

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Identification link –
Part 1 : General requirements**

**Lien d'identification –
Partie 1 : Exigences générales**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Identification link –
Part 1 : General requirements**

**Lien d'identification –
Partie 1 : Exigences générales**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 35.240.15

ISBN 978-2-8322-5605-3

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	10
2 Normative references	10
3 Terms, abbreviated terms and definitions	11
4 Identification Link string.....	12
4.1 ILS-1: Global uniqueness.....	12
4.1.1 Requirement.....	12
4.1.2 Rationale and supplemental guidance.....	12
4.2 ILS-2: Link to additional information.....	13
4.2.1 Requirement.....	13
4.2.2 Rationale and supplemental guidance.....	13
4.3 ILS-3: No reuse.....	13
4.3.1 Requirement.....	13
4.3.2 Rationale and supplemental guidance.....	14
4.4 ILS-4: No altering.....	14
4.4.1 Requirement.....	14
4.4.2 Rationale and supplemental guidance.....	14
4.5 ILS-5: String length.....	14
4.5.1 Requirement.....	14
4.5.2 Rationale and supplemental guidance.....	14
4.6 ILS-6: URL syntax.....	14
4.6.1 Requirement.....	14
4.6.2 Rationale and supplemental guidance.....	14
4.7 ILS-7: Allowed characters	15
4.7.1 Requirement.....	15
4.7.2 Rationale and supplemental guidance.....	15
4.8 ILS-8: Uppercase and lowercase characters	15
4.8.1 Requirement.....	15
4.8.2 Rationale and supplemental guidance.....	15
4.9 ILS-9: No character-combinations with special functions	16
4.9.1 Requirement.....	16
4.9.2 Rationale and supplemental guidance.....	16
5 Identification Link with 2D symbol.....	16
5.1 2D-1: When marking with 2D symbol.....	16
5.1.1 Requirement.....	16
5.1.2 Rationale and supplemental guidance.....	16
5.2 2D-2: 2D symbol content.....	17
5.2.1 Requirement.....	17
5.2.2 Rationale and supplemental guidance.....	17
5.3 2D-3: Symbology	17
5.3.1 Requirement.....	17
5.3.2 Rationale and supplemental guidance.....	17
5.4 2D-4: Module size.....	17
5.4.1 Requirement.....	17
5.4.2 Rationale and supplemental guidance.....	17

5.5	2D-5: Quiet zone.....	17
5.5.1	Requirement.....	17
5.5.2	Rationale and supplemental guidance.....	18
5.6	2D-6: Error correction	18
5.6.1	Requirement.....	18
5.6.2	Rationale and supplemental guidance.....	18
5.7	2D-7: Label print quality	18
5.7.1	Requirement.....	18
5.7.2	Rationale and supplemental guidance.....	18
5.8	2D-8: Direct part marking print quality	18
5.8.1	Requirement.....	18
5.8.2	Rationale and supplemental guidance.....	19
5.9	2D-9: Durability of the 2D marking	19
5.9.1	Requirement.....	19
5.9.2	Rationale and supplemental guidance.....	19
5.10	2D-10: Frame.....	19
5.10.1	Requirement.....	19
5.10.2	Rationale and supplemental guidance.....	19
5.11	2D-11: Positive image.....	20
5.11.1	Requirement.....	20
5.11.2	Rationale and supplemental guidance.....	20
5.12	2D-12: Location of the 2D symbol	21
5.12.1	Requirement.....	21
5.12.2	Rationale and supplemental guidance.....	21
6	Near Field Communication for the Identification Link	22
6.1	NFC-1: When marking with NFC	22
6.1.1	Requirement.....	22
6.1.2	Rationale and supplemental guidance.....	22
6.2	NFC-2: Air interface standards.....	22
6.2.1	Requirement.....	22
6.2.2	Rationale and supplemental guidance.....	22
6.3	NFC-3: Data format and content	23
6.3.1	Requirement.....	23
6.3.2	Rationale and supplemental guidance.....	23
6.4	NFC-4: Data consistency	23
6.4.1	Requirement.....	23
6.4.2	Rationale and supplemental guidance.....	23
6.5	NFC-5: Protection classes and approvals.....	23
6.5.1	Requirement.....	23
6.5.2	Rationale and supplemental guidance.....	23
6.6	NFC-6: Durability	24
6.6.1	Requirement.....	24
6.6.2	Rationale and supplemental guidance.....	24
6.7	NFC-7: Write protection	24
6.7.1	Requirement.....	24
6.7.2	Rationale and supplemental guidance.....	24
6.8	NFC-8: Tag location for use in installed state.....	24
6.8.1	Requirement.....	24
6.8.2	Rationale and supplemental guidance.....	24

6.9	NFC-9: Tag position relative to existing marking for identification	25
6.9.1	Requirement.....	25
6.9.2	Rationale and supplemental guidance.....	25
6.10	NFC-10: Tag position relative to neighbouring tags	25
6.10.1	Requirement.....	25
6.10.2	Rationale and supplemental guidance.....	25
6.11	NFC-11: Generic RFID Emblem in frame.....	25
6.11.1	Requirement.....	25
6.11.2	Rationale and supplemental guidance.....	26
6.12	NFC-12: RFID Emblem visibility	26
6.12.1	Requirement.....	26
6.12.2	Rationale and supplemental guidance.....	26
6.13	NFC-13: RFID Emblem position relative to tag	26
6.13.1	Requirement.....	26
6.13.2	Rationale and supplemental guidance.....	27
Annex A (normative)	Overview of characters permitted for the IL string	28
Annex B (informative)	Examples of Identification Link strings.....	31
B.1	Examples: URL syntax according to IETF RFC 3986 with restrictions according to this document	31
B.2	Examples: Parameters with data identifiers according to ISO/IEC 15418.....	33
Annex C (informative)	2D symbol examples and layout considerations	35
C.1	Choice of symbology.....	35
C.2	Square and rectangular symbols	35
C.3	Selection of corner for triangle when using QR Code	36
C.4	Symbols not centered in the frame	36
C.5	Layout example when space is not sufficient.....	37
Annex D (informative)	2D symbols on curved surfaces.....	38
Annex E (informative)	Duplicates of the Identification Link	39
Annex F (informative)	Search Engine friendliness	40
Annex G (informative)	Cybersecurity aspects.....	41
Annex H (informative)	IL string as IRDI	42
Bibliography		43
Figure 1	– Example of an IL linking a physical object to information associated with it	13
Figure 2	– Frame around the 2D symbol	20
Figure 3	– Comparison of a 2D symbol as negative and normal positive image	20
Figure 4	– Representation of an IL on a dark background	21
Figure 5	– marking of an NFC tag as an IL.....	26
Figure C.1	– IL size may vary depending on the used symbology.....	35
Figure C.2	– IL with square and rectangular Data Matrix.....	36
Figure C.3	– IL with 2D symbols not centered in the frame.....	36
Figure C.4	– IL with 2D symbols quiet zone below 4 modules on 2 sides	37
Table A.1	– List of ASCII Code Characters permitted as this standard to create an IL.....	29
Table B.1	– Structure of example a).....	31
Table B.2	– Structure of example b).....	31

Table B.3 – Structure of example c)	31
Table B.4 – Structure of example d)	32
Table B.5 – Structure of example e)	32
Table B.6 – Structure of example f)	32
Table B.7 – Structure of example g)	33
Table B.8 – Structure of example h)	33
Table B.9 – Structure of example a)	34
Table B.10 – Structure of example b)	34
Table D.1 – Recommended maximum radii when using QR Codes	38

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IDENTIFICATION LINK

Part 1: General requirements

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61406-1 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65E/845/CDV	65E/905/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61406 series, published under the general title *Identification link*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Every year, industry purchases hundreds of millions of items of technical equipment – referred to here as physical objects – for setting up new production facilities and maintaining existing ones. When applying this standard, these physical objects can be simply and unambiguously identified by using a standardized Identification Link (IL), attached for example on the nameplate. This means that all information relating to the physical object can be identified in various IT systems and then called up, edited and stored as necessary across all processes from storage and retrieval to assembly, maintenance, inspection, repair and disassembly. This is an invaluable advantage in all these processes. The manufacturer in turn can link all information such as drawings, operating instructions and spare part lists to this IL in its systems. Users, e.g. owners or operators, can do the same with their information in their systems. In communication between the manufacturer and user, this IL alone then suffices for both parties to find and exchange all the information they need about a physical object throughout its lifecycle. This IL is therefore a prerequisite for easy accessing and maintaining information in the physical object's digital twin.

Previous standards for machine-readable identification of physical objects essentially describe how the traditional identification features (manufacturer, product number, serial number) can be stored in a machine-readable way using standardized syntax (e.g. as per ISO/IEC 15434 [6]) and semantics (e.g. as per ISO/IEC 15418 [7]) so that the strings used for identification according to these standards can be analyzed (parsed) and processed across all manufacturers using suitable software. These regulations allow a great variety of identifiers and technologies to be used, some of which can be highly complex, depending on the chosen solution. This means that in the relationship between the manufacturer and the user, which parts of these regulations and which of the identification methods specified in them are to be used needs to be determined. A universally usable identification by the manufacturer is not possible without consulting the respective user. The identification options listed in these regulations also always require analysis of the character string and the information encoded in it using suitable software, which involves much greater requirements for further processing. Furthermore, for industrial applications such as in the process manufacturing industry, there are special requirements for the long-term legibility and reliability of markings in the harsh conditions of industrial environments.

Production systems, e.g. in the process manufacturing industry, usually consist of several thousand individual physical objects. Each of these physical objects must be uniquely identified during all steps and processes in its lifecycle by both the manufacturer and the user. On the part of the manufacturer, this identification starts during the production of the physical object, and continues during its packaging and shipping. On the part of user, this process continues with the receipt, storage and retrieval of the physical object, carries on through installation, commissioning, operation, inspection, maintenance, repair and disassembly, and finally ends when it is scrapped.

The manufacturer usually provides each physical object with an identifier that allows it to be uniquely identified. This identification of the physical object usually takes place using a nameplate.

The product type of the physical object can generally be clearly identified using the information on the nameplate. If it is a serialized physical object, which means a serial number is present on the nameplate, then it can also be identified as a single, distinguishable instance of a model.

However, in practice this identification of physical objects on a nameplate often cannot be read and used automatically. This is a serious drawback to optimizing and in particular automating identification in all work processes. The reason for this is that the characteristics of a nameplate such as the content, designation, layout and fonts vary greatly according to the physical object and the manufacturer. The same applies to the physical properties of the nameplate, such as the material and the process for producing the graphic content (e.g. printing, etching, engraving, laser marking etc.).

This document does not try to standardize nameplates or physical properties of nameplates, due to the widely differing requirements of manufacturers and users and the vast variety of objects.

Optimizing and automating the identification of a physical object merely requires a unique machine-readable ID attached to the object.

Linking to information on the internet with a URL in a 2D symbol or NFC tag on the physical object is more and more used.

This Identification Link covers in a simple, monomorphic and single solution both major use cases for machine readable product marking, the unique identification and the link to data on the internet.

IDENTIFICATION LINK

1 Scope

This part of IEC 61406 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). The IL is machine-readable and is attached to the physical object in a 2D symbol or NFC tag.

The requirements in this document 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.

This document does not specify any requirements on the content and the layout of nameplates/typeplates (e.g. spatial arrangement, content of the plain texts, approval symbols etc.).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-351, *International Electrotechnical Vocabulary (IEV) – Part 351: Control technology*

ISO/IEC 8859-1, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

ISO/IEC 14443-1, *Cards and security devices for personal identification – Contactless proximity objects – Part 1: Physical characteristics*

ISO/IEC 14443-2, *Cards and security devices for personal identification – Contactless proximity objects – Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-3, *Cards and security devices for personal identification – Contactless proximity objects – Part 3: Initialization and anticollision*

ISO/IEC 14443-4, *Cards and security devices for personal identification – Contactless proximity objects – Part 4: Transmission protocol*

ISO/IEC 15415, *Information technology – Automatic identification and data capture techniques – Bar code symbol print quality test specification – Two-dimensional symbols*

ISO/IEC 15693-1, *Cards and security devices for personal identification – Contactless vicinity objects – Part 1: Physical characteristics*

ISO/IEC 15693-2, *Cards and security devices for personal identification – Contactless vicinity objects – Part 2: Air interface and initialization*

ISO/IEC 15693-3, *Cards and security devices for personal identification – Contactless vicinity objects – Part 3: Anticollision and transmission protocol*

ISO/IEC 16022, *Information technology – Automatic identification and data capture techniques – Data Matrix bar code symbology specification*

ISO/IEC 19762, *Information technology – Automatic identification and data capture (AIDC) techniques – Harmonized vocabulary*

ISO/IEC 18004, *Information technology – Automatic identification and data capture techniques – QR Code bar code symbology specification*

ISO/IEC 29158, *Information technology – Automatic identification and data capture techniques – Direct Part Mark (DPM) Quality Guideline*

ISO/IEC 29160, *Information technology – Radio frequency identification for item management – RFID Emblem*

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

IETF RFC 3986:2005, *Uniform Resource Identifier (URI): Generic Syntax*

3 Terms, abbreviated terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-351, ISO/IEC 19762 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

data carrier

device or medium used to store data as a relay mechanism in an AIDC system

Note 1 to entry: Bar code, OCR character string and RF tag are examples of data carriers.

[SOURCE: ISO/IEC 19762:2016, 01-01-59]

3.2

Identification Link

IL

combination of 2D symbol or NFC tag and contained IL string

3.3

Identification Link string

IL string

data string in URL syntax which is the globally unique identification of a physical object and points to related information on the internet

Example: <https://www.domain-abc.com/sd09fqw4?1P=productcode&S=serialnumber>

3.4

manufacturer

company or organization with ultimate responsibility for the compliance of the physical object with the appropriate standard or standards and to provide the product information

3.5

user

organization or person that is the owner or operator of the physical object

3.6

physical object

technical equipment such as vessels, units, machines, electronic devices and components, assemblies, batteries, components, spare parts etc.

3.7

RFID Emblem

graphical symbol specified in ISO/IEC 29160 to inform users of the presence of RFID

3.8

symbology

standard means of representing data in optically machine readable form

Note 1 to entry: Each symbology specification sets out its particular rules of composition or symbol architecture.

[SOURCE: ISO/IEC 19762:2016, 02-01-02]

4 Identification Link string

4.1 ILS-1: Global uniqueness

4.1.1 Requirement

The IL string shall be a globally unique string that is assigned to only one physical object.

4.1.2 Rationale and supplemental guidance

The manufacturer and the user have an interest in unambiguously linking a physical object to data accrued during its lifecycle using machine reading processes. The reasons for this might include the following:

- If measures are carried out on a physical object, it must be unambiguously identified in order to rule out any confusion with other physical objects which would endanger the physical object itself, the system it is installed in, human beings or the environment.
- Any consistent and clear inventory management depends on unambiguous identification.

Figure 1 shows an example of the role of the globally unique IL for linking a physical object to various data and information.

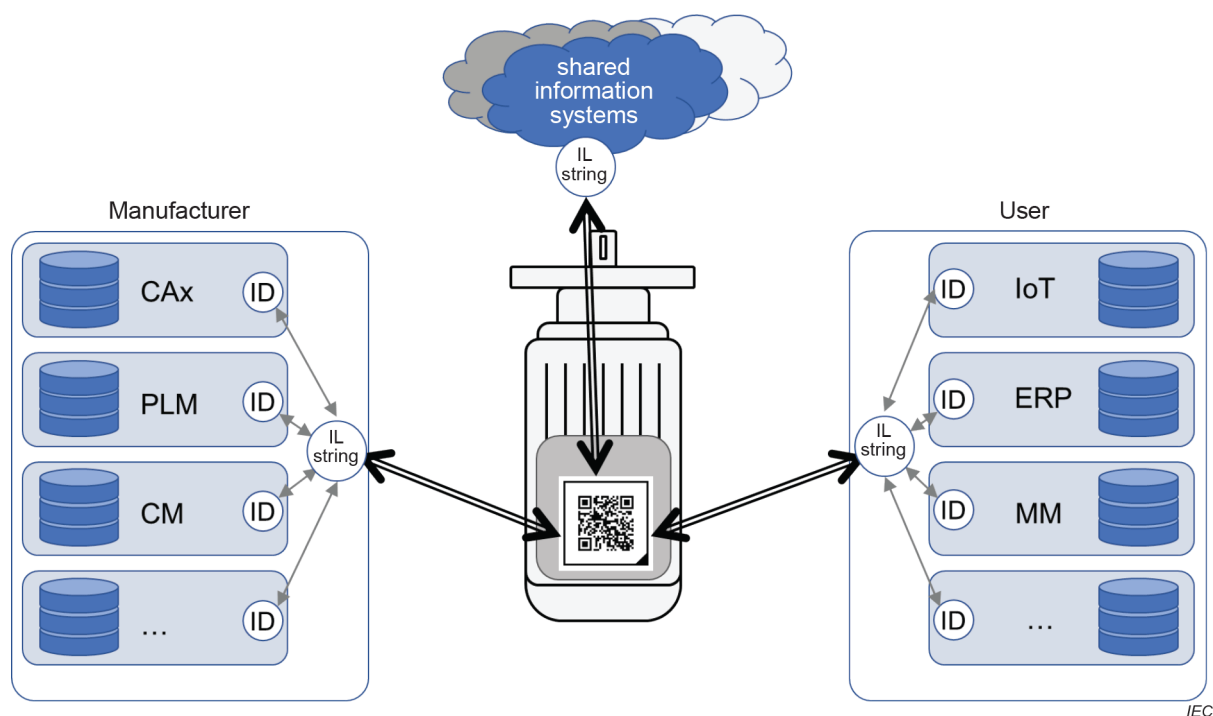


Figure 1 – Example of an IL linking a physical object to information associated with it

Examples of information possibly associated to the physical object are:

- information from the manufacturer such as operating instructions, drawings, spare parts lists and calibration records;
- operating data such as speeds, power consumption and pressures;
- models such as function and simulation models;
- maintenance and inventory management data.

This information is required in many processes during the lifecycle of the physical object. Simplifying access to this information using an IL is thus of significant benefit.

4.2 ILS-2: Link to additional information

4.2.1 Requirement

The IL string shall lead to additional information in digital form related to the physical object.

4.2.2 Rationale and supplemental guidance

In addition to identifying the physical object, the IL is also able to link to information pertaining to the object in the manufacturer and the user systems, as well as in other systems such as cloud-based third-party systems and to further information provided via the Internet.

NOTE This document does not specify requirements on format and content of the information provided.

4.3 ILS-3: No reuse

4.3.1 Requirement

Once an IL string has been assigned to a physical object, it shall not be reused for any another physical object, even after the maximum lifetime of the physical object has expired.

4.3.2 Rationale and supplemental guidance

An IL string is always associated with the one physical object to which it was originally assigned, even after the end of life of that object.

4.4 ILS-4: No altering

4.4.1 Requirement

Once an IL string has been assigned to a physical object, it shall not be altered.

4.4.2 Rationale and supplemental guidance

An IL string is always associated with the one physical object to which it was originally assigned, even after the end of life of that object.

4.5 ILS-5: String length

4.5.1 Requirement

The length of the IL string shall not exceed 255 characters.

4.5.2 Rationale and supplemental guidance

The limit of 255 characters results from 8-bit data types in databases, as $2^8 = 256$, which are still relevant in some legacy applications.

In practice, it may be necessary to encode numerous or lengthy pieces of information in the IL string. However, to make the IL string easy to place, to scan and to display and to use in brown field legacy systems of the users, it must be as short as possible. Space for large 2D symbols is typically very limited, especially on front panels or nameplates, and manufacturers typically make strong efforts to reduce the content of the 2D symbol as much as possible.

It is recommended that external constraints are checked before creating strings longer than 72 characters.

NOTE 1 The largest rectangular Data Matrix code according to ISO/IEC 16022, with 16 x 48 cells, has the data capacity of 72 alphanumeric characters.

NOTE 2 The shorter the length of the IL-string, the less risk there is of length conflicts with field limitations of the IT-systems of business partners.

NOTE 3 Including a digital signature according to ISO/IEC 20248 [10] in the IL string increases the string-length by around 120 additional characters.

4.6 ILS-6: URL syntax

4.6.1 Requirement

The IL string shall use the URL syntax according to IETF RFC 3986, with the exception that scheme ("https") and "://www." may be omitted.

4.6.2 Rationale and supplemental guidance

The URL syntax is in common use and well defined. The domain name is unique by definition. Apart linking to information on the internet, this syntax is also suitable for representing information from the manufacturer such as the model name, serial number, date of manufacture. This can be done without excessive data overheads, as for example when using XML.

Not all valid URL strings according to IETF RFC 3986 are allowed for the IL string. See ILS-5, ILS-7, ILS-8 and ILS-9 with restrictions.

NOTE 1 Examples are provided in Annex B.

NOTE 2 This document does not specify any semantic requirements (see Annex F).

NOTE 3 The ULR-syntax is critical in regard to cybersecurity (see Annex G).

4.7 ILS-7: Allowed characters

4.7.1 Requirement

Only the following ASCII characters shall be used in the IL string:

All reserved characters according to IETF RFC 3986:2005, 2.2. These are:

- gen-delims = ":" / "/" / "?" / "#" / "[" / "]" / "@"
- sub-delims = "!" / "\$" / "&" / "'" / "(" / ")" / "*" / "+" / "," / ";" / "="

These delimiters shall only be used for the purpose or function for which they have been reserved in IETF RFC 3986, for example as delimiters between the different components of the syntax of a URL according to IETF RFC 3986. They shall not be used in the URL in the form of a %-encoding according to IETF RFC 3986:2005, 2.2 ff.

All unreserved characters according to IETF RFC 3986:2005, 2.3. These are:

- unreserved = ALPHA / DIGIT / "-" / "." / "_" / "~"

NOTE 1 "ALPHA" means the letters "a" to "z" and "A" to "Z" from the ASCII code, inclusively.

NOTE 2 "DIGIT" means the Arabic numerals "0" to "9" from the ASCII code, inclusively.

4.7.2 Rationale and supplemental guidance

The IL string shall be easily and reliably processable all over the world.

Annex A contains a tabular overview of all characters of the ASCII code, in which all characters permitted for creating an IL string according to this document are marked.

4.8 ILS-8: Uppercase and lowercase characters

4.8.1 Requirement

Uppercase letters shall be used only in the <Path>, <Query> and <Fragment> components of the IL string.

4.8.2 Rationale and supplemental guidance

The <Scheme> and <Host> components of a URL according to IETF RFC 3986 are "case-insensitive", which means the case of the letters does not affect the function of the URL in this part of the URL string. From the <Path> component onward, the URL is case-sensitive, which means that from here on, the case of the letters affects the URL function.

The capitalization of the letters in an IL string is a feature that is relevant to its uniqueness. It must be taken into account when creating an IL string. If a URL is to be used for this, the entire character string of the URL, in other words each of its individual components, is case-sensitive.

EXAMPLE 1: The two following URLs are identical in their function as a URL:

- https://www.domain-abc.com/free_text
- HTTPS://wWw.DOMAIN-ABC.com/free_text

EXAMPLE 2: The two following URLs are not identical in their function as a URL:

- https://www.domain-abc.com/free_text

– https://www.domain-abc.com/FRree_Text

EXAMPLE 3: A negative example for an URL which would result in errors is shown by the two URLs shown below, which differ only in the case used in the <Scheme> and <Host> components, which has no effect on the function as a URL. However, with regard to their property as a globally unique identification string according to this standard, they are not identical, because the case is different in the <Scheme> and <Host> components:

– https://www.domain-abc.com/free_text

– HTTPS://wWw.DOMAIN-ABC.com/free_text

4.9 ILS-9: No character-combinations with special functions

4.9.1 Requirement

No part of the URL string shall contain any combination of the characters permitted in Requirement ILS-6 that in another RFC has been assigned a special function within the URL as a whole or a component thereof. In other words, the combination shall not be one of the reserved characters or combinations which, when interpreted, leads to the IL string being altered or encoded.

4.9.2 Rationale and supplemental guidance

Processing the IL string must be easy and reliable, without any erroneous or unwanted effect.

EXAMPLE 1: A negative example for an URL which would result in errors is punycode according to IETF RFC 3492 [15]. The character combination "--" is used in IETF RFC 3492 [15] to mark the coding of a mutated vowel. For example, the punycode string "xn--bume-loa", when used in the domain name, is transcoded by the URL autodetection into the string "bäume". If this string is entered in the form www.xn--bume-loa.de into a browser, for example, the string will be transcoded into "www.bäume.de".

5 Identification Link with 2D symbol

5.1 2D-1: When marking with 2D symbol

5.1.1 Requirement

The IL string shall be marked on the physical object in a 2D symbol, unless if by the nature of the physical object it is impossible to implement the 2D symbol. In this case using only NFC is acceptable and the following requirements for 2D symbol do not apply.

5.1.2 Rationale and supplemental guidance

To allow easy identification of a physical object and automated processing of the IL, technologies must be used for identification that are robust and as widespread as possible. Marking physical objects with an identifier with a 2D symbol as medium is a robust and sufficiently widespread technology in the industrial environment.

Mobile devices currently available on the market for industrial use generally contain a camera and thus have the ability to recognize and process 2D symbols such as QR Code or Data Matrix codes using the appropriate software.

Not enough space on the nameplate, no flat surface close to the nameplate or similar justifications do not substantiate that it is technically not possible to implement the 2D symbol for the IL string, if the physical object is big enough and if with another construction this could be solved.

NOTE "Flat surface" is to be seen relative to the size of the 2D symbol. See Annex D "2D symbols on curved surfaces".

5.2 2D-2: 2D symbol content

5.2.1 Requirement

The 2D symbol for the IL shall contain only the IL string and no other data.

5.2.2 Rationale and supplemental guidance

Any need for specific parsing or processing of the content of the 2D symbol shall be avoided to ensure a maximum of robustness and reliability.

5.3 2D-3: Symbology

5.3.1 Requirement

Only 2D symbologies that have been standardized by ISO and IEC shall be used. These include Data Matrix according to ISO/IEC 16022 and QR Code according to ISO/IEC 18004.

5.3.2 Rationale and supplemental guidance

There are various 2D symbologies on the market. Not all 2D symbols can be read by the available readers. But some new types of 2D symbols have significant benefits, such as square shapes, which often are easier to add on physical objects and nameplates, and this document does not intend to hinder progress. Readers in industrial environments often have a long lifetime and are designed more for robustness than for supporting new features. Therefore, it can take much time until new symbologies are supported in the different facilities of the users.

NOTE Annex C provides examples of layouts, and related considerations.

5.4 2D-4: Module size

5.4.1 Requirement

The module size shall be at least $X = 0,25$ mm. The recommended minimum module size is $X = 0,35$ mm.

5.4.2 Rationale and supplemental guidance

In industrial applications the environmental conditions such as illumination and dust are often challenging and the reading performance of the readers is often poor, e.g. with ruggedized devices. A module size of $X = 0,35$ mm provides more robustness than smaller module sizes. Larger module sizes require more space. With very large 2D symbols the readers have challenges to focus on them.

On small physical objects, there may be not enough place available for a 2D symbol with a module size of $X = 0,35$ mm. For such cases, when the size of the physical object to be identified makes it necessary, the module size may be reduced to $X = 0,25$ mm.

5.5 2D-5: Quiet zone

5.5.1 Requirement

If the size of the object permits, the quiet zone shall have a minimum extent of 4 module sizes.

NOTE 1 Quiet zones of QR Codes compliant to ISO/IEC 18004 must have a minimum extent of 4 module sizes.

NOTE 2 Quiet zones of Data Matrix codes compliant to ISO/IEC 16022 must have a minimum extent of 1 module size.

5.5.2 Rationale and supplemental guidance

A larger quiet zone makes it easier for the readers to detect the 2D symbol and to focus on it, and provides the robustness needed in industrial applications.

5.6 2D-6: Error correction

5.6.1 Requirement

For sufficient error correction, Data Matrix shall only be used in version ECC 200 and QR Code with an error correction level of "M" or higher. The recommended error correction level for QR Code is "Q". For other symbologies, an equivalent or better error correction level shall be used.

5.6.2 Rationale and supplemental guidance

Ambient conditions in industrial environments are often challenging and the service life of the marked physical objects can be long. This makes it necessary to take use of the error correction features of the 2D symbols.

Higher error correction levels of QR Codes increase the size of the symbol. The size of the object to be identified makes it necessary to choose either to reduce the module size or to reduce the error correction level. For QR Codes with already small module sizes, the reading performance is typically better for decreased error correction level to "M" than for decreased module sizes.

An error correction level for QR Codes higher than "Q" may be used. But for QR Codes with small modules increasing the module size is typically better for the readability than increasing the error correction level above "Q".

NOTE For Data Matrix error correction levels other than for version ECC200 are partly still supported, but have not much relevance any more, and can be removed in future versions of the Data Matrix standard.

5.7 2D-7: Label print quality

5.7.1 Requirement

If the 2D symbol is printed on a label, then the method used to produce the 2D symbol shall achieve at least Grade C labelling quality according to ISO/IEC 15415 at the time of printing.

5.7.2 Rationale and supplemental guidance

Ambient conditions in industrial environments are often challenging and the service life of the marked physical objects can be long. This makes it necessary that the print quality of the 2D symbol on the label is in good quality.

Typical measures to control the label print quality are to verify the print quality of sample labels with dedicated verifiers, and to make 100% optical inspections by trained personal.

This requirement 2D-7 applies only if labels are used for the 2D symbol. Otherwise requirement 2D-8 applies.

5.8 2D-8: Direct part marking print quality

5.8.1 Requirement

If the 2D symbol is implemented in a direct part marking technology, e.g. laser marking, then the method used to produce the 2D symbol shall achieve Grade C or better according to ISO/IEC 29158.

5.8.2 Rationale and supplemental guidance

Ambient conditions in industrial environments are often challenging and the service life of the marked physical objects can be long. This makes it necessary that the print quality of the 2D symbol on the physical object is in good quality.

Typical measures to control the print quality are to verify the marking quality of samples with dedicated verifiers, and to make 100% optical inspections by trained personal.

This requirement 2D-8 applies only, if direct part marking is used for the 2D symbol. Otherwise requirement 2D-7 applies.

5.9 2D-9: Durability of the 2D marking

5.9.1 Requirement

The 2D marking shall be able to withstand the environmental effects expected solely from the intended use for the lifetime of the physical object as specified by the manufacturer, but not necessarily more than the service life according to ISO 13849-1.

5.9.2 Rationale and supplemental guidance

To be able to use the IL over the intended life time of a physical object, the data carrier of the IL string has to withstand the expected ambient conditions at least over the intended life time of a physical object. Otherwise, the ability to identify the physical object might get lost in the intended lifetime, what might cause additional costs, and in the worst cause harm to production facilities or human beings.

As the intended lifetime of the physical object can be an issue of different views between the manufacturer and the user, the clear definition of service life according to ISO 13849-1 is set as the minimum requirement.

NOTE A classification of ambient conditions can be found in the IEC 60721 [3] series.

5.10 2D-10: Frame

5.10.1 Requirement

The 2D symbol shall be surrounded by a frame with the line width of one module. The frame shall be at a distance of at least 4 modules from the 2D symbol and the lower right corner of the frame shall be filled with modules in a triangular shape. The perpendicular legs of the triangle shall be 6 modules long.

5.10.2 Rationale and supplemental guidance

The frame with the triangularly filled corner is highly recognizable and helps the user to identify the IL among all 2D symbols attached to the physical object.

The risk of reading a wrong symbol shall be as little as possible. However, it is widespread that there are several 2D symbols attached to a physical object. Without clear marking of the 2D symbol with the IL there would be a great risk of reading the wrong 2D symbol.

The angle shall not touch the 2D symbol, as this would harm the detection of the 2D symbol.

Figure 2 shows a frame around a symbol with a unique identification, and its shape, dimensions and distances.

$X \geq 4$ module sizes; $Y = 6$ module sizes; $Z = 1$ module size

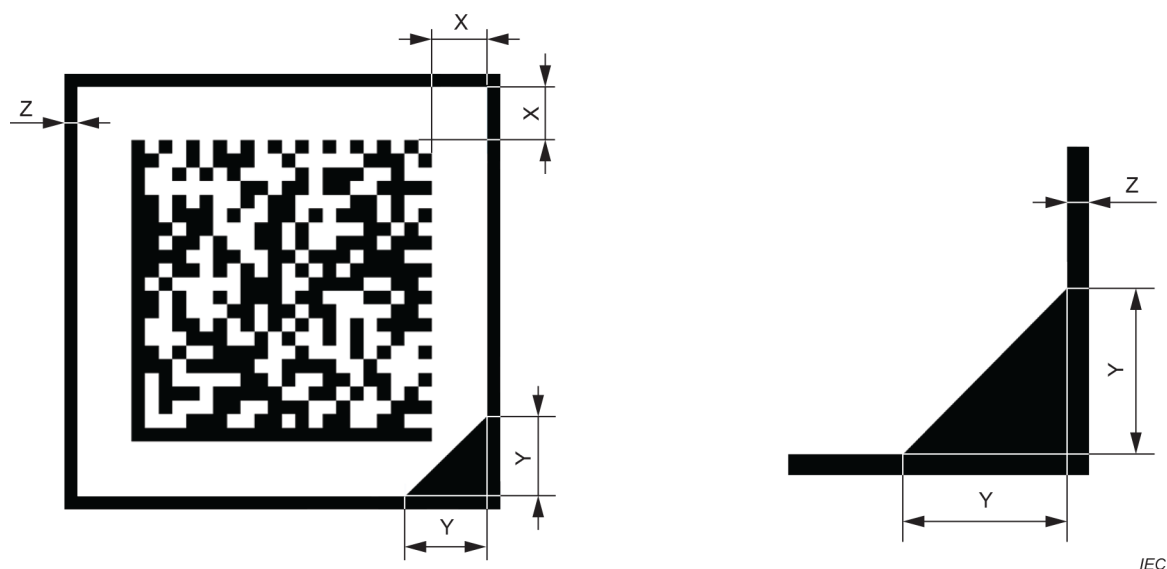


Figure 2 – Frame around the 2D symbol

5.11 2D-11: Positive image

5.11.1 Requirement

Unless it is not applicable to the marking technology being used, the 2D symbol shall be applied as a positive image, even if the background is dark. The frame around the 2D symbol shall be surrounded by an additional light-coloured frame with a thickness of 1 module minimum.

5.11.2 Rationale and supplemental guidance

Figure 3 shows a comparison of a 2D symbol as negative and as positive image. Typical readers are optimized for symbols with positive images.



Figure 3 – Comparison of a 2D symbol as negative and normal positive image

Figure 4 shows a correct implementation of an IL as positive image as example on a nameplate with dark background.



Figure 4 – Representation of an IL on a dark background

For printed symbols, an increased marking speed, less ink consumption or similar justifications do not substantiate a technological necessity to allow a negative image.

For some direct part marking technologies such as nailed symbol, the categories "positive image" or "negative image" do not apply. In case that the technological constraints of the direct parts marking technology being used define different solutions to create a contrast for the reading device, this requirement is not applicable.

5.12 2D-12: Location of the 2D symbol

5.12.1 Requirement

The 2D symbol shall be readable in installed state. It is recommended that it is attached on or very close to the existing marking for the identification of the physical object, for example the front panel label or the nameplate, unless this is technically not possible or the existing marking is not readable in installed state.

5.12.2 Rationale and supplemental guidance

Typically, the location of the existing marking for the identification of the physical object is also the location which is best accessible for the IL and where a typical user will start searching for the IL. This should be a location, where the marking is readable in installed state.

Other locations are acceptable if this results in better detection and readability of the marking with the IL. For example, if the existing nameplate is on the rear of the physical object and not visible in installed state, then it is acceptable that the 2D symbol with the IL string is marked on the front of the physical object.

Not enough space on the nameplate, no flat surface close to the nameplate or similar justifications do not substantiate that it is technically not possible to attach the IL on or close to the nameplate, if the physical object is big enough and that with another construction this could be solved.

"Very close to the existing marking" is to see in relation to the size of the marked physical object and the existing marking / nameplate. It is less than 5 % of the width of the marked physical object or less than twice the width of the nameplate, whatever is more.

NOTE The manufacturer cannot know all and support all possible situations of the installations at the users' facilities. Therefore, the customer can create specific adoptions or a duplicate of the marking. See Annex E "Duplicates of the Identification Link".

6 Near Field Communication for the Identification Link

6.1 NFC-1: When marking with NFC

6.1.1 Requirement

The physical object shall be marked with a NFC tag containing the IL string when by the nature of the physical object it is likely, that the IL in the 2D symbol does not provide a sufficient readability or if there is no IL in a 2D symbol. Otherwise, additional marking with NFC is optional.

If there is no marking with NFC, then the following NFC requirements are not applicable.

6.1.2 Rationale and supplemental guidance

Physical objects are also used in environments where a 2D symbol is hard to read because of dirt, vibrations, inaccessibility or other conditions. In environments like this, it can be advantageous to use a non-contact, non-optical technology.

The RFID tag specified here uses NFC technology, which is a subset of RFID technology and is supported by many smartphones and other mobile readers. For this purpose, an RFID/NFC transponder (referred to from here on as an NFC tag) must be put on the physical object to be identified. The physical interface and protocols of NFC systems are specified in ISO/IEC 18092—Near Field Communication Interface and Protocol-1 (NFCIP-1) and ISO/IEC 21481—Near Field Communication Interface and Protocol-2 (NFCIP-2).

NOTE If a physical object is marked with an IL in NFC this does not substitute the requirement to mark with 2D.

6.2 NFC-2: Air interface standards

6.2.1 Requirement

The tags shall meet either the HF standard according to ISO/IEC 15693-1, ISO/IEC 15693-2 and ISO/IEC 15693-3 in NFC type V format or the HF standard according to ISO 14443-1, ISO/IEC 14443-2, ISO/IEC 14443-3 and ISO/IEC 14443-4 in NFC type II or type IV format.

6.2.2 Rationale and supplemental guidance

The preference for the selected passive HF technology results from:

- the 13,56 MHz worldwide non-intersecting operating frequency;
- the low cost of purchasing tags;
- the tags that do not need a battery and are powered via the reader;
- the wide availability of mobile readers;
- the process-related reason for use.

The worldwide availability of the 13,56 MHz RFID frequency makes it possible to use this technology globally. In addition, the robustness of this technology allows it to be reliably used even in highly challenging industrial environments. During the period when a physical object is use, the important thing is not usually mass recording and identification of many individual physical objects (bulk reading) as is usually the case for example in the logistics industry, but targeted and reliable recording and identification of individual physical objects to support mainly internal processes such as assembly, maintenance and inspections. The very short reading distance of the NFC technology ensures that the tag can be clearly assigned to the physical object.

The energy required to operate the chip and transmit the information is supplied to the NFC tag via high frequency electromagnetic fields, in other words inductively (passive tag). Because they are powered inductively, passive tags are more durable and not limited to the service life of a battery. Another advantage of the inductive power supply is that under certain conditions, these tags are simple electrical equipment according to IEC 60079-14 [1]¹ that can be used in explosion hazard zones without additional certification.

Physical objects used in industry are often made of metal. Due to eddy current losses, metal surfaces sometimes greatly reduce the strength of high-frequency magnetic fields. These eddy current losses occur because the magnetic field also acts on the metallic surface, inducing eddy currents on it. Lenz's law states that these induced currents oppose the magnetic field that caused them, thus attenuating the magnetic field on the metal surface. Without countermeasures, this leads to a significantly reduced reading range or even complete failure of communication. Nevertheless, NFC tags can easily be used on metal objects if they have suitable ferrite shielding (ferrite films, ferrite shells etc.), if spacer materials are used, or similar measures are taken.

6.3 NFC-3: Data format and content

6.3.1 Requirement

The IL string shall be stored in an NDEF record of the "text" type in UTF8 encoding. Except for the IL string, no other data shall be stored on the NFC tag.

6.3.2 Rationale and supplemental guidance

Any need for specific parsing or processing of the content of the tag by must be avoided to ensure a maximum of robustness and reliability.

6.4 NFC-4: Data consistency

6.4.1 Requirement

The data content of the NFC tag shall be identical to the data content of the 2D symbol.

6.4.2 Rationale and supplemental guidance

The same IL string is valid, independent from the media.

6.5 NFC-5: Protection classes and approvals

6.5.1 Requirement

The NFC tag shall have at least the protection classes and approvals of the physical object to be identified or shall not negatively affect these.

6.5.2 Rationale and supplemental guidance

Physical objects with an NFC tag can also be used in areas with moisture, water, foreign bodies and dust.

The term "protection class" refers to the general protection classes that can be found on a physical object in industrial use. An example for a standard defining protection classes is IEC 60529 [2].

¹ Numbers in square brackets refer to the Bibliography.

If the NFC tag is approved for narrower application conditions than the physical object, then the tagged object shall be marked with the limiting conditions of the NFC tag.

6.6 NFC-6: Durability

6.6.1 Requirement

The data on the NFC tag shall be readable for the life of the physical object as specified by the manufacturer under the ambient conditions expected in normal use, but not necessarily more than the service life according to ISO 13849-1.

6.6.2 Rationale and supplemental guidance

Robustness and reliability are required for industrial use.

6.7 NFC-7: Write protection

6.7.1 Requirement

The manufacturer shall protect the NFC tag by means of write protection against subsequent manipulation of the IL string.

6.7.2 Rationale and supplemental guidance

It is important, that the relationship between IL and physical object is reliable over the whole lifecycle of both the physical object and the identification.

Measures to ensure write protection may for example be to use read-only-tags, or to set a permalock.

6.8 NFC-8: Tag location for use in installed state

6.8.1 Requirement

The NFC tag shall be affixed on the physical object so that when the object is installed as intended, the NFC tag is accessible for reading using common mobile terminals designed for industrial use.

6.8.2 Rationale and supplemental guidance

Most of its lifetime the typical physical object in industrial environments is in installed state. This phase must be supported by the NFC tag for easy and reliable identification.

In industrial environments there are typically physical objects and reading equipment from many manufacturers. If some physical objects would require specific readers, then this would hinder easy identification.

If there are several possibilities to install the marked physical object and there is not a specific location where the NFC tag is accessible for all common installation scenarios, then the manufacturer shall provide several options for the NFC tag locations, or propose a NFC tag for affixing by the user.

NOTE There is no more concrete specification where to fix the tag, as the possibilities and the expectations of the users vary largely with the marked objects.

6.9 NFC-9: Tag position relative to existing marking for identification

6.9.1 Requirement

The NFC tag with the IL string shall be affixed to or attached very close to the existing marking for identification of the physical object, for example the nameplate, unless this marking is not accessible in the installed state.

6.9.2 Rationale and supplemental guidance

At this location a typical user will expect to find the IL.

If the existing marking for identification is not readable in the installed state, then this requirement does not apply. The readability of the tag in the installed state is more important than the closeness to the existing marking for the identification.

"Very close to the existing marking for identification" is seen in relation to the size of the marked physical object and the existing marking for identification.

NOTE There is no concrete normative definition of what constitutes a "very close" distance, as the possibilities and the expectations of the users vary largely with the marked objects.

6.10 NFC-10: Tag position relative to neighbouring tags

6.10.1 Requirement

The NFC tags used for identification shall be appropriately arranged on the physical object, far enough away from other NFC tags to be read without errors or confusion.

6.10.2 Rationale and supplemental guidance

If there would be many tags in a reading distance, then reading the correct tag is not reliable anymore. Reflections, absorptions, distortions, antenna angles and other effects may e.g. have the effect that a wrong tag is read, even if the wrong tag might be farer away from the reader than the correct tag.

NOTE 1 There is no concrete normative definition of what constitutes a "far enough" distance, as the possibilities and the expectations of the users vary largely with the marked objects.

NOTE 2 Depending on the geometry of the physical object and the tag location it can be useful to add a note in the installation instructions to keep sufficient distances to other tags.

6.11 NFC-11: Generic RFID Emblem in frame

6.11.1 Requirement

The generic RFID Emblem according to ISO/IEC 29160 shall be at least 5 mm × 5 mm in size. The emblem may only be smaller if it is technically possible to represent it in distinguishable quality. The RFID Emblem shall be marked by placing it inside a frame with the line width of one module. The frame shall be at a distance of at least 1,3 mm from the horizontal and vertical lines of the RFID Emblem and the lower right corner of the frame shall be filled in a triangular shape. The legs of the triangle that are perpendicular to each other shall be at least 2,1 mm long. The resulting ratio of the frame elements to each other shall be maintained. If the RFID Emblem is enlarged, the thickness of the frame shall be at least 25 % of the line thickness of the RFID Emblem. The proportions of the frame and RFID Emblem to each other shall only vary within the resulting range.

6.11.2 Rationale and supplemental guidance

An IL with NFC shall be marked with the RFID Emblem. It serves among others to indicate for the user the existence of an IL in an NFC tag. In many countries it is a legal requirement to indicate the usage of an RFID technology with an emblem, and there may be additional legal requirements e.g. on the minimum size of the emblem for the specific application.

The NFC tag used for the IL shall be visually distinguishable from other tags. The frame around the RFID Emblem shown in Figure 5 is a highly recognizable optical marker hereto.



Figure 5 – marking of an NFC tag as an IL

Should in some country exist a legal requirement for a different emblem than the generic RFID Emblem, then – and only then – for this country the legally required emblem may be used as alternative to the emblem according to the generic RFID Emblem. In that case, this emblem is to be surrounded with the frame.

NOTE The generic RFID Emblem in ISO/IEC 29160 is the same as the RFID Emblem in EN 16656 [17]. The ISO/IEC 29160 includes alternatives to the emblem in the ISO/IEC 29160, and some organizations promote their alternative RFID Emblems in own standards. But in Europe, the usage of the emblem according to EN 16656 [17] is mandatory, and this emblem is currently accepted everywhere in the world.

6.12 NFC-12: RFID Emblem visibility

6.12.1 Requirement

The RFID Emblem for the IL shall be clearly visible when the physical object is installed or in operation.

6.12.2 Rationale and supplemental guidance

An emblem, that is not easily visible, can fulfil legal requirements. But the tag for IL is intended to support also processes requiring the identification of equipment in operation.

NOTE The manufacturer cannot know all and support all possible situations of the installations at the users facilities, and there is no clear criteria for "clearly visible". Therefore, there can be need for customer specific adoptions or a duplicate of the marking. See Annex E "Duplicates of the Identification Link".

6.13 NFC-13: RFID Emblem position relative to tag

6.13.1 Requirement

The RFID Emblem shall mark the position of the NFC tag visibly and accurately enough to allow reliable reading.

6.13.2 Rationale and supplemental guidance

The reading distance of NFC is short. Without clear indication where to read it takes more time to read and increases the risk to read a wrong NFC tag.

NOTE The manufacturer cannot know all and support all possible situations of the installations at the users' facilities, and there are no clear criteria for "visibly" and "accurately enough". Therefore, there can be need for customer specific adoptions or a duplicate of the marking. See Annex E "Duplicates of the Identification Link".