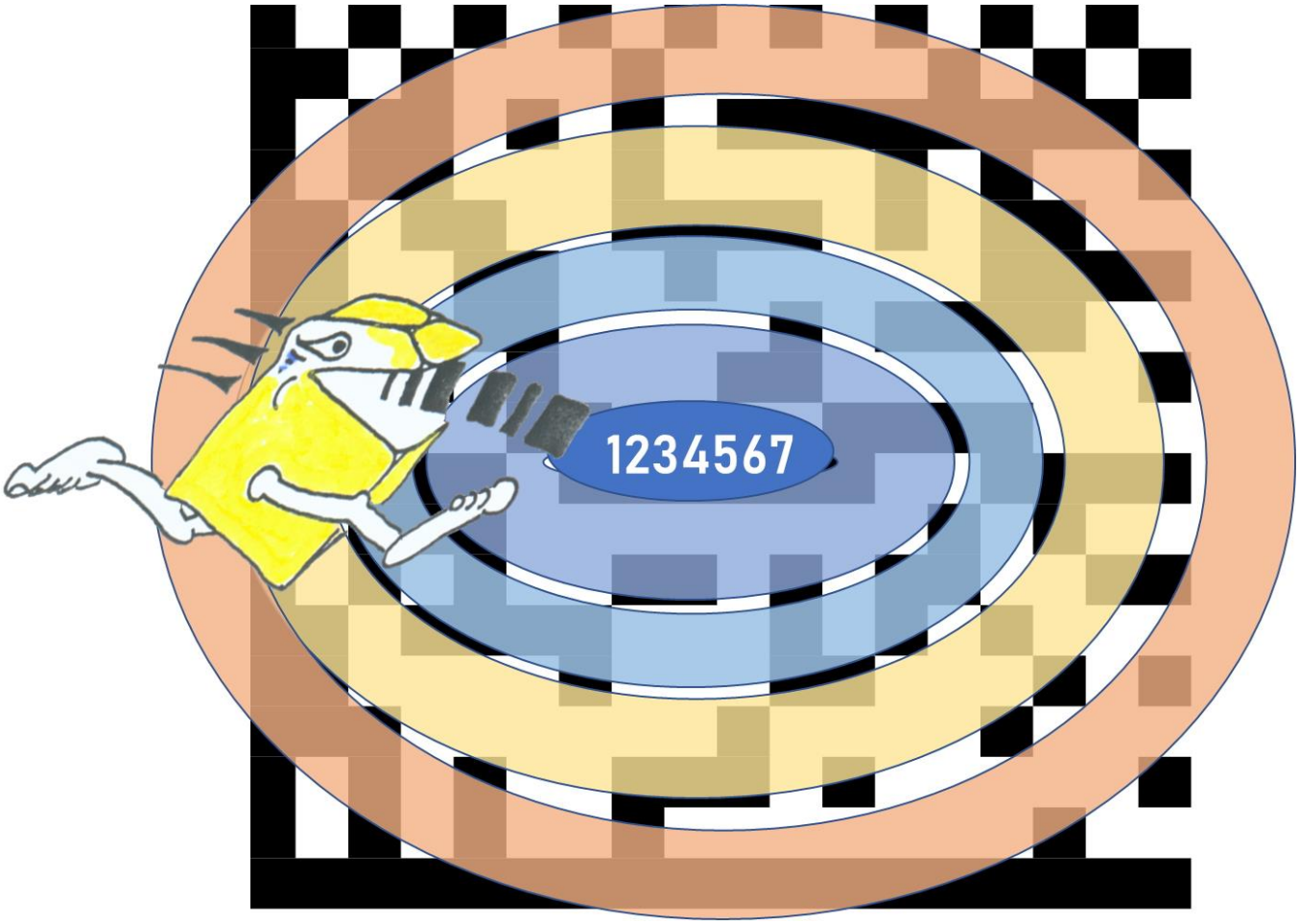

Fig. I-Title) CODE ART EDC2

Report on the continued standardization of Barcode, RFID and its data structures, including applications for automatic identification, traceability and Internet of Things (IoT) communication

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AIDC Standards Report 2021/2022

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AIDC standards report content

AIDC Standards 2021

Report update on cross-industry and transnational standardization of the application of barcode, RFID & associated data communication for automatic identification, tracking & tracing and the "Internet of Things"

The report provides information on the evolution of AIDC technologies from the point of view of standardization but also toward practical applications with focus on internationality.

AIDC applications in development

Was barcode a while ago just enforced by specific sectors for transfer of data via items, today barcode got a mandatory status in some areas even demanded by governmental regulations. Examples are UDI (Unique Device Identification) for medical devices and In-vitro-Diagnostica, serialized codes for medicinal products (pharmaceuticals), tobacco products, Marine equipment, Fish Boxes with the catch, etc. In such applications, barcodes on the items carry references to databases where the related master data is stored. Examples are the Global UDI Database (GUDID) and the European equivalent EUDAMED with public access to the master data. Many countries follow this trend, like China, Japan and all other areas as members of the International Medical Device Forum (IMDRF).
The report will supply an update of the standards developed by ISO/IEC JTC 1/Sub Committee 31 or by adjacent bodies and associations. Also it will include information about trends of combining traditional solutions with Internet communication and the use of QR Code in the public. This trend linking to Internet surely had impact to optimization to numbering systems for internal processes, global processes and for processes with communication up to the INTERNET of THINGS.
Internet was the driver for the “Syntax for keyboard and Web compatible encoding of data elements in machine readable symbols applied with ASC Data Identifiers” promoted by DIN 16598, EDIFICE, IFA and used in applications of different areas like for UDI and healthcare. The benefit was not only to ease designing and printing of codes avoiding “non printable characters” but WEB compatibility using same principle.
Links to the WEB in 2d-barcodes become more and more common as we face with the acceptance of QR carrying WEB links fully in WEB syntax.
Also GS1 developed an WEB-compatible solution using WEB-syntax fully: “GS1 Web URI Structure Standard” enabling consistent representation of GS1 identification keys within WEB addresses to link to online information and services. Other then traditional AIDC syntax the WEB URI Structure is promoting WEB syntax fully, as alternative?, as trend? This might be answered under chapter “Standards and developments in progress”.

“Radio Frequent Identification technology (RFID) will be included in the report as well. Interesting enough, according to observations, RFID did not replace Barcode yet as predicted by promoters, but takes the place as an option to barcode or for special applications.

Still, not every supplier of goods and items may have realized that the barcode adds value to a product if members of the supply chain can process the barcode content for tracking purposes. To achieve this, the labeler only has to look up the relevant ISO standards and supplement the internal numbers with standardized IDENTIFIERS as flags indicating what the number means. In fact appropriate standards have been developed since the 80/90th but it doesn’t mean, that everybody understands it’s value (see chapter “How do AIDC manufacturers label?”)

What does a code carry - How to recognise coding systems automatically

Flags identify a syntax, Identifiers identify data meaning:
"FLAGs first".

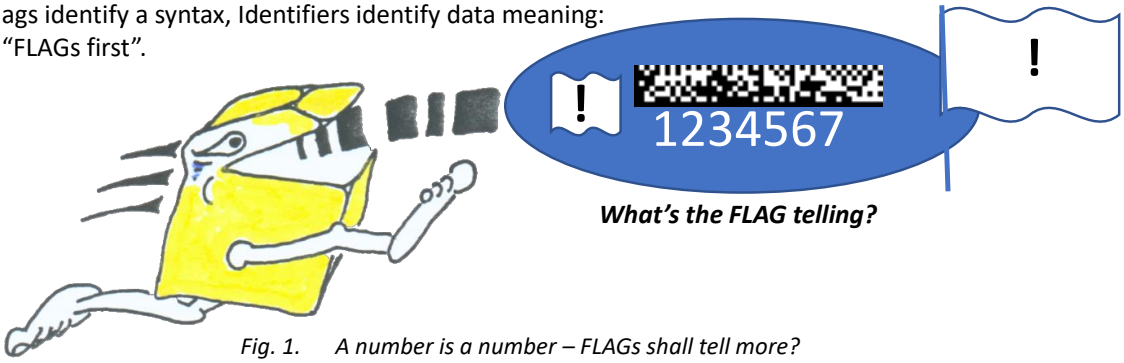


Fig. 1. A number is a number – FLAGs shall tell more?

As soon a number in a code for automatic data capture shall mean something for a third party anywhere in the world, the labeler shall use the appropriate AIDC language. Two common languages are standardized by ISO/IEC 15418 GS1 Application Identifiers and ASC Data Identifiers. Both use specific syntax for auto discrimination against each other but also to any other coding system.
Where Identifiers (AIs, DIs, TEIs, ..) tell about the content of a single data element, the syntax is identifying the coding system as such by system identifiers called "FLAGs".
Common FLAGs proceeding encoded data elements or messages are listed in ANSI MH10.8.2 appendix "FLAG Characters" and completed by table 1 of DIN 66403 System Identifiers:

Table 1 Flag Characters/System Identifiers

FLAG	*Data Structure/Syntax*	*Separator within the coded syntax*	*Support by Issuing Agency*	*Global/ Regional*	*for*	***
+	Health Industry Bar Code - HIBC	HIBC </>	HIBC	G	HIBC+DIs	Yes
-	Pharmaceutical Central No. - PZN	HPC <^>	IFA Coding System	R/G	PZN+DIs	Yes
.	Keyboard & WEB compatible syntax	<^>	CAICT, DIN, EDIFICE, FIDE, IFA, EDC, ZIIOT	G	DIs	Yes
&	ICCBBA (ISBT 128)	<=>	ICCBBA	G	ISBT	Yes
=	ICCBBA (ISBT 128)	<&>	ICCBBA	G	ISBT	Yes
!	Eurocode	<!>		R	Eurocode	Yes
/	Graphic Communications Industry					
FNC1	GS1	<FNC1>(<gs>	GS1	G	AIs	No
[)>rs	Syntax for high capacity data carrier **[)>rs**"**nn**" formats: "02"EDI, "05"=AIs, **"06"=DIs**; "12"=TEIs	<gs>	EDIFICE, EDC, FIATA, ODETTE, UPU, …	G	AIs, DIs, TEIs, EDI, …	No
https://	RFC syntax	&		G	URL, URI	Yes

**Keyboard and WEB compatible Yes/No ↑*

FLAGs tell the syntax: Let's print a serialized product code with a selection of syntax, e.g. product **REF: PROD1, SN: 9876ZY**, where Company IDs (CIN) differ by Issuing Agency:

FLAG	*Example*	
+	**+**A999**PROD1**0/$+**9876ZY**0	**HIBC**
.	**.**25PQCCOMP**PROD1**^S**9876ZY**	**DIs**
FNC1	<FNC1>0101234567123456219**876ZY**<gs>241P**PROD1**	**AIs**
[)>rs06	**[)>rs06**25PQCCOMP**PROD1**<gs>S**9876ZY<rs><eot>**	**DIs**

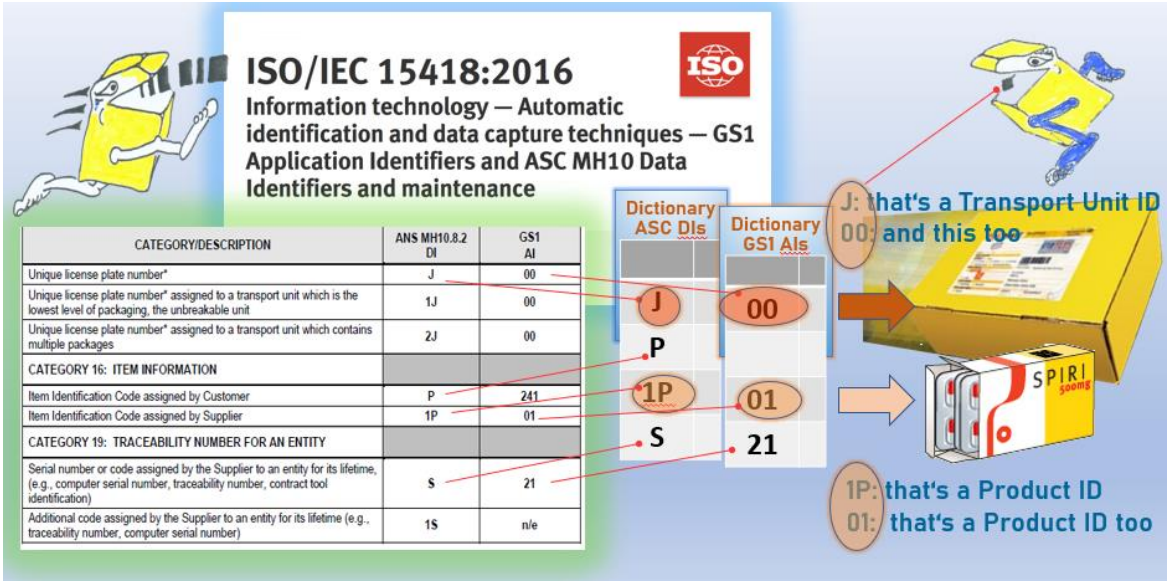
The problem can be seen easily, that data elements without FLAG and syntax cannot be identified automatically in open systems nor differentiated from internal numbers,
e.g. as a CSV string:

FLAG	*Example*	
	A999**PROD1**;**9876ZY**0	**?**
	25PQCCOMP**PROD1**;S**9876ZY**	**?**
	0101234567123456219**876ZY**;241P**PROD1**	**?**
		?

What is the meaning of encoded data elements

Where a FLAG identifies the coding structure and tells what kind of IDENTIFIERs are used, the Identifiers tells the meaning of a single data element.

The most common IDENTIFIERS for proceeding data elements are the two options ASC DIs and GS1 AIs standardized by ISO/IEC 15418 – GS1 Application Identifiers and ASC MH10 Data Identifiers.



CATEGORY/DESCRIPTION	ANS MH10.8.2 DI	GS1 AI
Unique license plate number*	J	00
Unique license plate number* assigned to a transport unit which is the lowest level of packaging, the unbreakable unit	1J	00
Unique license plate number* assigned to a transport unit which contains multiple packages	2J	00
CATEGORY 16: ITEM INFORMATION		
Item Identification Code assigned by Customer	P	241
Item Identification Code assigned by Supplier	1P	01
CATEGORY 19: TRACEABILITY NUMBER FOR AN ENTITY		
Serial number or code assigned by the Supplier to an entity for its lifetime, (e.g., computer serial number, traceability number, contract tool identification)	S	21
Additional code assigned by the Supplier to an entity for its lifetime (e.g., traceability number, computer serial number)	1S	n/e

Fig. 2. Excerpt of the list of ASC Data Identifiers and GS1 Application Identifiers

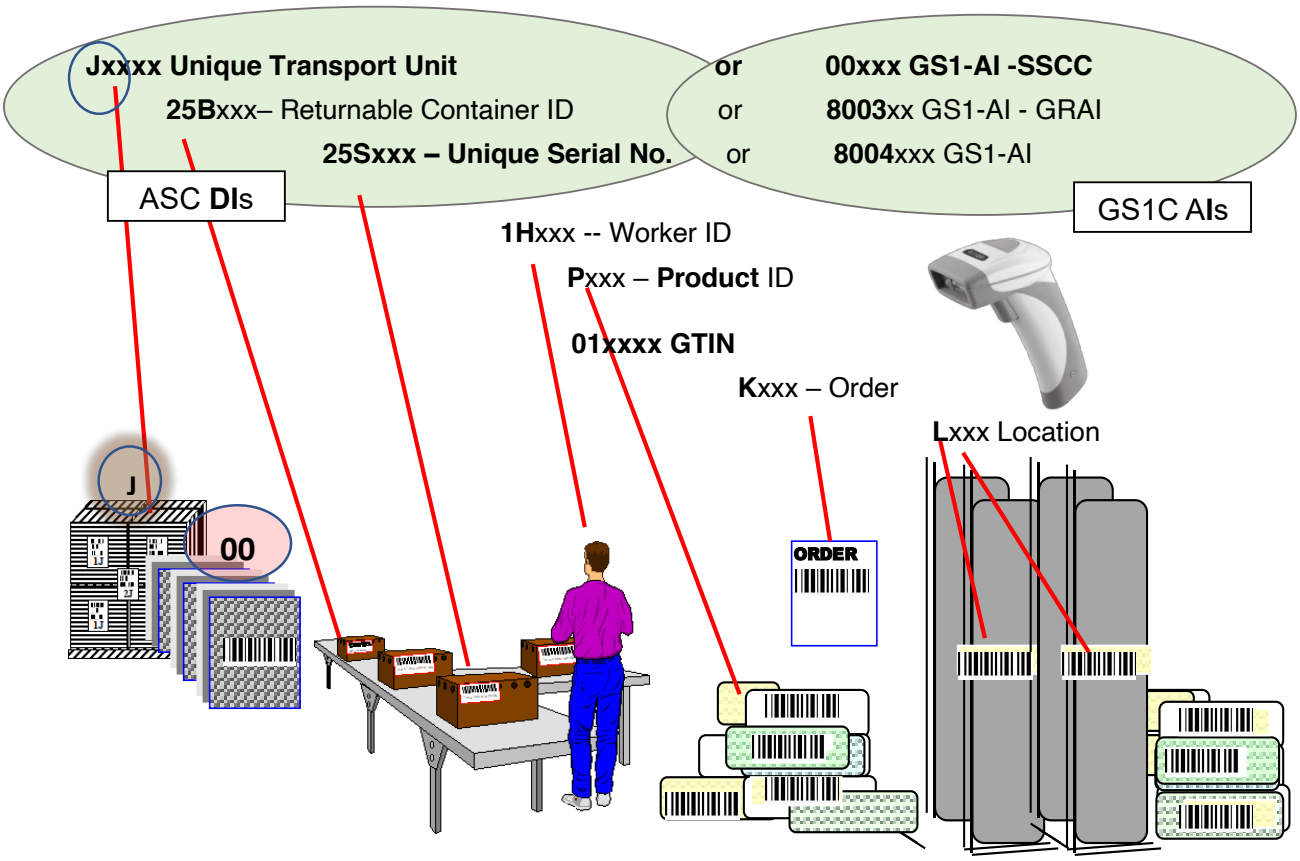


Fig. 3. ASC DIs or GS1 AIs for unique scanning of every item (FLAGs are not illustrated)

AIDC Standards and applications in progress

Standardization of AIDC includes data carrier and data. Adopting of standards is in a continuing progress for solving problems and for optimizations. Some solutions shall be illustrated by means of selected examples. Five examples are showing specific solutions below. There is a “before” and an “after” illustrated at table 1) and barcode symbols as FLAGs and syntax are important elements for the individual solution.

Example 1: Adaption of ISO/IEC 21471 Data Matrix Rectangular Extension (DMRE)
to solve the space problem of a small device. DMRE has been developed to fill the gap between small surfaces and symbols being not adoptive enough to solve the problem. Fig. 4) is showing the benefit of before and after.

Fig. 4. A small medical device hall get an UDI code, a square Data Matrix would be to large but a DMRE does fit.

Example 2) The IFA CODING SYSTEM adopted *DIN 16598 Syntax for keyboard and Web compatible encoding of data elements in machine readable symbols applied with ASC Data Identifiers for the **“Health Product Code (HPC)”** to ease implementation for the labeler and to simplify scanning and processing at the points of scanning.

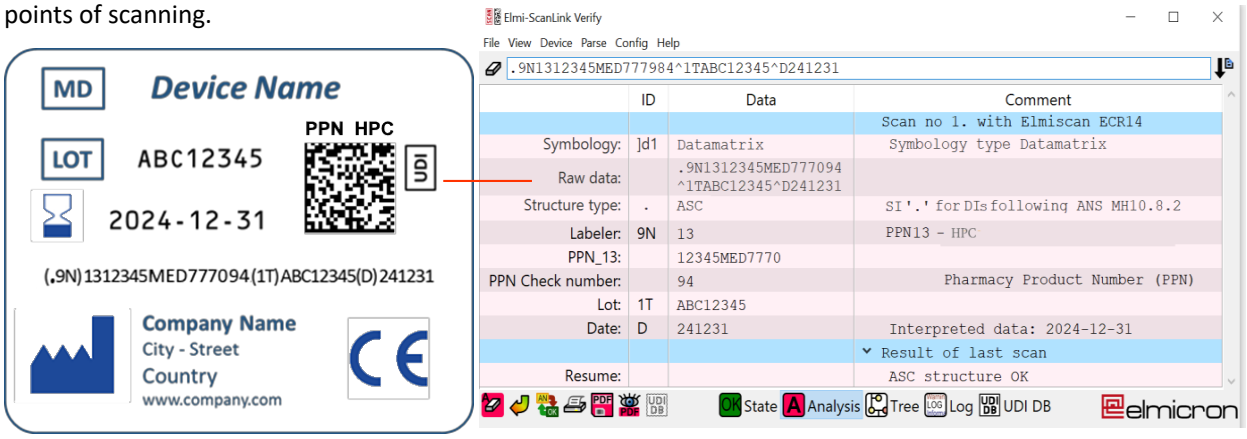


Fig. 5. UDI Health Product Code (HPC) of a medical device within the IFA CODING SYSTEM + Scan analysis

***Note:** See chapter “UDI” with another example of adopting standards, the IDCODE from ZIIOT.*

Example 3) Adaption of keyboard and Internet compatible Syntax *DIN 16598 to ease scanning for logistical processes for live saving boxes to be uniquely identified all over the world, specifically by smart phone and in emergency cases.

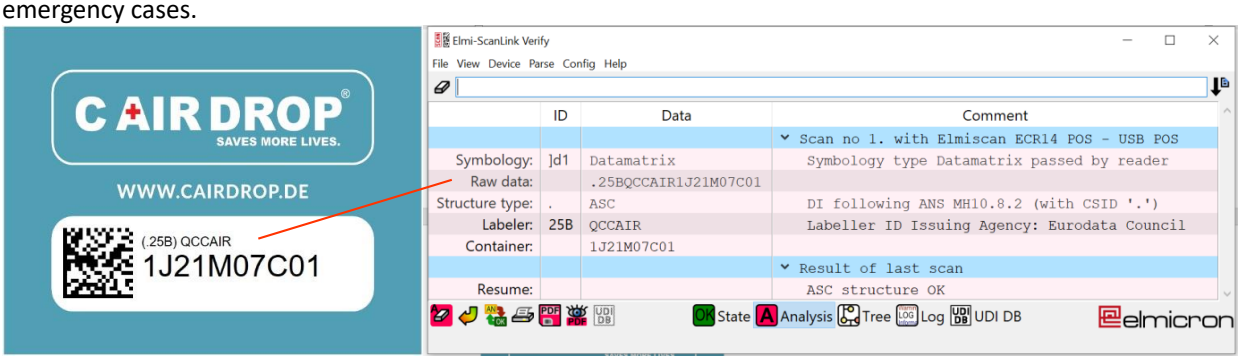


Fig. 6. Unique container code for Life-saving box for emergency care + Scan analysis

**Note: DIN 16598 includes the DOT (.) as System Identifier and the (^) as delimiter for concatenated data.*

Example 4) Combined item identification and Internet Link (ID+URL) for access to additional information or opening Internet dialog by means of ASC DI "34L Pointer to process (P2P)"

Fig. 7. Item ID + Internet link using ADC Data Identifier syntax

Note: In this example CIN 123456789 is the DUNS No. of SECUREUID.COM

Here, "Item Management" is using the unique serial number, the first part of the code-

→ "**(25S)UN123456789PA1234**",

but as link to the WEB the whole code is used, where the item part will moved at the end **becoming** appendix to the **WEB address** linking to the specific serial number in this case transmitted in syntax RFC 1738 as URL:

→ HTTP://WWW.SECUREUID.COM/ITEMDATA/?SCAN=**25SUN123456789PA1234** → WEB LINK

Note 1: The labeler of that code also might care for maintenance of the Internet site reached by that link.
Note 2: For processing the data of a "34L" element see definition ANSI MH10.8.2. , category "L", DI "34L"

4b) IDENTIFICATION LINK (IL) IEC 61406: "URL first – ID after (URL+ID)"

"Identification Link" is the term of "IEC 61406 ED1 Identification Link – Unambiguous biunique Machine-Readable Identification", an approach for using WEB domains as unique ID and WEB syntax for encoding in AIDC media. IEC 61406 is in the final committee stage of the of the Electrotechnical Committee (IEC), TC 65/SC 65E Devices and integration in enterprise systems, expected release is early 2022. "IEC 61406" is promoted by the Electrotechnical Committee for their business area for use on product nameplates.
An excerpt of the scope of IEC 61406 explains the intention:
<Quote>
"SCOPE: This standard specifies minimum requirements for a globally unique identification of physical objects which also constitutes a link to its related digital information. This identification is designated hereinafter as "Identification Link" (IL), with the encoded data designated as IL string. The IL string has the data-format of a link (URL/URI). The IL is machine-readable and is attached to the physical object in a 2D symbol or NFC tag. The requirements in this standard apply to physical objects,
• that are provided by the manufacturer as an individual unit,
• and that have already been given a unique identity by the manufacturer.
<End of quote >

The construct of an IL is defined as "Domain URL + Alphanumeric string, freely chosen by the creator of the IL". No content is encoded in the alphanumeric string; its only property is that it is unique within the domain.
Let's call the IL construct "**URL+ID**".
The Alphanumeric string can be applied with an ASC DI, e.g. "25S" for a Serial number, but it is up to the generator of the IL how the string might be constructed and how it may link to an item internally.

Fig. 8. Data Matrix carrying IEC 61406 Identification Link "URL first – ID after (URL+ID)

Example 5) GS1 solution combining item identification and Internet Link using AI "8200 Extended packaging URL"

Where the DI "34L" specifying rules how to combine any data element and also concatenated data elements with a WEB link, the AI "8200" is supplying a WEB link to a GTIN (example 5b goes further).

FNC1**01**09234567123457**8200**HTTP://WWW.SECUREUID.COM/ITEMDATA/

Fig. 9. Item ID + Internet link using GS1 Application Identifier syntax with URL add on

Scanned data of example 5) will be transmitted to the WEB by swopping GTIN and URL, see below example 5 continued. Encoded structure: **ID + URL**

Transmitted as: **URL + ID**

Also here like example 4) the first part of the code, which is the GTIN in this case, will be used for item management: → "**(01)09234567123457**",

but for linking to the WEB both data elements will be used, where the item part, the GTIN, will be moved to the end of the URL **becoming** appendix to the **WEB address** transmitted in syntax RFC 1738 as below:

HTTP://WWW.SECUREUID.COM/ITEMDATA/09234567123457

The GS1 solution to add an URL to an item ID is similar to the ASC DI solution with DI "34L" but AI 8200 is dedicated to a GTIN. The Example 5b) goes further toward full use of the WEB syntax instead of AIDC syntax.

Example 5b) "URL + ID" GS1 Initiative for full use of WEB RFC 1738 syntax

In opposite to "**ID first – URL after**", the "GS1 Web URI Structure Standard" is using the "**URL first – ID after**" approach. The WEB URI standard of 2018 describes how to build a WEB URI by UDI domain (URL)followed by data elements flagged by GS1 AIs or it's short terms for building a WEB URI for encoding in symbols like Data Matrix, QR, etc. The structure is <URL><separator><data element><separator><etc.>. Separator is the character < / >. A GTIN in such a WEB syntax simply will be flagged by the AI <01> or by the short term <gtin>, similar with all other AIs of the GS1 GenSpec. URL comes first as the domain address, followed by the identification key "GTIN" followed by the GTIN number separated by "/",

e.g. domain "example.com" and GTIN "5000127163096"

*Encoded string: http://example.com/gtin/5000127163096

As alternative coding AI "01" can be used as identification key:

*Encoded string: http://example.com/01/5000127163096

**Note: Source of the example "GS1 Web URI Structure Standard (2018)", table 4.1.*

The initiative may be an attempt to motivate to follow the GS1 proposal instead of simply using a domain address, where the information to an item can be found. But it may also motivate to try to avoid the GS1 AI syntax in favor of compatibility to WEB syntax RFC 1738 ?

Lets compare the example 5b) with an example of a regular WEB address followed by a product key and both encoded in QR-Code:

URL+ID

http://example.com/gtin/5000127163096 http://example.com/healthpro99B

Fig. 10. Comparison WEB link to a product with a GTIN and with another product reference – same principle

The difference is, that the WEB link with /gtin/ tells what the value is meaning, the right sample doesn't tell anything but "I'm an URI.

Before and After approach for the 5 examples

1 to 5

Where the 5 examples are not necessarily self-explanatory, table 2) may try to summarize the approach in view of “before and benefit after”.

Table 2) Before and after to application examples 1 to 5

#	before	intention	solution	example	benefit after
1	Space problem on small surface	Unique coding (UDI)	Choose DMRE	+J017A6D344CU0/$H31Z	DMRE fit’s to space
2	Codes with complex ISO/IEC 15434 syntax	Keyboard + Internet compatibility	ASC DI’s in KB/Internet compatible syntax	<.><9N13><REF><CC>^… .9N13MEDIX12B129^1TLOT99	Uniqueness & simplification for both labeler as user
3	Just a container number	Global uniqueness, simplification, easiness	ASC DI’s in KB/Internet compatible syntax	<.><25B><IAC><CIN><SN> .25BQCCAIR1J21M07C	easy and unambiguous handling anywhere in the world
4	Item ID - No WEB link	Direct link to Internet information	4a) Add ASC DI “34L” with URL in ASC structure and use item code for item manage-ment and whole code for WEB access	<.><25P><REF>^<34L><URL> .25SUN123456789PA1234^34LHTTP://WWW.SECUREUID.COM/ITEMDATA/?SCAN=	a) Backward compatible item identification combined with WEB Link. ID usable without WEB connection.
			4b) or move to WEB syntax like IEC 61406.	<URL><DI><value> HTTP://WWW.SECUREUID.COM/ITEM?DI=25SUN123456789PA1234	b) just WEB compatible for WEB environment, if this is the intention.
5	GS1 AIs - No Internet Link	Direct link from to Internet information sources	a) Place GS1 “Extended Packaging URL”: AI “8200” and URL after a GTIN	<GTIN><8200><URL> (01)09234567123457(8200)HTTP://WWW.SECUREUID.COM/ITEMDATA/	a) Backward compatible GTIN identification combined with WEB Link. ID usable without WEB connection.
			b) or move to GS1 Web URI Structure Standard	<URL><AI/term><value> http://example.com/01/5000127163096	b) just WEB compatibility for WEB environment, if this is the intention

This approach included some examples for illustration of solutions but it is not exhaustive in view of continuing development of AIDC and it’s applications and might be completed by contributors of different areas not having been mentioned.

Facing a certain trend to WEB syntax specifically for IoT applications and learning from example 4a,b) and 5a,b) it migth be appropriate to look for a solution for using a WEB domain like a unique Company ID in conjunction with ASC DI data elements. The GS1 Digital Link is showing the principles, also the converted URI out of a code including DI “34L”.
Lets go to a **“ASC DI Digital Link” IoT scenario**
as illustrated below.

“ASC DI Digital Link” IoT scenario

As shown and discussed above, regular “QR-CODE LINKs”, the “IDENTIFICATION LINK (IL) IEC 61406” and the “GS1 DIGITAL LINK” are showing the interest in using WEB syntax for encoding and scanning.
So, why not to draw down a scenario for using ASC Data Identifiers within WEB syntax.
With DI “34L - Pointer to Process URL (P2P URL)” conversion from ASC structure to WEB structure has been done already, so it does not need much, to describe the mechanism to encode such a WEB link, let’s call it “ASC DI Digital Link”.
The modules of such a “ASC DI Digital Link” would be:

<URL> the Domain name in function as unique company ID like “IAC + CIN” in ISO/IEC 15459 environment.
</ART> the code indicator what the code is about, here article/item data are encoded
</?> the query indicator that data are following
<DI> Data Identifier according to ISO/IEC 15418, part ANSI MH10.8.2
<=> the control between DI and value
<Value> the data following the DI
<&> the separator to concatenated DI headed data elements

“ASC DI DIGITAL LINK” logical sequence:

<URL domain><code indicator><query indicator><DI><=><value><separator><DI><value>, etc.

Example with domain “https://srv.de”, Article/PN “ABC345”, Serial Number “98765”, prod date “2022-03-09”:

https://srv.de/ART/?DI**1P**=ABC345&DI**S**=98765&DI**16D**20220309

Within the query string, not every character can be encoded directly, some shell be “percent encoded”.
Letters (A–Z and a–z), numbers (0–9) and the characters '~','-','.' and '_' belong to the standard characters for the data, others like Slash "/" should be encoded as: "%2F" in the query segment of the WEB string.
Notes to the structure of a “Query string” can be found under:
https://en.wikipedia.org/wiki/Query_string#URL_encoding

As logical consequence upgrade of ISO/IEC 15459 Unique identification would apply as well:

- **Inclusion of “Internet Domain” in ISO/IEC 1549 equal to “IAC+CIN”**
  as Partner Identification Code (PIC).

While the developments are going on, any comment is appreciated and will be summarized in one of the next reports.
Note: If there is interest, the above definition could serve as the basis for a public document produced by an ad hoc working group.

Considerations to WEB syntax “URL+ID” versus AIDC syntax “ID+URL”

Item IDs constructed as “**URL+ID**” like the Identification Link constitute a WEB address purely, but would it be processed by today’s data entry systems as AIDC syntax do?
The scope of the Identification Link includes the term *“globally unique identification”* but to process it is technically restricted to applications where the WEB syntax is used without request for identifiying meanings of the data at the users side or just as a generic data string.
According to IEC 61406, the responsibility for ensuring that the Identification Link is unique lies with the manufacturer owing a Domain address.
The “**URL+ID**” approach has similarities to the GS1 approach of example 5b) “GS1 Web URI Structure Standard” but GS1 is recommending AIs or it’s short terms for the data following after the leading Domain URL instead of leaving it to the labeler.
The ASC DI DIGITAL LINK” IOT SCENARIO has been add to show the possibility of an alternative approach using ASC DIs for meaningful data elements like GS1 AIs with the Digital Link.

CONSIDERATIONS TO WEB SYNTAX CONTINUED

It might be appropriate to raise some questions to the different WEB syntax approaches for getting a better picture of it.
The examples 4 to 5b may lead to the question:
"Should WEB syntax for Auto ID applications remain a supplement option like example 4a) and 5a) or could it be a solid alternative to today's practices like examples 4b and 5b?"

Additional questions related to the examples may bring even more light in the scenarios of AIDC syntax versus WEB syntax or combinations and preferences:

*# Does the "**URL+ID**" approach have the power to replace ISO/IEC 15418 AIs and DIs and it's syntax?*
*# Is today's infrastructure for item management and tracking & tracing set for **"URL+ID"** Codes in WEB syntax?*
 # Is the WEB and it's syntax a good trend for safe unique identification or just an aid for communication?
 # Is combination of AIDC syntax for Unique Item Identification (UID) and WEB syntax for WEB look up (see DI 34L, AI 8200) a preferable solution?
 # Will separation between UID and WEB link (URI) remain common practice, like one code for UID and one for the WEB (QR)?
Further questions for discussion relate to user areas:
 # What areas will keep ISO/IEC 15459 practices "Unique AIDC ID first-URL separated", examples 4a,5a)
Areas: ……, ……., ……., ……., …….
*# What areas may use **"URL+ID"** (URL first – Data after in RFC 1738 syntax - example 4b, 5b):*
Areas: ……, ……., ……., ……., …….

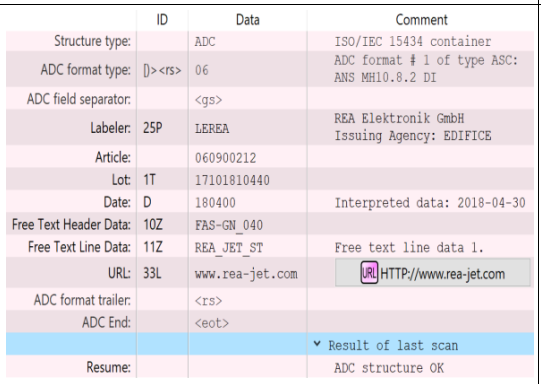
Please direct your answers or comments to the authors to mail address info@e-d-c.info
A summary can be published and inserted in the next report issue.

Labeling practices - How do AIDC manufacturers label?

It would also be interesting to venture a look at the practices of labeling by AIDC providers as manufacturers of AIDC equipment. Do they mark all their products to standard?, so that distributors, like end users, can use the codes for inventory and maintenance documentation with all the clarity that standards provide?

Let's have a look at a few label examples that have recently come to the editor's attention. It is the intention to show optimization potentials but it is not the intention to reprimand certain companies, therefore company brand has been blacked out.

Table 3) Examples of AIDC manufacturers labels

Example	Analysis/Comments	Potential optimization
 T3.1		Perfect label performing for global tracking & tracing as for product information via WEB! ← *Source of label, see "33L"*

LABELING PRACTICES CONTINUED

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T3.2</td>
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<tr><td>Symbology:</td><td>]L0</td><td>PDF417</td><td>Symbology type PDF417 passed by reader</td></tr>
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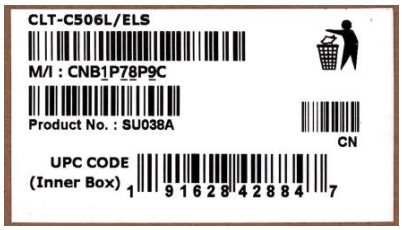
<tr><td>Article:</td><td>1P</td><td>DS2278-HC0000BZZRW<9>VN<9>S200915237 01153</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Result of last scan</td></tr>
<tr><td>Resume:</td><td></td><td></td><td>ASC structure OK</td></tr>
</table>
</td>
<td>Data can be interpreted, but company ID is not present. Adding an ASC Data Identifier with company ID (e.g. 18V) or company ID to Part number (e.g. 25P) or to SN (e.g. 25S) would make the label globally unique by telling who the labeler is and differentiating to numbers of other labeler.</td>
</tr>
<tr>
<td> 

T3.3</td>
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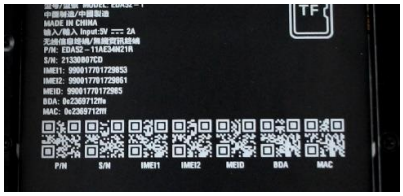
<tr><td>Raw data:</td><td></td><td>191628428847</td><td></td></tr>
<tr><td>Structure type:</td><td></td><td>EAN/UPC</td><td>GTIN</td></tr>
<tr><td>Article:</td><td></td><td>19162842884</td><td>GTIN-12 product code Labeller ID Issuing Agency: GS1</td></tr>
<tr><td>Check character:</td><td></td><td>7</td><td>Modulo 10 check character correct</td></tr>
<tr><td></td><td></td><td></td><td>Result of last scan</td></tr>
<tr><td>Resume:</td><td></td><td></td><td>EAN/UPC structure OK</td></tr>
</table>
The UPC Code is unique, but the other 3 codes are not. Product No. SU038A could wrongly be interpreted as flagged by ASC DI “S” for SN. UPC alone does not perform for tracking and tracing by Date, LOT or SN.
</td>
<td>Computer identifies the UPC code, but In order to tell to the computer what the content is of the other codes is, add the appropriate GS1 Application Identifiers or ASC Data Identifiers,
e.g. for Country of Origin Code “CN”:
(422)CHN or (4L)CN, similar to the other two codes according to content.</td>
</tr>
<tr>
<td> 

T3.4</td>
<td>This is a package label of a supplier of barcode equipment too. The two code lines are encoded in Code 39 without identifiers. A data entry system would read the code but would conclude “unknown structure” because of missing identifiers.</td>
<td>Add ASC Data Identifiers for unique codes, e.g. add “25P” sequence with IAC and CIN to product code and ASC DI “S” to Serial number in the codes. Example with IAC “QC” and CIN “Comp” linear coded:
(25P)QCCOMPWWCG20032
(S)FH202742
Option “one” Data Matrix: .(25P)QCCOMPWWCG20032^(S)FH202742</td>
</tr>
<tr>
<td> 

T3.5</td>
<td>This is a label of a barcode scanning device. The QR Code is containing just the serial number as printed in the text, no structure at all.
The Code content: E52N2138</td>
<td>In order to make the code useful for automatic data capture, add DI for unique SNs “25S” for IAC and CIN prior to SN:
Example with Issuing Agency Code “MA” of ZIIOT, CIN “276.M0.100001” and SN:
.25SMA.276.M0.100001.E52N2138</td>
</tr>
<tr>
<td> 
T3.6</td>
<td>This is a label of a barcode scanning device too. For whom might be this code benefitial?
Seven QR Codes are attached closely together, hart to read each single code. If you read it, you see nacked data without any structure:
QR1: EDA52-11AE34N21R (PN),
QR2: 21330B07CD (SN),
QR3: 990017701729853 (IME11 ?), etc.</td>
<td>One QR would be convinient. For global useability of the data content each data element should be applied with a Data Identifiers. Some data elements might be for internal use only and could be printed in a separate code marked “for internal use” or similar. The example contains DI 25P with IAC, CIN above and SN:
.25PMA.276.M0.100001.EDA52-11AE34N21R^S21330B07CD</td>
</tr>
<tr>
<td colspan="3">Please provide more samples for analysing and to get a wider picture.</td>
</tr>
</table>

As you can see, it might be worth wile to check the CODE CONTENT and STRUCTURE carefully prior to label the products. ISO/IEC 15459-3 provides the rules how to label products uniquely and unique labeling is the pre-requisite for tracking and tracing throughout a supply chain. Some regulations require already such unique codes as mandatory, like for medical devices, etc. We can see the acceptance by labelers facing that the efforts of providing unique codes are appreciated by the users for automation of data entry and documentation at users processes.

Radio Frequency Identification - RFID

Radio Frequency Identification has been seen as “THE future technology” for automatic identification, even seen as replacing barcode soon. But it did not happen yet as predicted and the question is, and the question may be asked why this has not been achieved in this way?
Reasons might be that the technology is pretty much depending on the environment where the RFID Tags should be read. And the technology needs much more engineering then barcode would need for scanning, RFID is “High Tech”. Institutions such as the RAIN Alliance are trying to improve the attractiveness of UHF RFID (see RAIN Alliance chapter below), because it's not just about technology and cost, but about the benefits that can be achieved with RFID.
Nevertheless RFID is getting ground steadily offering features, barcode does not have, e.g. invisible scanning without optical contact. The example below is typical for a successful RFID implementation for automation of a weighing process using HF Air Interface 13,56 MHz.

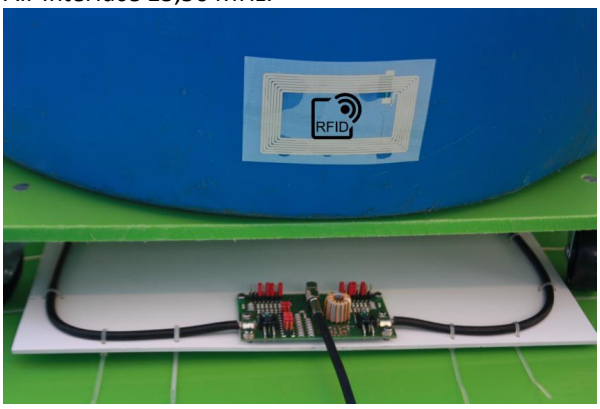


Fig. 11. RFID Application: Scale reads RFID TAG (HF) during the weighing process of a barrel.

Weight and keg ID will be captured automatically, here within a production process. This method is enabling the documentation of the weight of each individual empty or full barrel.

There are many of similar RFID applications where RFID is transferring data and connecting items to processes, mostly of local nature or bound to closed applications where the system parameters are under control. Nevertheless, RFID is attractive for supply chain management. GS1 does it’s best to promote RFID for global applications by means of the “Electronic Product Code – EPC” concept where other organizations try it with different data structures.

The RFID Emblem has been standardized on demand of regulators in order to inform users about the existence of an RFID system and they could be registered automatically and invisibly. But the emblem is also beneficial for handling reasons to tell that an item is readable by RFID. Barcode would not need an emblem, it is visible anyway.

Fig. 12. ISO/IEC 29160 RFID emblem

Fig. 13. RAIN Alliance trademark

Alliance for promoting RFID: RAdio frequency IdentificatioN – RAIN

President RAIN Alliance: Steve Halliday

The RAIN Alliance is an Alliance of companies representing the use of passive UHF RFID. The brand name RAIN distinguishes the technology from other less used RFID technologies. RAIN RFID is used in many industries/applications including retail, healthcare, and aviation. RAIN tags conform to the air interface standardized by ISO as ISO/IEC 18000-63 and GS1 as the GS1 UHF Gen 2 air interface. Unlike barcodes which require a visual identification of the image, RAIN tags can be seen and identified at up to 1000 tags per second without the need for a visible sight of the tags.

Fig. 14. ISO/IEC 18000-63 RFID TAG

GS1 EPC standard provides a unique way to identify a tag and the application that it is attached to with their EPC data system. With the proliferation of RAIN tags, many organizations have taken to encoding their own data in the tag without due regard to the standards that exist. This causes Tag Clutter which is defined as tags intended for use in one application impact the performance of another system or application (Acid RAIN) or when too many tags are present in the field at the same time in the read zone resulting in some tags not being read (RAIN Flooding).

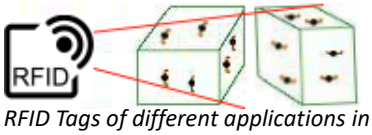


Fig. 15. RFID Tags of different applications in a reading zone

The RAIN Alliance looked for a way to reduce Tag Clutter.

Recently the RAIN ALLIANCE announced its new ISO numbering system at WEB page:
https://rainrfid.org/technology/rain-alliance-iso-numbering-system/
For entering in the family of ISO standard users RAIN applied for ISO/IEC 15459-2 ISSUING AGENCY. RAIN has got the **Issuing Agency Code "XRA"** from the authorized Registration Agency AIM Global,
see https://www.aimglobal.org/uploads/1/2/4/5/124501539/register-iac-def_2022.pdf

Now RAIN is an Issuing Agency with more then 40 other "IAs" is registering ISO/IEC 15459-3 Company Identification Codes (CIN) as of Feb. 2022 for users of RAIN RFID. RAIN CINs are registered on request with length of 2, 4, 6 or 8 digits. RAIN is stating in the terms of use:
"Assignee shall use the XRA CIN only in compliance with the applicable ISO standards and this Agreement."
These ISO standards are subject of ISO/IEC JTC 1/SC 31, Working Group 2 and 4, where delegates of RAIN are cooperating *(see chapters WG2 and WG4).*

RAIN has also applied for and been issued with the Application Family Identifier (AFI) AE. When the AFI and the CIN are used together this provides a standards-based method of uniquely identifying the tags in use with the ability to filter these tags from non-conforming tags for a reduction in Tag Clutter. The RAIN CINs are available at minimum cost to any user of the technology. One of the first application to use the RAIN CIN is Amerisource Bergen (https://www.amerisourcebergen.com/newsroom/press-releases/acute-care-medication-tray-solution) for their medication tray solution. Other companies are applying for this easy-to-use data system. The RAIN web site has full details of the system - https://rainrfid.org/CIN/ along with a chart to help people decide how to put data in a RAIN tag and which numbering system they should be using.

The RAIN RFID Alliance is an organization supporting the universal adoption of RAIN UHF RFID technology. A wireless technology that connects billions of everyday items to the internet, enabling businesses and consumers to identify, locate, authenticate, and engage each item. The technology is based on the GS1 EPC Gen2 UHF RFID specification, incorporated into the ISO/IEC 18000-63 standard.
Membership in the RAIN Alliance is open to any company with an interest in the technology. See more at www.rainrfid.org/members/join/

Note: Thanks to Steve Halliday, President of RAIN UHF Alliance, for his contribution to this chapter.

AIDC STANDARDIZATION by ISO/IEC JTC1/SC 31

The Committee ISO/IEC JTC 1/SC 31 for Automatic Identification & Data Capture is embedded in the ISO/IEC network for standards that connect the world
https://www.iso.org/committee/45332.html

AIDC, the technology for Automatic Identification & Data Capture, is merging in IT systems as a connecting key for communication between items and data bases accessible via interfaces of ERP systems and/or Internet. With AIDC the authenticity of items and sources of coded information can be secured, counterfeiting avoided and handling optimized. The globally agreed ISO standards provide the basis for application of AIDC consisting of the standard modules for data carriers like barcode and RFID, it's quality specifications and even more important, the data structures, syntax and repositories for data elements. The standards for the AIDC media provides the means for carrying the data where the standards for data structures and syntax care for uniqueness of the uniqueness where ever they will be scanned and processed.

The standardization projects have a different importance for different parties, but important for all parties is

➔ Reliability and stability of the standards.

ISO/IEC JTC 1/SC 31 was specifically formed by stakeholders to harmonize standards for automatic identification and data collection. SC 31 is integrated into the infrastructure of the Joint Technical Committee (JTC1) of ISO and IEC with a focus on standards for information technologies. Figure 8) shows an excerpt from the structure of this standardization network.

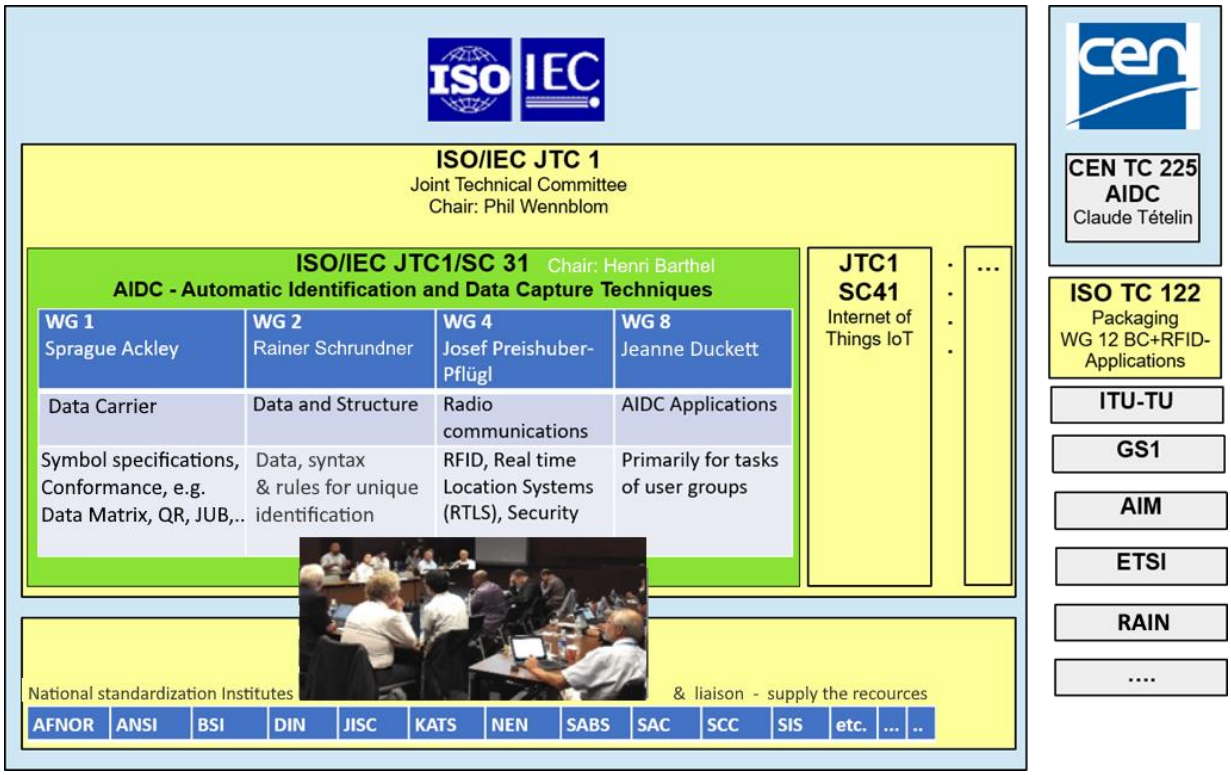


Fig. 16. Structure of ISO/IEC JTC1/SC 31, embedded in the network of ISO and IEC, and related organizations

ISO/IEC JTC1/SC 31 committee work

ISO/IEC JTC1/SC 31 was given responsibility for AIDC by the controlling ISO/IEC Joint Technical Committee JTC1 and has the objective of bringing standardization projects (New Work Items -NWI) according to the ISO rules at the request of the members and ensuring the continuous maintenance of the standards already published.
The strength of the ISO/IEC JTC 1/Sub Committee 31 is the combined expertise and experience of the delegates of the National Standards Institutes and liaison. See Fig 9) with flags of ISO/IEC JTC 1/SC 31 member countries (an excerpt, not complete).

Australia	Austria	Belgium	China	Canada	Switzerland	Germany	Finland	France
Japan	Singapore	S. Africa	S.Korea	Sweden	NL	Russia	UK	USA
.. and contributing organizations, e.g.:								
AIM	**CEN TC225**	**RAIN**	**EDC**	**ETSI**	**GS1**	**IATA**	**ISO TC122**	**IFA**	**ITU**	**SC41 IoT**	**UPU**

Fig. 17. Some flags of ISO members and contributing liaisons

Resources for the committee work are provided from the contributors, some being in business for standardization since a long time. For example, 2017 the **German Institute for Standardization DIN celebrated its 100th anniversary** (1922 - the DIN paper format standard, like “A4” used for the report, today). SC31 was found 1996 celebrating 25 years anniversary June 17, 2021. Maintenance of existing standards and new projects is keeping the committee busy.
There is a regulated procedure for the standardization processes. Each project has to go through an agreement procedure of the members before the elaboration process starts. ISO rules require a 2/3 majority of the members entitled to vote (P-Members) for the admission of new projects. Proposed standardization projects with a positive vote are allocated to the relevant Working Group (WG).
The actual standardization process with the development of ISO/IEC standards consists of defined process stages, which are made visible by an indicator (n): Proposed Work Item - PWI (10), Approved Work Item - AWI (20), Working Document – WD at committee processing stage (30), survey stage for the Draft International Standard - DIS provided (40), positive vote on "Approval Stage" (50) and final publication stage (60). The revision level is (90). Each individual level is in turn assigned an additional attribute for detail steps within the level using a decimal point. Each project is listed in the ISO catalogue; the indicators make the status of the standard transparent, see "International harmonized stage codes" https://www.iso.org/stage-codes.html#60.00
The results of the Working Groups with status 40/50 have to be voted on by a 2/3 majority of the "P-Members" entitled to vote before it is published. The SC 31 is involved in the ISO network with other committees. Through cooperation and exchange, duplications are to be avoided across the board. Figure 1) illustrates links to committees and organizations such as AIM, CEN TC 225, ETSI, GS1, ISO TC 122, SC 41, etc.
Every year a planery meeting takes place. Invited are the representatives of the national standards committees, liaison partners and the project leaders and editors. The plenary meeting is for control of ongoing projects, for discussions on new projects and on responsibilities.
The last “Face to Face” meeting took place 2019 in Qingdao, China but all subsequent meetings have been held virtually.
The 2022 meeting June 2022, 14-17, is planned to be virtually again and organized by the National Standardization Institute of **South Korea**. The meeting after should turn for Europe.
There are advantages and disadvantages of F2F versus virtually, the disadvantage of not meeting each other face to face was compensated by the advantage of time and cost savings. Nevertheless most of the delegates missed the personal contacts and the social events helping to understand the thoughts of each other much better and to ease agreements.

AIDC projects of the Working Groups

AIDC media standardization belongs to Working Group 1

Convenor Sprague Ackley.

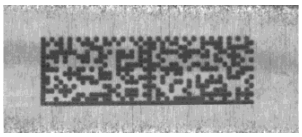
AIDC media includes the linear and two-dimensional symbologies but also OCR and its quality test specifications. Last Face to Face meeting took place in Boulder (USA) 26 to-28 of March 2019, all subsequent meeting by conference calls.

Fig. 18. WG1 Virtual meeting

The current projects of WG1 include new projects, finalizations and maintenance. Data Matrix rectangular extension has been published as ISO/IEC 21471 DMRE in 2020 already, Han XIN code (ISO/IEC 20830) was publish 2021. The rectangular extension of QR and the colored JAB Code – Just Another Barcode will follow 2022.
Finalization of the Quality guideline for direct part marking (DPM) ISO/IEC 29158 was a major project. "Continuous Quality Grading" has been add in order to meet the special conditions of Direct Part Marking technologies.
The pre-work of the WG1 study group on Character Set encoding (Unicode & others) led to the new project "Extended Channel Interpretation (ECI) for 2D-symbols".

Table 4 is illustrating some of the symbols subject of the WG1 work.

ISO/IEC 21471 DMRE Data Matrix Rectangular Extension, 18 rectangular formats have been add to the 6 original formats for more data on small surfaces by 24 rectangular sizes, e.g.  See: www.dmre.info Project editor: Harald Oehlmann	ISO/IEC 20830 Han XIN code a 2-dimensional matrix code developed by the Chinese Standards Institute and specialized for China character sets and URLs. See: https://committee.iso.org/standard/69321.html?browse=tc Project editor: Wang Yi
QR Code extension: ISO/IEC 23941 Rectangular Micro QR (rMQR) is following the idea of DMRE and in "approval stage (50)" for estimated publication early in 2022. See www.iso.org/standard/77404.html	ISO/IEC DIS 23634.2 Just another Bar code (JAB) is a 3-dimensional code for high volume data capacity. See: https://jabcode.org/

Project editor: Tomohiro Watanabe	Project editor: Waldemar Berchtold
Revision of ISO/IEC 16022 Data Matrix The standard is getting an update reflecting the development of “continuous grading” and other technical details.  Project editor: Harald Oehlmann	ISO/IEC 29158 Quality guideline for direct part marking (DPM) moved from Technical Report (TR) to standard. Major update: Continuous Quality Grading”.  See: AIDC report 2019 https://www.e-d-c.info/images/documents/guidelines/AIDC-Report-2019-en.pdf Project editor: Harald Oehlmann

New WG1 work item for encoding international character sets:

Extended Channel Interpretation (ECI) for encoding languages in 2D-symbols

Logistic codes, codes for international use for data collection, are defined as simple as possible with character sets understandable everywhere. This is usually the case with numbers and uppercase letters in the Latin character set. But as more barcode is used, the more ideas come up for extension of applications, e.g. to transmission of terms written in specific character sets like Slavic, Kanji, Korean and many other languages. Think about coded names on wrist bands or ID cards.

Two dimensional symbols like Data Matrix or QR offer for example a switch to “UNICODE” (ISO 10646) to encode ISO°8802 character sets. The default character set is ISO-Latin1. Within this character set, the character “Ö” can be encode e.g. in Data Matrix with the symbol code word “214”. The name “Ölmann" encoded in Data Matrix after ASC DI “1H” (DI for Employee Identification Code) will look like the sample to the right →→→→→→→→→→→→→→→→→→→→

In this case Data Matrix contains: <1><H><214><h><l><m><a><n><n>
So, Data Matrix enables encoding of “**Ö**” according to ISO LATIN-1 by help of the symbol character Byte <214> without ECI.
With activated symbology ID the scanner would transmit “<]d1>1H**Ö**hlmann”.
*Note: The ISO/IEC 15424 symbology identifier “]d1” informs the application, that **no ECI** is used and thus, the default encoding ISO-Latin1 applies.*

There are names and terms to be encoded but written in characters of character sets not being supported by the 2d-symbols’ default character encoding. For such cases “Extended Channel Interpretation (ECI)” is the solution.

If we would want to encode the character <ę> (ISO-Latin2) with the Slavic name “Jędrek”, then e.g. Data Matrix or QR Code would not offer a code word for it, but ECI solves the problem. Staying with the Data Matrix sample, the 2d-symbol specification has been provided with a switch to “ECI” already, even so Data Matrix has got a specific symbol identifier for it, indicating “I’m carrying ECI encoded characters”. The symbol ID is <]d4>.

Let’s illustrate the functionality of ECI

by encoding the name “Jędrek” for an ID card code flagged with ASC DI “1H” → the ECI value for the ISO-Latin 2 character table is <4> and the ISO-Latin2 Byte value is <234>. The ISO-Latin2 Byte value <234> applied with the ECI value would be shifted to the proper interpretation of the reader output.

The sample “1Hjędrek” contains: <ECI:4><1><H><J><234><d><r><e><k>
Data Matrix enables encoding of <ę> according to ISO-LATIN2 by help of ECI value <4> of a the ECI table shifting the interpretation of the symbol character <234>. The scanner would transmit “]d4\0000041HJ<234>drek”.
An application is informed by the symbology ID “]d4”, that an ECI is used and that the ECI number will follow. The application receives ECI 4 by the sequence “\000004” and thus interprets the received message as ISO-Latin2 encoded data. Thus, the understood message is: “1HJędrek”
The idea of “ECI” came along with the development of the stacked code “ISO/IEC 15438 PDF417” for optimizing support of languages. ECI become standard published in 2004 as “AIM Technical Specification on Extended Channel Interpretations (ECI). The ECI standard specifies the protocol for extending the interpretative capabilities of basic 7-bit, 8-bit, multi-byte and 16-bit codes when the data is encoded in data

carriers. The 3 parts contain Part I defining the protocol, Part II defining the registration process for additional ECIs and Part III is the registry of current ECIs.
The outcome of the WG1 will be a state-of-the art ISO/IEC ECI standard based on the given AIM standard, appointed project editor is Harald Oehlmann.

Working Group 2 AIDC data structures

After Joo-Sang Park from Korea and interim of Henri Barthel now Rainer Schrundner (DIN) became Convenor of SC31 WG2 in 2021. WG2 is responsible for key standards of AIDC data structures and syntax such as ISO/IEC 15459 Unique Identification, which forms the basis for unique identifiers (see ANNEX Quick Guide), ISO/IEC 15434 Syntax for High Capacity ADC Media, ISO/IEC 29161 Unique Identification for IoT, etc. While security features for RFID are specifically assigned to WG4, WG2 is responsible for general security aspects, such as ISO/IEC 20248 DigSig (project editor: Bertus Pretorius). Mr. Rainer Schrundner reported that the six parts of ISO/IEC 15459 entered into systematic review

Parts of ISO/IEC 15459 Unique identification

Project editor: Harald Oehlmann:
— Part 1: Individual transport units
— Part 2: Registration procedures
— Part 3: Common rules
—Part 4: Individual products and product packages
— Part 5: Individual returnable transport items (RTIs)
— Part 6: Groupings
The standard or parts of ISO/IEC 15459 are referenced by several national and international regulations becoming binding rules for unique IDs for companies and products such as for Medical Devices (UDI), TOBACCO Europe, Military (NATO) and everywhere where traceability is to be achieved under legal aspects and regulations.

WG 2 on ISO/IEC 15418 GS1 Application Identifiers and ASC Data Identifiers

Project editor: Bill Hoffman (also Chair of ANSI MH10.8.2 Data Identifier Maintenance Committee – DIMC)
With ISO/IEC 15418 the ASC Data Identifiers (DIs) and the GS1 Application Identifiers (AIs) became ISO standard 1998. The Maintenance of the IDENTIFIERS is not the responsibility of WG2, it has been delegated to the responsible maintenance committees at ANSI and GS1. Concerning maintenance of the part ASC Data Identifiers it was concluded that this is in good hands of the appointed ASC Data Identifier maintenance committee – **DIMC** (Chairman: Bill Hoffman) at MHI - Material Handling Industry, MH10.8.2 committee, Charlotte, NC 28217-3992 USA, phone: +1 704/522-8644 http://www.mhi.org/standards/di
Maintenance of the part GS1 Application Identifiers is delegated to the GS1 Global Standards Management Process (GSMP) https://www.gs1.org/standards/wr

WG 2: ISO/IEC 15434 Syntax for high-capacity ADC

Project editor: Craig MacDougall
The syntax for encoding multiple data structures and text data in AIDC media. It is a "File system for barcode" featuring:

- Syntax with ASC DIs, GS1 AIs, Text Element Identifiers TEIs, UN EDIFACT Qualifiers, Text,… →
- Adoption of JSON (under work)
- Encoding/concatenating of different syntax structures in one code
- Autodiscrimination to all other standardized syntax
- Using printable and NON-printable character set
  See: https://www.iso.org/standard/72372.html)

ISO/IEC 15434 Table 1 — Format header table showing associated separators

Format indicator	Variable header data	Format trailer	Format description
00			Reserved for future use
01	$^{G}_{S}vv$	$^{R}_{S}$	Transportation
02			Complete EDI message / transaction
03	*vvvrrr* $^{F}_{S}{}^{G}_{S}{}^{U}_{S}$	$^{R}_{S}$	Structured data using ANSI ASC X12 segments
04	*vvvrrr* $^{F}_{S}{}^{G}_{S}{}^{U}_{S}$	$^{R}_{S}$	Structured data using UN/EDIFACT segments
05	$^{G}_{S}$	$^{R}_{S}$	Data using GS1 application identifiers
06	$^{G}_{S}$	$^{R}_{S}$	Data using ASC MH 10 data identifiers [1)]
07		$^{R}_{S}$	Free form text
08	*vvvvrrnn*		Structured data using CII syntax rules
09	$^{G}_{S}ttt\ldots t^{G}_{S}ccc\ldots c^{G}_{S}nnn\ldots n^{G}_{S}$	$^{R}_{S}$	Binary data (file type) (compression technique) (number of bytes)
10-11			Reserved for future use
12	$^{G}_{S}$	$^{R}_{S}$	Structured data following text element identifier rules
13			Blocked for use to avoid conflict with ISO/IEC 15961-2
14-99			Reserved for future use

PROS and CONS of ISO/IEC 15434

ISO/IEC 15434 has pros and cons for the applications. Pros is the strong autodiscrimination and the multiple structuring.
Cons is the character set with NON-printable characters like <rs>, <gs>, <eot>. Such characters don't pass keyboards and are not WEB compatible.

SOLUTION for keyboard + WEB compatibility
As a solution several initiatives resulted to the "Syntax for keyboard and Web compatible encoding" standardized by institutions like DIN (DIN 16598), EDIFICE, IFA CODING SYSTEM and adapted by applications of industry and healthcare
The syntax applies everywhere where ASC DIs apply in a keyboard and WEB compatible environment
(see chapter: Standards and developments in progress, example 2).

WG 2: ISO/IEC 20248 Digital Signature Meta Structure for bar code and RFID

Contribution by the editor Bertus Pretorius, Solutions Architect

The most modern Automatic Identification data standard, ISO/IEC 20248 Information Technology - Automatic Identification And Data Capture Techniques - Data Structures - **Digital Signature Meta Structure**, is fondly known by its developers and users as the DigSig Standard, specifies the syntax for the specification of a schema-based data structure using a X.509 Digital Certificate. The use of X.509 (both the certificate and the digital signature) provides for the verification of issuer, schema (data structure definition) and the data. ISO/IEC 20248 uses JSON as the specification and data delivery method, as such, fully interoperable with all modern Cloud and IoT systems. JSON (ISO/IEC 21778) has become the default message format for the Internet.

The picture Fig. 17) depicts a 3rd License Plate windscreen label. It contains a DigSig data structure in the QR code and in the embedded RAIN tag providing for secure manual access using a mobile phone to the tag data (QR and NFC) and fully automated access to the data (RAIN).

Fig. 19. Windscreen label applied with RFID and QR and embedded DigSig

E-D-C for ISO/IEC 20248 DigSig

Issuing Agency E-D-C is applying DigSig secured QR code to the CERTIFICATES confirming validity of CIN registrations. Reading the code and transmission the URL to the WEB will provide access to the registry file of the individual CIN. The “pop up” will display address of the CIN holder and validity, active, passive or expires.

The Online Verifier for the CIN certificates is hosted by TRUEVOLVE, for more information see https://truevolve.com/suite-20248/

Fig. 20. DigSig secured QR Code leads to the verification page of the dedicated CIN certificate

For more information on DigSig application see AIDC Report 2019+2020 and *https://digsig.io/*

Working Group 4 on RFID

Convenor Josef Preishuber-Pflügl

Fig. 21. RFID Emblem ISO/IEC 29160

Fig. 22. One last WG4 F2F meeting

ISO/IEC 29160 RFID emblem above is used for the indication “Where you see the RFID emblem – RFID is in”. It can be considered as a warning “pay attention – you might be identified” or it can be an indication that the item can be scanned automatically.

Obviously, RFID is still an emerging technology for supply chain management applications. The ambitious agenda of WG 4 includes quite a number of RFID-related work items and reviews of existing standards undertaken by about 12 editors. Still the basic standard is ISO/IEC 15963 for the Tag ID being important for the Tag identification and anti-collision in bulk reading processes.

While barcode standards have long been established and mature, RFID standards still have some catching up to do, especially with regard to interoperability and for hybrid solutions with RFID and barcodes as reciprocal backups. Application standards such as the electronic type plate and RFID for railways, as well as industrial guidelines of user groups, such as the automotive industry, are based on the standards of WG 4. Security mechanisms for RFID using cryptographic methods are attracting increasing interest for protecting the data in the RFID data stream. This is also reflected in an increasing number of work items. ISO/IEC 29167, Part 1 forms the basis for the implementation of various security features with RFID. This standard defines the architecture for security services for the air interface of RFID according to ISO/IEC 18000 by so-called "crypto suites", which can be used by the tags according to the applications. Each "Crypto-Suite" is described in its own ISO/IEC 29167-x standard part, like part-19 is defining the "RAMON" crypto suite. The names of the "suites" refer to the algorithm being used. The security experts have to make the recommendations as to which mechanism provides the security required for the specific application.

ISO/IEC 20248 DigSig is another method to secure RFID applications. More and more countries use RFID for car license plate recognition where the DigSig is used for anti-counterfeiting. But DigSig can be used for any RFID application where authentication is required (see chapter ISO/IEC 20248).

RFID standards for AIR Interfaces, Data Structures, Security, Quality measurement, etc. are the base for RFID APPLICATION standards of other working groups of ISO but also of industries and associations like the RAIN Alliance (see chapter RAIN) or AIAG, JAIAG and ODETTE for automotive industries.

Working Group 8 AIDC Applications

Convenor: Jeanne Duckett,

took over the work of ISO TC122 on **RFID Applications for supply chain management** previously split in one standard each for the levels 0 to 3 shown with Fig. 21.

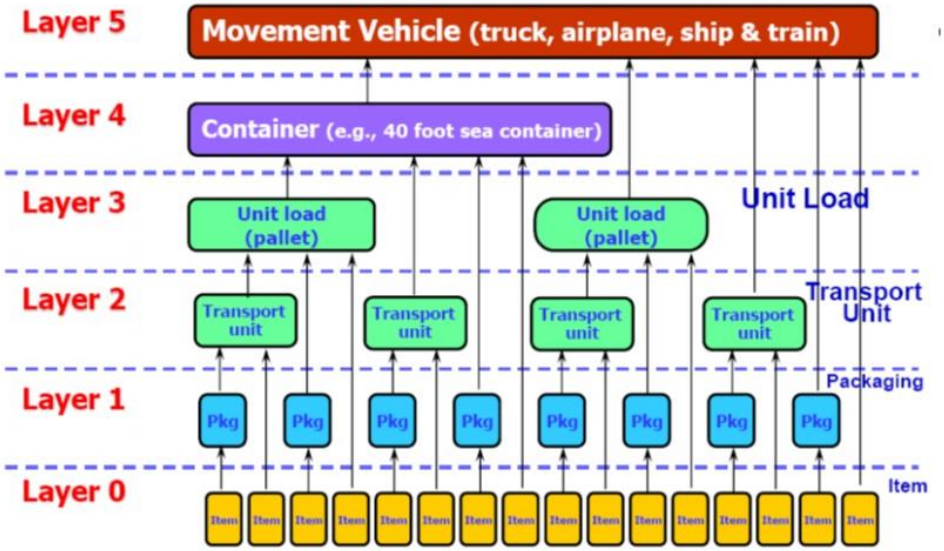


Fig. 23. Chart of Barcode and RFID application standards for supply chain management

WG 8 decided to integrate the RFID application standards for the four layers

"0" Item, "1" Packaging, "2" Transport "3" Unit and Unit Load

into one standard ISO/IEC 17360 Supply chain applications of RFID — Product tagging, product packaging, transport units, returnable transport units (RTIs) and returnable packaging items (RPIs).

ISO/IEC 17360 will integrate the previous standards ISO 17364 to ISO 17367 and will have a layer for returning packaging.

Layer "4" will be left to the responsible Technical Committee for sea containers.

The work of the WG 8 includes also Internet of Things (IoT) projects and Electronic Labelling:

- ISO/IEC 18574 Internet of Things (IoT) in the supply chain - Containerized cargo
- ISO/IEC 18575 Internet of Things (IoT) in the supply chain - Products & product packages
- ISO/IEC 18576 Internet of Things (IoT) in the supply chain - Returnable transport items (RTIs)
- ISO/IEC 18577 Internet of Things (IoT) in the supply chain - Transport units
- ISO/IEC 22603 Electronic labelling, a muti-part standard planned for
  Part 1 - Electronic Labelling General Principles
  Part 2 - Electronic Labelling in Electronic Goods
  Part 3 - Electronic Labeling of Intrinsically Unsafe Products
  Part 4 - Electronic Labeling Medical Devices
  - further parts are in preparation like for AIDC in Industrial Construction

For a more complete picture of the status of application related standardization in other ISO groups it is also worth taking a look at ISO TC122 "ISO 28219 Labelling and direct product marking with linear bar code and two-dimensional symbols", and for marking packaging of electronic components the "IEC 62090:2017 Product package labels for electronic components using bar code and two-dimensional symbology's" is of interest.

China Initiative for WG 8:

AIDC Application in Industrial Construction.

WG8 accepted the proposed New Work Item as NWI 8506. The idea is to have a guide for building houses like cars in terms of control of parts and traceability. As convenor Mr. Wang Yi was appointed.

AIDC has not yet been used extensively within this business area, but the demand seems to be rising due to the call for better traceability for components and processes in the international arena. There are enough examples how to use AIDC in other areas and it will be interesting to see the special requirements in the industrial construction business. It might be expected that RFID will be seen as one of such tools for automatic identification and data capture where Barcode might not be neglected. Nevertheless standards like the new ISO/IEC 17360 RFID for supply chain management and corresponding Barcode application standards of WG 8 are available for applications of Industrial Construction too.

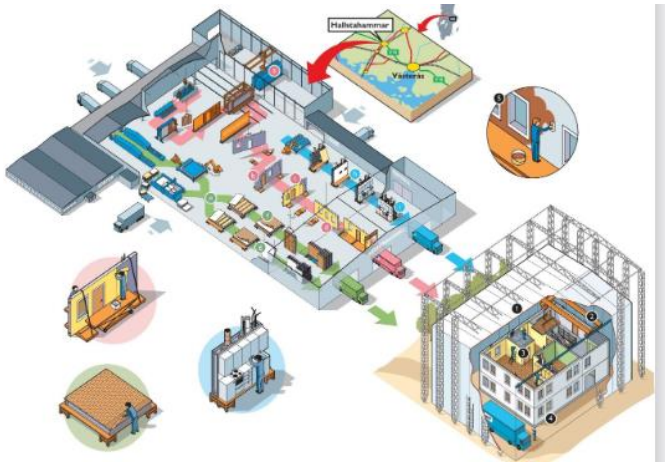


Fig. 24. Field of Industrial Construction, source SACS

Reports from specific comittees with focus on AIDC

DIMC responsible for Maintenance of ASC Data Identifiers

***Bill Hoffman, Chairman of DIMC*,**

Statement of the DIMC Chairman Bill Hoffman: *"Once a DI was adopted - it will stay for ever."*

Today their are 48 Issuing Agencies relying upon the stability and quality of the ASC Data Identifiers maintained by the accredited Data Identifier Maintenance Committee (DIMC), a sub-committee of ANSI MH SC8. MH10 SC8 controls and maintains ANSO MH10.8.2.

"MH" stands for the Material Handling Institute an American National Standards Institute (ANSI) accredited standards development organization.

For worldwide availability Data Identifiers have been standardized on ISO level by ISO/IEC 15418 jointly with GS1 Application Identifiers. Up to issue 2020-08-17 the standard was called

"Data Identifier and Application Identifier Standard".

It included not only both ASC DIs and GS1 AIs but also a very useful section III "ANS MH10.8.2 DIs & GS1 AIs and vice versa". This mapping helped a lot for all applications where both "code languages" occurred, e.g. in cross country and cross industry supply chain systems. Nevertheless in 2021 GS1 applied for taking the mapping to GS1 terms out. As consequence you would need to look in two independent documents. The maintenance might be easier but there is less service for system integrators and IT responsible.

Since the February 11, 2021 issue the standard is just called **ANSI MH10.8.2-2021 Data Identifiers**

The Chairman of DIMC Bill Hoffmann was so kind to supply additional input to the report as follows:

For 2022, the DIMC did in depth review of MH10.8.2 , as regards DIs, their descriptions, and metadata, and corrected grammar issues and a number of "errors" that have been in the document for quite a while. (For example, metadata that was incorrect when placed into the document when the DI was added, metadata that changed because the organization that requested the DI changed it's data construction, etc.)

DATA IDENTIFIER MAINTENANCE COMMITTEE CONTINUED:

Meanwhile

DIMC has got a further DI request being approved after careful discussions:

- **DI "32Q Clinical term code** as defined with the clinical nomenclature: "The international standard for identifying health measurements, observations, and documents – LOINC" (https://loinc.org), in the following sequence: <DI><LOINC Code><Plus Sign><Value>. The unit and format of the Value is defined by the LOINC Code.

DI "32Q" became required in conjunction with the European Medical Device Regulation (MDR) for increasing granularity but it is useful in general to apply medical parameters as attributes to the product codes being available every time and everywhere even offline.

DIMC will be busy with continued maintenance of ANSI MH 10.8.2 as part of the Material Handling Institute according to the slogan of the MHI "THE INDUSTRIES THAT MAKE SUPPLY CHAINS WORK".
Contact to MHI: Mr. Pat Davison, Director of Standards,
phone +1 704-676-1190, mail pdavison@mhi.org, link: www.mhi.org/standards
Data Identifier Requests will reach the desk of Bill Hoffman at:
DIMC, c/o MHI DIRequests@MHI.org, phone +1 704.676.1190

GS1 2021 Liaison with ISO/IEC/JTC1/SC 31

Where the DIMC is responsible for maintenance of the ASC Data Identifiers (DIs), GS1 is responsible for maintenance of the GS1 Application Identifiers (AIs). Both are appointed by ISO/IEC 15418 and follow same principles for reliability of the Identifiers. AIs remain as key elements for the GS1 systems even for WEB-communication (see GS1 Digital Link).
As liaison member of SC 31 GS1 reported on the latest activities highlighting to quite interesting developments, seen as trends. One is the project:
"Global migration to 2D" reflecting the success of the optical data recognition technology and the explosion of 2D applications (see below).
Another project is the **"GS1 Digital Link"** merging in the trend of Internet syntax for universal use (see discussion under chapter: *Considerations to WEB syntax "URL+ID" instead of AIDC syntax "ID+URL"*).
The Global Work Group **"Scan4Transport"**
is reported being set up for further optimization of logistical processes. Here 2D barcode and

Digital Link URI syntax are relevant, where the "Serial Shipment Container Code – SSCC" shall remained as mandatory on the Transport Label and in the 2D barcode.
The "Electronic Product Code – EPC" shall be modernized and GS1 is calling for an action on it. Headline is "Simplified encoding and optimized data capture to ease adoption of EPC/RFID".
If we look to the developments within the RAIN Alliance we can assume, that both organizations GS1 and RAIN may see that RFID would need better promotion to get the expected acceptance. In this case the activities target to technical optimizations to ease implementation (see chapter Alliance RAIN).
In terms of "security of IDs and sources" GS1 announced the
"GS1 Digital Signature " for coded data. The GS1 liaison report 2021 did not mention the standard "ISO/IEC 20248 Digital Signature" but it can be assumed that ISO/IEC 20248 is the common base for it.

GS1 Global Migration to 2D

The "Barcode Wand", the light pen was invented in the 70th enabling scanning the first codes (UPC, 2 out of 5, Code 39, …) by manual moving the pen. Laser avoided the manual moving by the moving beam and the acceptance of barcode could grow further. Now we have camera based Image Scanners and even a smart phone can read both linear barcodes as 2D symbols. Users are recognizing that a 2D code can carry much more information then a linear barcode, so why not to carry traceability data for food and non-food products not only for scanning at the Point Of Sales (POS) but also at home via smartphone, like the expiry date.
The recent announcement of the **GS1 Global Migration to 2D** is the answer to state of the art technology and to related market demand for using it.
The migration to 2D is seen as a smooth process (see Fig. 25 and it will take a certain implementation time.

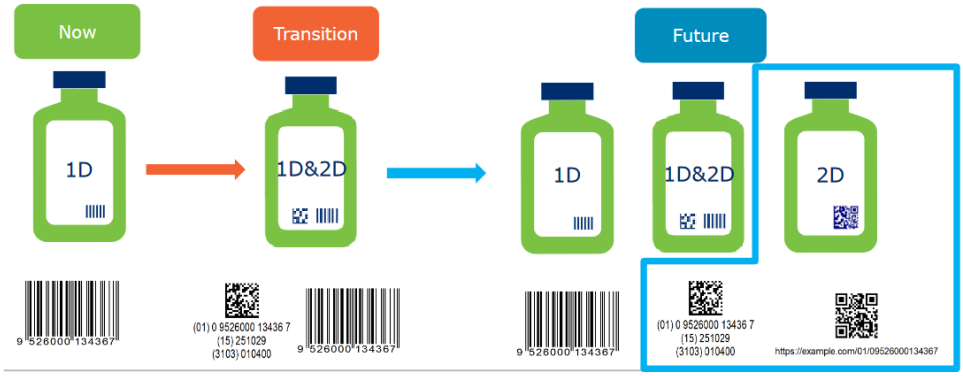


Fig. 25. GS1 Global Migration to 2D: Now – Transition – Future (source GS1 report 2021)

It's not just a matter of simply replacing the POS scanners, data bases need an update as well for processing the traceability data. For sure, it is an major step toward increased customer services. But as seen with the Scan4Transport initiative of the GS1 Global Work Group, the 2D migration is becoming a global importance.

Automotive Industries

Automotive Industry Action Group (AIAG), Odette International Limited (ODETTE), Japan Automotive Manufacturers' Association, Inc. (JAMA) and Japan Auto Parts Industries Association (JAPIA) are strong cooperating partners specifically to improve logistical processes by help of AIDC. The group formed the "Joined Automotive Industry Forum (JAIF) to counter international business and networking.
JAIF is considering both Barcode as RFID as essential tools for supply chain management, tracking and tracing, and anti-counterfeiting.
A statement explains the view of the group *(Source: Doc. B21, V3, 2021)*:
An extensive effort has been undertaken by the automotive industry to make data interchangeable between 2D (e.g., Data Matrix /QR Code) optical symbols and electronic media such as RFID to permit the user to select the appropriate technology with a minimum impact on IT infrastructures. These technologies complement each other and may be used jointly or separately as the application may require.

Fig. 26. Barcode & RFID on one label

Barcode has been implemented since a long time for supply, production and distribution. Previous documents have been focusing on Barcode an RFID for Transport and Container identification:

- JAIF B-16 Global Transport Label Standard for the Automotive Industry
- JAIF RC-6 Global Guideline for Returnable Transport Items

JAIAG add key documents for additional RFID implementation, source https://www.odette.org/resources/rfid :

- Implementing RFID in the Automotive Supply Chain, Ref. LR07, Sept. 2021
- RFID Item Level Standard, Ref. LR05/B21, Version 3, March 2021

Fig. 27. Inlay of option ISO/IEC 18000-63 RFID tag.

JAIF announces Guideline LR07 aiming to help the automotive industry, project leaders and users, and external technology integrators or vendors to implement RFID processes across different partners of the supply chain, in order to obtain good interoperability and avoid multiple solutions that could become a blocking point for industry suppliers. It focuses on issues which contribute to defining common standards for a better interoperability between the partners involved.
RFID Item Level Standard LR05/B21 describes best practices, processes, and methods **for item identification**, verification, traceability, product characteristics, **and Vehicle Identification** Number (VIN) throughout the global automotive supply chain. Extensive efforts have been made by the automotive industry to incorporate interchangeable data use between 2D optical symbols and electronic media such as RFID. This publication gives standards for the implementation and use of RFID in such applications and was jointly produced by Odette, AIAG, JAMA and JAPIA.

Healthcare: AIDC for the Medical Device sector “UDI”

Unique Device Identifier “UDI”: Regulation for Medical Devices and In-vitro-Diagnostica

Under the roof of the International Medical Device Regulatory Forum – IMDRF nations follow the recommendations for implementing UDI steadily. The US FDA was first, followed by Turkey, Europe was next but now the UDI concept gets accepted around the globe like for **Australia, China, Brazil, Japan, Saudi Arabia, South Korea, etc.**

UDI stands for a unique Barcode (RFID optional) for products and/or packages, whose associated master data is mirrored in a publicly-accessible database. In fact, this looks like an innovative step towards the "Internet of Things" (IoT), because database access can take place automatically with scanning.
Already in 1984 a milestone of product traceability was set with the development of the "Healthcare Bar Code (HIBC)", but it took a while until the bar code was also recognized in the areas of industry and distribution as a general means for lightning fast and secure data acquisition. Now, especially in the healthcare sector, parliamentarians and state leaders at state and interstate levels have recognized that AIDC can actually improve patient safety, efficiency and logistical security.

The UNIQUE DEVICE IDENTIFICATION (UDI) project was launched accordingly. UDI was enacted by law in the USA already in 2013 and the "FDA" became the extended arm of the executive. Implementation time exceeds up to Sept. 24, 2022. Each medical device offered in the USA is subject to the requirement of having a barcode on the product and to have the master data centrally registered (See also www.fda.gov/UDI or www.hibc.de/de/udi.html). FDA followed the recommendation of IMDRF to accredit Issuing Agencies with experience in the healthcare sector: GS1, HIBC and ICCBBA.

Fig. 28. UDI emblem (enlarged)

UDI

Europe (The EC) accredited four Issuing Agencies and it’s systems for UDI

For Europe, the project was adopted by the Parliament in Strasbourg in April 2017 and submitted to the European Commission (EC) for implementation. The UDI conformity date for manufacturers of Class III products is already 2021. In accordance with the "MDR" and "IvDR" regulations, UDI will be binding step by step for medical devices of all classes and all in-vitro diagnostics. The EC accredited four systems for UDI: GS1, HIBC, ICCBBA and the IFA CODING SYSTEM. Both HIBC and IFA supply a coding system for alphanumeric article numbers and **Keyboard and WEB compatible syntax** for encoding in 2D symbols. The IFA CODING SYSTEM is calling it “**Health Product Code – HPC**” *(see chapter Standards in progress, example 2)*.
EC is setting special requirements for products with high granularity in terms of medicinal parameters. For this task the DI “32Q” was assigned for attributes of the Nomenclature LOINC *(see chapter DI “32Q” LOINC Code).*

UDI for China

For China the National Medical Products Administration - NMPA (former CFDA)
is setting the “Rules for Unique Device Identification (UDI) System”.
NMPA is cooperating with the IMDRF, so there are expectations that China would accept UDI coding on the products interoperable with the UDI-Codes used widely in other regions in proper way. This would be helpful for tracking and tracing products distributed globally inclusive to China. At least the UDI on the Medical Device shall consist of same data elements: The UDI-Device Identifier with Company ID and Device reference and the connected UDI-Production Identifier with variables like Dates, LOT, Serial Number. The first batch of medical devices subject to the UDI system in China covers 9 categories and 69 specific “high risk” devices classified as Class III according to the Medical Device Classification Catalogue. NMPA is also encouraging manufacturers to voluntarily implement the UDI for other medical devices that do not fall within this initial scope. On September 13, 2021, an announcement on the second batch of implementation of the unique identification of medical devices was issued. The announcement requires that all class III medical devices (including class III in vitro diagnostic reagents) produced from June 1, 2022 should have the unique identification of medical devices.

NMPA will also accredit specific Issuing Agencies and it's systems for UDI, organizations aready named are:
GS1 and ZIIOT, but HIBCC is reported to be preparing in the queue.
ZIIOT, the Zhonguancun Industry & Information Research Institute of Two-Dimensional Code Technology is a global code issuing agency located in China. ZIIOT has got the ISO/IEC 15459-2 Issuing Agency Code "MA". *(see: ANNEX ISO/IEC 15459-2 Issuing Agencies and Registry).*

ZIIOT updated it's IDCODE for UDI recently. The update is following the trend toward standardized identifiers. The definitions divide UDI codes in 3 modules:

a) UDI-Device Identifier (UDI-DI) with IAC, CIN and product reference
b) UDI Production Identifier (UDI-PI) with variable data (expiry, production date, LOT, SN)
c) Optional manufacturer information, e.g. quantity, WEB link, etc.

The ZIIOT registered CIN is a construct containing an ISO 3166 country code for a sub issuer, a sub issuer code and the CIN separated by a Dot in sequence <IAC><.><country code><.><sub agency code><.><CIN><.>

Example: <MA.276.M0.100001.>

IAC, CIN and Product REF will build the UDI-DI sequence accordingly: <MA.276.M0.100001.><Product REF>
The UDI data will be embedded in the "Keyboard and WEB compatible Syntax for ASC Data Identifiers" and encoded in a 2D symbol like QR Code or Data Matrix in the sequence:

<.><UDI-DI><^><UDI-PI><^><add ons>

The preliminary list of ASC Data Identifiers is including Data Identifiers like listed with table 5) below.

Table 5) Excerpt of the preliminary ASC DIs for building UDI codes applied with sample data, flag and separator circumflex (^)

UDI-DI	54P	UDI-DI for Medical Devices (MD) and In-vitro-Diagnostics (IvD) as the unique key to public UDI data bases (GUDID, EUDAMED, UDID, etc.), according to national regulatory requirements,…	**.54P**MA.276.M0.100001. MEDIX129^
UDI-PI options	14D	Expiration Date (YYYYMMDD	**14D**20291212^
	16D	Production Date (YYYYMMDD) – Date of manufacture	**16D**20220215^
	1T	Traceability Number assigned by the Supplier to identify a unique group of entities (LOT)	**1T**123X^
	S	Serial Number or Code Assigned by the Supplier to an Entity for its Lifetime (SN)	**S**98765Y
Add on options	Q	Quantity, Number of Pieces, or Amount (numeric only)	
	33L	Uniform Resource Locator (URL)	

Note: Where ASC DI "54P" indicates an UDI Code, the ASC DI "25P" could be used for "Non UDI Codes" on demand.

Example of a ZIIOT UDI Code

applied with the sample data of table 5) printed in QR
and for comparison in Data Matrix without add on options:

.54PMA.276.M0.100001.MEDIX129^
14D20291212^16D20220215^
1T123X^S98765Y

	ID	Data	Comment
			Scan no 1. with Elmiscan ECR14 POS – USB POS
Symbology:	]d1	Datamatrix	Symbology type Datamatrix passed by reader
Raw data:		.54PMA.276.M0.100001.MEDIX129^14D20291212^16D20220215^1T123X^S98765Y	
Structure type:	.	ASC	Data Identifier (DI) following ISO/IEC15418 (with SID '.')
UDI-DI:	54P	MA.276.M0.100001.MEDIX129	
Expiry date:	14D	20291212	Interpreted data: 2029-12-12
Production date:	16D	20220215	Interpreted data: 2022-02-15
Lot:	1T	123X	
Serial number:	S	98765Y	

Fig. 29. Screen shows raw data having passed the keyboard fully and the interpreted data.

Pharma: The European Regulation for Medicinal Products moves one step further, requiring serialized ISO/IEC 16022 Data Matrix strictly

The EU Parliament and the Commission dealt with the regulation on medicinal products somewhat earlier than the UDI project. The "COMMISSION DELEGATED REGULATION (EU) 2016/161" was already published on 2 October 2015. This essentially contains the unmistakable identification of the pharmaceutical packaging by serialized ISO/IEC 16022 Data Matrix and the entry of the serial number (SN) by the manufacturer in the associated database before sale. The pharmacies scan the package with the cash register scanner, at this moment an automatic check of the SN to the database is carried out via the pharmacy network.

Fig. 30. Medicinal product applied with a PPN of the IFA Coding system and using DMRE.

If the specific SN being scanned and transmitted is contained in the DB, it is discharged and the drug gets green light for the sale. A second request with the same SN would presumably be a plagiarism and would trigger "STOP". In addition, the Ordinance contains measures for the detection of opened packages (tamper evidence). Both together are measures against counterfeiting, but the serialization of the packs can also be used excellently for the optimization of pharmaceutical logistics all the way to the clinic. Named pharmaceutical industry organizations are adapting their coding systems to the new requirements of legislation, for example the "IFA Coding System", which migrates the previous "Pharma Central Number PZN" to the internationally unique "Pharma Product Number-PPN". See also Fig. 5) "PPN coded in DIN 16587 DMRE". Alternatively, serialized GTINs with country-specific pharmaceutical identification are also in use. The new feature of the "IFA Coding System" is that the PPN offers capacity for each national drug identification system and uses "ISO/IEC 15434 Syntax for High Capacity AIDC Media". (*See also* http://www.ifaffm.de/en/ifa-codingsystem.html).

AIDC for TOBACCO products sector in Europe

EU system for traceability and security features of tobacco products

The Tobacco Products Directive published with the Official Journal of the European Union “L96” April 16, 2018.
(see: https://publications.europa.eu/en/publication-detail/-/publication/536e4d37-4140-11e8-b5fe-01aa75ed71a1)
The Directive requires AIDC techniques for physical marking and storage of related information in repositories. After put in force March 20, 2019 the system is running and live as seen by the additional markings on tobacco products in practice. Like the Directive for medicinal products and for medical devices the Directive for TOBACCO enables both, unique identification and access to product related data stored in a regulator controlled data base. Nevertheless the methods differ slightly due to the project specifics. In addition to traceability for TOBACCO products control by the customs authorities belongs to the targets of the project. A specific structure has been defined by the European Commission to secure authentication of the identity of the TOBACCO items in relation to transmission and storage of the information in the Repositories (see Fig. 28). Data of Primary Repositories are copied in one universal Secondary Repository for access through the user interface.

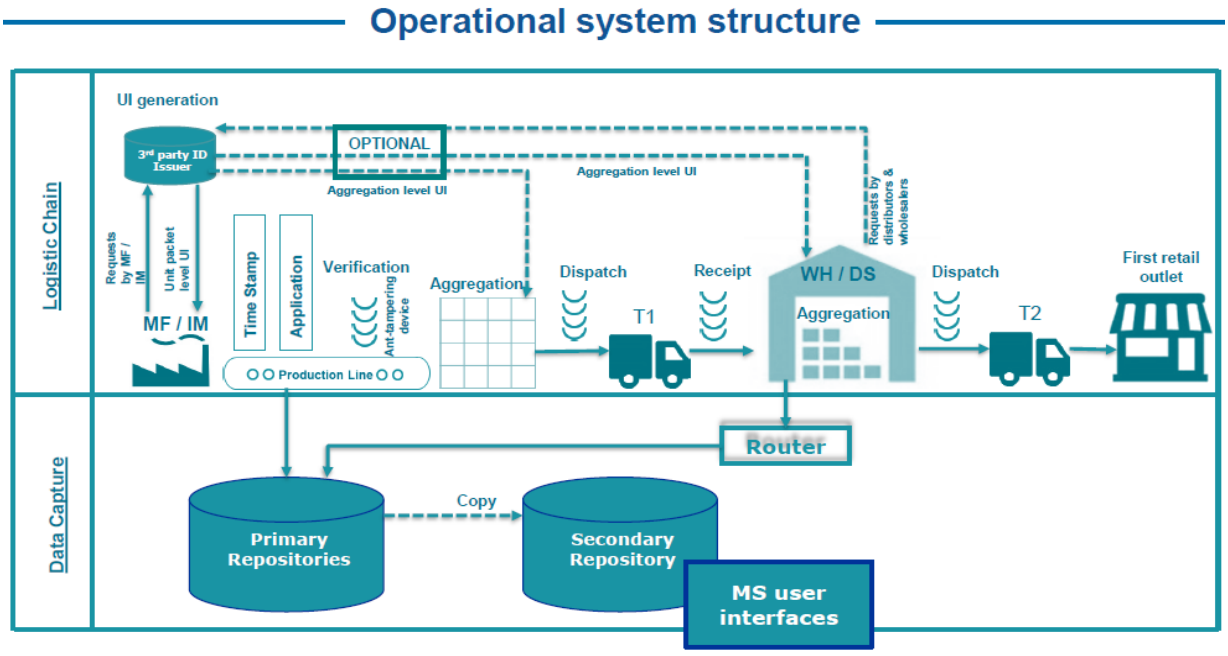


Fig. 31. Chart TOBACCO operational system structure,
source EC Directorate General for Heath and and Food Safety, Stockholm Workshop 2018-01-25

For TOBACCO different physical levels apply: Unit level (packs) and aggregated level (e.g. carton or master case)
At "unit level" all packs have to be marked with a unique identifier (upUI), supplied by a "competent national ID Issuer" as third party to be consulted by the manufacturer. The competent national ID Issuer is in charge to generate a unique string of data conforming to ISO/IEC 15459-2/-3 to be submitted to the Economic Operator and to the repository for later access by the authorities like customs.
The structure of the unit level upUI generated by the competent national Issuer is:
<Data string Identifier><Issuing Agency Code><Competent Issuer ID><Serial number><Product information>.
The EO has to add a time stamp while marking the product package or affixing a Tax Stamp which carries the unique identifier , the format is: YYMMDDhh.

- Example of an upUI using the Issuing Agency Code "QC" *(EurodataCouncil.org)*:
- Data string Identifier: ASC Data Identifier **"5R"** for UI structured by the Competent Issuer (CI)
- Issuing Agency Code: **QC**
- Competent Issuer C: **ABCD**:
- Serial no.: **123aBcD890**
- Product information: **12123456712345n4Ts8P**
- Time Stamp: **19**09**01**09

Example unit level UI data string
with above data → 5RQCABCD:**123aBcD890**12123456712345n4Ts8P**19**09**01**09

*Fig. 32. Example → 5RQC… encoded with **Data Matrix** and/or **QR Code** (same dot size)*

Aggregated UI (aUI) for the upper levels concatenated (carton, master cases, palettes)
If generated by the ID Issuer same rules as for the unit level apply for the aggregated. Despite the difference in Information which have to be included in the aUI. If the EO is generating the aUI for that level by himself then the rules of ISO/IEC 15459-1 Barcode for Transport Units or ISO/IEC 15459-4 Individual products and product packages can be used alternatively. For master case and pallets marked by the EO same rules apply for enabling traceability of packed products and cartons by reference to the higher level markings.

Data Carrier for TOBACCO

So far just UPC and EAN codes have been printed on the product for the purpose of scanning at Point of Sales. An additional code has to be added on packages and concatenated bundles for the UIs. For marking the levels different symbology's apply for encoding the UIs.
Unit Level UI: ISO/IEC 18004 QR Code, ISO/IEC 16022 Data Matrix but also AIM DotCode. The latter for reasons of high volume fast printing processes by ink jet printing systems (Unit level UI with DotCode see Fig. 31).

Fig. 33. ISO/IEC 16022 Data Matrix, ISO/IEC 18004 QR Code, AIM DotCode

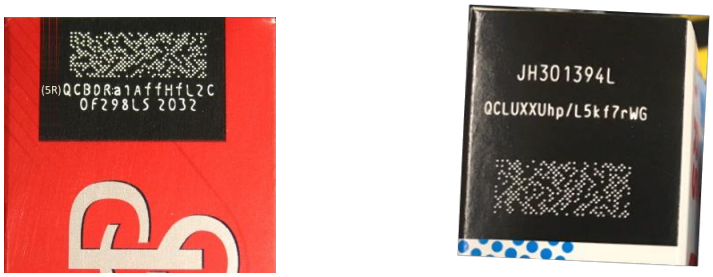


Fig. 34. AIM DotCode placed on unit level tobacco package, sources: BDR, Incert

For marking the upper levels ISO/IEC 16022 Data Matrix, ISO/IEC 18004 QR Code are the symbology's foreseen by the tobacco regulation in conjunction with ISO/IEC 15459-4 and Code 128 with ISO/IEC 15459-1 under the responsibility of the Economic Operator labeling that levels.

AIDC for MARINE EQUIPMENT required by the European Regulation EU/2018/608

DIRECTIVE 2014/90/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL required declaration of conformity by a specific emblem, the “wheel mark”. It was indicated that the wheel mark might be supplemented by an electronic tag in due time. This happened 2018 already. The Official Journal L 101/64 published the IMPLEMENTING REGULATION (EU) 2018/608 of 19 April 2018 laying down technical criteria for electronic tags for marine equipment. The regulation requires a ISO/IEC 16022 Data Matrix and/or an UHF RFID Tag according to ISO/IEC 18000-6:2004 Type C (ISO/IEC 18000-63). The regulation defines also how to combine the marine emblem “wheel” with the RFID emblem ISO/IEC 29160 and/or a Data Matrix according to ISO/IEC 16022 (Fig. 32).

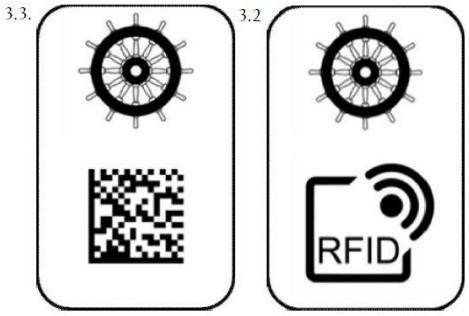


Fig. 35. Marine Equipment emblem for Data Matrix and/or RFID marking, source EU L 101/67

The required data elements in the electronic data carrier are the conformity certificate number, the ID of the notified body assigned by the Commission and a proceeding character indicating the type of conformity assessment undertaken. Additional item related data can be add optionally, like product code, the lot or serial number structured in accordance with ISO/IEC 15434 and using ISO/IEC 15418 Identifiers. The electronic tag contains key information, able to provide for a link to the database (https://www.mared.org/) with a full set of information like manufacturer data, certificates, document of compliance, etc. In essence, the tag shall ease control of conformity to EU regulations for increasing safety.

ANNEX 1) Application ISO/IEC 20248 Digital Signature
Example DigSig secured Object Identification

ISO/IEC 20248-DigSig can be used to verify the contents of AIDC media such as barcodes, 2D and RFID.
Here is a generic example application which can be used anywhere and anytime:

A) The manufacturer adds the product code to identify a 20248-DigSig, but also to verify it via Internet recourse

B) The receiving partner can use it not only to identify the product, but also to verify the contents of AIDC media such as barcode, 2D and RFID.

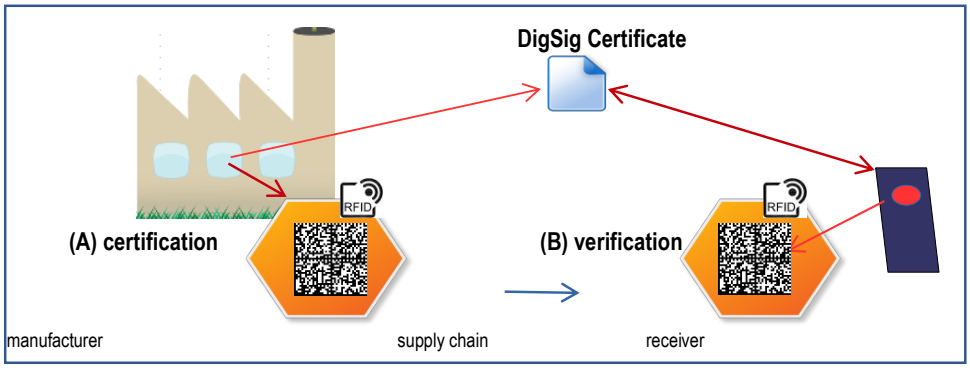


Fig. 36. Illustration of a DigSig application

The example code protected with DigSig contains the following data elements:

data element	*ASC-DI*	*value*	*ASC-data string*
Unique SN (UID)	**25S**	QCTRUE123456	**25S**QCTRUE123456
product reference	**1P**	MOT25X	**1P**MOT25X
production date	**16D**	2017-07-20	**16D**20170720
Additional element:	**6R**	*https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*	***6R****https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*

→ The DigSig for the verification of the above data is generated by the manufacturer during marking and provided with the standardized ASC-DI "**6R**" ISO/IEC 20248 digital signature data construct.

The "**DigSig data element**" structured according to 20248 rules is added to the object data. This in a suitable medium such as QR Code, Data Matrix or RFID encoded in "ISO/IEC 15434 Syntax for High Capacity Media" forms the protected code. In Data Matrix the start-[])><$^{R}_{S}$>06<$^{G}_{S}$> and the stop sequence <$^{R}_{S}$><$^{E}_{O T}$> is substituted by the control character "Macro 06"). Figure 45 shows a DatMatrix containing the above data elements for automatic identification of the object/product and DigSig for verification of the data.

*<Macro06>**25S**QCTRUE123456<$^{G}_{S}$>**1P**MOT25X<$^{G}_{S}$>**16D**20170720<$^{G}_{S}$>**6R**https://v1.20248.info/?wJgJlkAByOEAEZiABcUOiUS-CcR7en-awDzEaTiV4-kxodnqQZvEdjBZbwRV*

Fig. 37. ISO/IEC 16022 Data Matrix with object data and DigSig, size 40x40 Modules, X 0,25 = 10x10mm

VERIFICATION at the receiver/user is performed automatically via the Internet by sending DigSig plus data to the verification address of the "**DigSig Verifier**" where the certificate is located. The address information is contained in the DigSig.
→ For transmission to the "DigSig Verifier" via Internet, e.g. via smartphone and "App", the scanned data string is easily converted by pushing the DigSig to the front without DI "6R" and without 15434 start/stop and replacing the separator <$^{G}_{S}$> with the tilde "~". Thus the data string is perfectly prepared for transmission and verification.

ANNEX 2) Quick Guide for the creation of global uniqueness for items

The hierarchical structure A, B, C, D

ISO/IEC 15459 describes the overall agreed hierarchy for generation of unique codes. Figure below shows the shared responsibilities from A to D. ISO/IEC 15459 adopted the original hierarchical concept from CEN EN 1572. The rule is as simple as it is effective:
ISO accredits a "Registration Authority" (A), which in turn registers Issuing Agencies (B), which assign unique "Company Identification Codes" to companies and institutions (C) on request. Companies that have received a "CIN" are in a position to encode everything that is to be uniquely marked. This includes not only products, packaging, containers, transport units, but also everything else, such as locations, papers, facilities, people, or their ID cards or wristbands. The sequence tells the computer all about the data with Issuing Agency, Company ID, meaning of the data value and value.

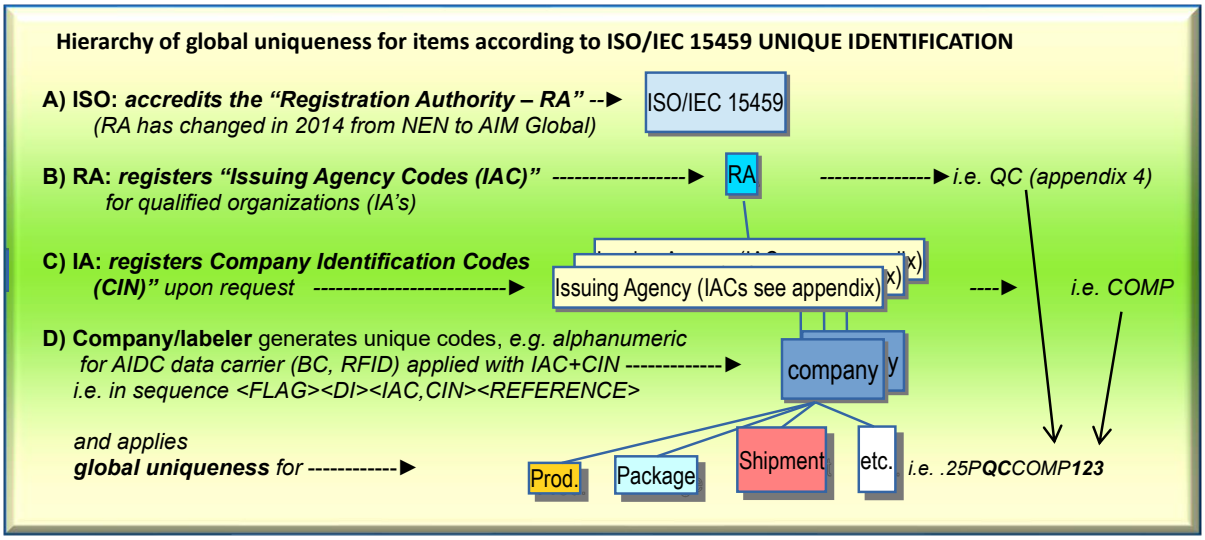
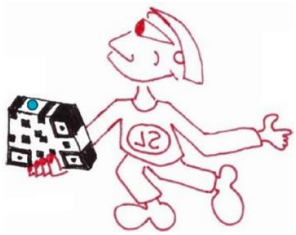


Fig. 38. Hierarchically distributed responsibility for unmistakable unique labelling

Example, how to generate a unique product code

The prerequisite for generating an unique code is to apply for a CIN from one of the Issuing Agencies. This issuing agency also determines the syntax of the relevant code, like alphanumeric or alphanumeric. In case of alphanumeric product codes rather any of the Issuing Agency can be chosen supporting ASC Data Identifiers, for numeric only product codes GS1 also would be a choice. For the list of Issuing Agency and it's codes see ANNEX 4 . The data length for ASC DI support can be from 1 to over 20 characters. For GS1 AIs, the product reference as "Global Trade Item Number (GTIN)" can typically be 3 to 5 digits long other Issuing Agencies like HIBCC and IFA support alphanumeric codes of up to 18 characters, others go beyond with the product code capacity.
A FLAG is determining the data structure as syntax and will be applied to the sequence prior to encoding.
Lets use an alphanumeric product reference for a "Quick Guide" of 5 steps to get a unique product code.

Quick steps to get a unique product code.



What are quick steps to encode a product with REF: M4215R73 for globally unique identification:

I) Determine the format of the product reference, numeric, alphanumeric, data length

II) Decide on coding a system and an issuing agency supporting numeric or alphanumeric product codes

→ a) in case of 5 digit product codes ISO/IEC 15418 ASC Data Identifiers and GS1 Application Identifiers can be used

→ b) if more than 5 digits or alpha characters like **REF: M4215R73**: Go to an Issuing Agency that supports ASC DIs.

III) Select an Issuing Agency, here for alphanumeric codes and apply for a CIN, e.g. "COMP" at E.D.C. (IAC "QC")

IV) Choose the appropriate ASC-DI for the sequence "unique product code" <DI><IAC><CIN><REF>

V) Choose your most convenient syntax for encoding the data, e.g. ISO/IEC 15434 or KB-WEB syntax DIN 165989

→ a) ISO/IEC 15434, FLAG "[]>rs06gs" and separator character "gs" (not for linear symbols)

→ b) Keyboard & WEB compatible syntax DIN 16598, FLAG " . ", separator "^" (for linear and 2D symbols)

VI) Generate your data string prior to encoding, e.g. <25P><QC><COMP><**M4215R73**>

→ in case of individual serialization add DI "S" and serial number e.g. 1234567:

.25PQCCOMP**M4215R73**^S1234567 (Additional data element, such as LOT, date, etc. as required)

VII) Choose the appropriate medium, e.g. Code 128 or Data Matrix (and/or RFID) and print it:

That's it --
...the unique product code is generated.

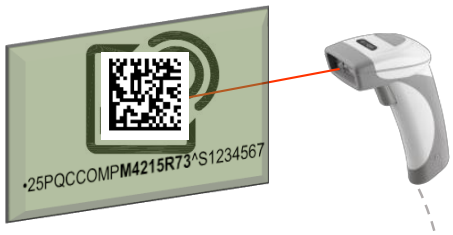


Fig. 39. That's the code ready for globally unique scanning where ever the code may appear

The scan analysis below will prove successful identification

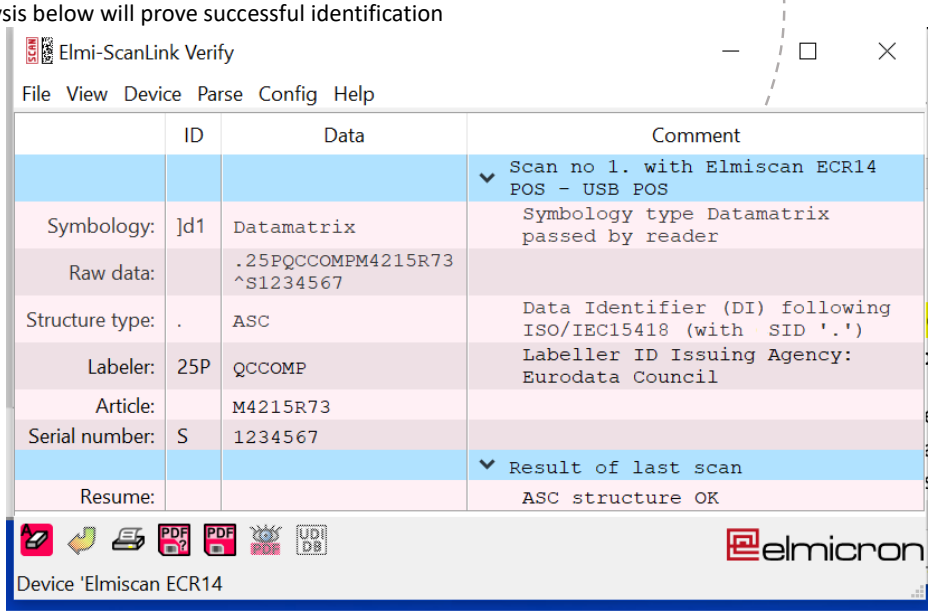


Fig. 40. Analysis of the serialized product code in KB&WEB syntax

ANNEX 3) DIN 16598 : “Web and keyboard compatible encoding

Standard for keyboard and WEB compatible syntax for AIDC media, published by DIN and EDIFICE and used for unique identification of ASC DI structured codes in industry and healthcare environments (see Fig. 5,6,7, 29)

AIDC data in AIDC media get structured in order to become globally unique. Structuring is specifically required in case of concatenated data elements in a code. There are structures using keyboard compatible character sets only, like HIBC, ISBT, Eurocode, but other structures are using extended character sets like ISO/IEC 15434 and GS1. DIN 16596 and EDIFICE standards are for simplification and optimization barcode integration by keyboard and WEB compatibility.

ISO/IEC 15434 syntax versus KB-WEB syntax:

The ISO/IEC 15434 is an envelope for multiple structures. Unfortunately, start and stop sequence and separators are "non-printable" special characters, not passing any keyboard. At the time when ISO/IEC 15434 was created in 1995 in CEN TC 225, serial interfaces and POS interfaces were still common for handling such data structures. In the meantime, these interfaces hardly play a role anymore, and with today's standard hardware and software of keyboard emulation via USB and web applications, the implementation of ISO/IEC 15434 is a great challenge.

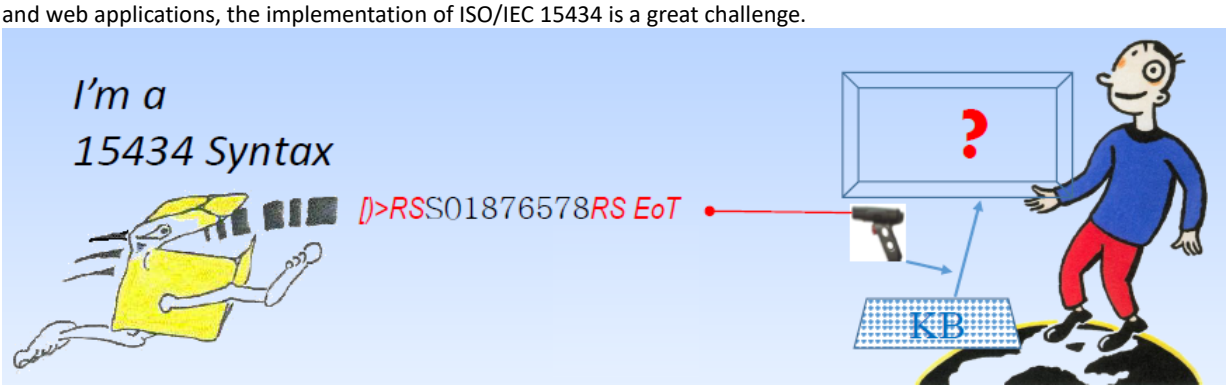


Fig. 41. Problem: Captured data with “non keyboard characters” do not pass keyboard interfaces

To avoid interface problems the "EDIFICE Guideline for Web and keyboard compatible encoding with ASC Data Identifiers" and DIN 16598 define the "Flag-Character ." (dot) and the Circumflex character "^" as separator, both pass keyboards.

Fig. 42. Solution: The Flag Character “.”(Dot) makes the barcode data unique and passing keyboard & web interfaces

The long years experience with the KB-WEB Syntax proved that the syntax is not only beneficial for concatenated data elements in 2D symbols but even for single data elements encoded in linear barcode. Historically it was assumed that no barcode would be occur without GS1 AIs or ASC DIs, so both has been considered as unique. But due to the explosion of barcode applications many numbering systems occurred in same environment. Now with the “DOT” prior to the first DI identifies the string as ASC DI structured and uniqueness is given, so scanners and computers can differentiate to any other code structure.
Meanwhile after the first publication by the French Normalization Institute AFNOR in 1994 the KB-WEB Syntax is standardized by normalization institutes and user associations like DIN, EDIFICE, IFA Coding Systems, Healthcare associations, etc. Where previous standards like DIN 66401 is calling the proceeding “DOT” a “System Identifier” the latest term used for it is simply “FLAG”.

The Guideline WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS is freely available by Internet access to www.edifice.org

ANNEX 4) ISO/IEC 15459-2 Issuing Agencies and Registry

Issuing Agencies serve for Uniqueness according to ISO/IEC 15459-3 Common Rules.

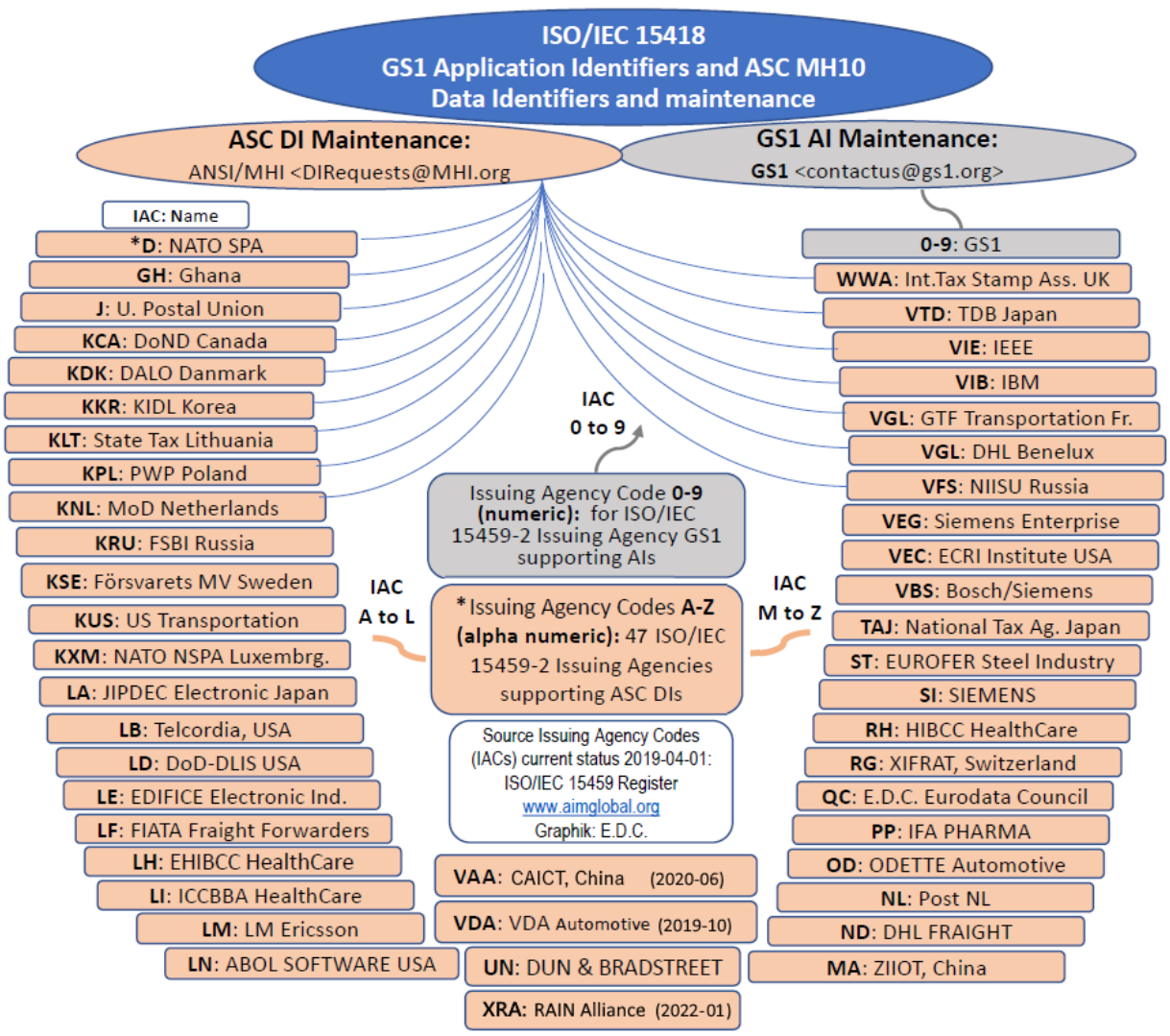


Fig. 43. ISO/IEC 15459-2 Issuing Agencies for Company Identification Numbers (CIN) conforming to ISO/IEC 15459-3

AIM Global is the appointed Registration Authority for maintenance of the ISO/IEC 15459-2 Registry. Access to the list is public accessible by https://www.aimglobal.org/uploads/1/2/4/5/124501539/register-iac-def_2022.pdf

Note: *Issuing Agency Codes (IACs) and assigned CINs do not become unique by themselves but in conjunction with the rules of ISO/IEC 15459-3. For example an IAC *D alone may mean different things under different context, like "D" for Deutschland" or a "3" as first number of a CIN from GS1 (GS1 prefix) may be part of a generic number. Same with all other IACs.*

ANNEX 5) Selection of AIDC technology and application standards

Comprehensive document

ISO/IEC 19762 Harmonized Vocabulary, 5 languages (+ Japanese under work)

Documents of ISO/IEC JTC 1/SC 31/WG 1 Data Carrier

ISO/IEC 15417 Code 128
ISO/IEC 15438 PDF 417
ISO/IEC 16022 Data Matrix and ISO/IEC 21471 DMRE
ISO/IEC 18004 QR Code
ISO/IEC 15415 Bar code symbol print quality test specification-Two-dimensional symbols
ISO/IEC 15416 Bar code symbol print quality test specification-Linear symbols
ISO/IEC 16480 Reading and display of ORM by mobile devices
ISO/IEC 30116 OCR Quality Testing
ISO/IEC 21471 Extended Rectangular Data Matrix DMRE

Documents of ISO/IEC JTC 1/SC 31/WG 2 Data Structure“

ISO/IEC 15418 GS1 Application Identifiers and ASC Data Identifiers
ISO/IEC 15434 Syntax for High-Capacity ADC Media
ISO/IEC 15459 Unique Identification, Part 1 to 6
ISO/IEC 29162 Guidelines for using ADC Media (Bar code & RFID)
ISO/IEC 29161 Unique Identification for IoT
ISO/IEC 20248 Digital Signature meta structure

Documents of ISO/IEC JTC 1/SC 31/WG 4 RFID for Item Management

ISO/IEC 18000-1 REV 1 (including Battery Assistants, Sensor functions)
ISO/IEC 18000-2 AMD 1 (including Battery Assistants, Sensor functions)
ISO/IEC 18000-6, part 61 to 64, rev. 2 (incl. Battery Assistants, Sensor functions)
ISO/IEC 18000-7 REV 1 (including Battery Assistants, Sensor functions)
ISO/IEC 15963 Tag ID: applied with the list of IC manufacturer IDs
ISO/IEC 29160 RFID Emblem
ISO/IEC 24791-Part 1 to 6 Software System Infrastructure (SSI)
ISO/IEC 24753 RFID & Sensors with reference to IEEE 1451.7
ISO/IEC 15961, 15962: RFID Data protocol – Update
ISO/IEC 15961-4: Sensors commands (NP)
ISO/IEC 29172-19179 Mobile item identification and management
ISO/IEC 29143 Air Interface Specification for Mobile Interrogators

Documents of ISO/IEC JTC 1/SC 31WG 4/ RFID Security on Item Management

ISO/IEC 29167 Air Interface for file management and security services for RFID
ISO/IEC 29167 part 10-19 crypto suites with ISO/IEC 19823-X Conformance test methods
ISO/IEC 17360 Supply chain applications of RFID — Product tagging, product packaging, transport units, returnable transport units (RTIs) and returnable packaging items (RPIs)

Documents of Liaison ISO TC122/WG 10 for BC&RFID applications

ISO 22742 Linear bar code and two-dimensional symbols for product packaging
ISO 28219 Labeling and direct product marking with linear bar code and 2d- symbols
ISO 15394 Bar code and 2d- symbols for shipping, transport and receiving labels

DIN Standards

DIN 66401 Unique Identification Mark – UIM
DIN 66403 System Identifiers
DIN 66277 Identification plate with RFID tag and/or 2D bar code
DIN 16598 Syntax keyboard and Web compatible encoding of data elements applied with ASC Data Identifiers
DIN Spec 16589 Product to Internet communication - Pointer to Process

Other relevant AIDC and Application standards

CEN 1573 Multi-Industry-Transport Label, www.din.de
IEC 62090 Product Package Labels for Electronic Components using Bar Code & 2-d symbologies
Global Transport Label V3, www.odette.org
Global Guideline for Returnable Transport Item Identification, www.aiag.org
GS1 Global Specifications, www.gs1.com
HIBC Health Industry Bar Code, www.hibc.de
PaperEDI-Standard, www.e-d-c.info
EDIFICE-Guideline WEB AND KEYBOARD COMPATIBLE ENCODING WITH ASC DATA IDENTIFIERS, www.edifice.org

Note: ISO, CEN and DIN standards are also available from all national institutes, e.g. via www.din.de

ANNEX 6) The UDI Book

On 26 September 2014, the law for barcodes on every medical device (UDI) came into force in the USA; on 5 April 2017, the corresponding EU regulation for Europe was published. Due to the penetration of these projects for the entire healthcare supply chain, DIN/BEUTH-Verlag published the reference book "UNIQUE DEVICE Identification" on 16 May 2017. The publication date matches the publication date of the Medical Devices Ordinance (MDR), in which "UDI" is integrated as a core element. The book provides instructions for UDI-compliant labelling for the manufacturer, but also informs users in hospitals how they can benefit from the legal requirements for UDI, because UDI is intended to increase patient safety and efficiency for all parties involved. With UDI, legislators are aiming for 100% barcodes for all medical devices. This will motivate users to implement AIDC in all areas where error-free recording is required. The book is written in German.

URL to the book: http://www.beuth.de/de/publikation/udi/228007232
URL to the MDR and IvDR: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R0745

ANNEX 7) Liaisons from Industry and Healthcare cooperating with the report:

- AIM DACH - AIM Germany, Austria, Switzerland, www.AIM-d.de
- CAICT - China Academy of Information and Communications Technology, www.caict.ac.cn
- DIN NA 043-01-31 - German Institute for Standardization, www.din.de
- EDIFICE, Global Network for B2B Integration in High Tech industries, Europe, USA, Asia, www.edifice.org
- EDC - Eurodata Council, www.e-d-c.info
- IFA - Information Center for Pharmaceuticals, http://www.ifaffm.de/en/ifa-coding-system
- JTCH AIDC - Joined Technical Committee Healthcare, www.e-d-c.info www.vddi.de
- Shi Yu, Consulting, Beijing/Washington D.C.
- ZIIOT - Zhonguancun Industry & Information Research Institute of Two-Dimensional Code Technology

Logos of cooperating partners:

DIN
VDDI Dental Solutions. German Manufacturers.
IFA CODINGSYSTEM
CAICT 中国信通院
TRUEVOLVE Technologies
elmicron
ZIIOT
EDC EuroData Council
IoT RFID I4.0 ident.one
REA Group
AIM
仁聚智汇
AUTO Data Corp.
EDIFICE

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