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SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Use of printed labels for communicating information on rare metals in information and communication technology goods

Recommendation ITU-T L.1102

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ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.1102

Use of printed labels for communicating information on rare metals in information and communication technology goods

Summary

Recommendation ITU-T L.1102 describes printed label methods to provide information on rare metals contained in information and communication technology (ICT) goods, and includes requirements specified in Recommendations ITU-T L.1100 and ITU-T L.1101 on the disclosure of rare metals information to consumers and recyclers.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.1102	2016-07-14	5	11.1002/1000/12881

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Barcode, ICT products, printing label, QR code, rare metals, recycling.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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Recommendation ITU-T L.1102

Use of printed labels for communicating information on rare metals in information and communication technology goods

1 Scope

This Recommendation explains printed label methods for communicating information on rare metals contained in information and communication technology (ICT) goods, and describes requirements from [ITU-T L.1100] and [ITU-T L.1101] specifying the disclosure of information on contained rare metals to consumers and recyclers.

This Recommendation recommends appropriate label printing methods for rare metals, provides a standard way of obtaining information on rare metals in ICT goods and specifies how to encode rare metals information, as defined in [ITU-T L.1100], into a printed label.

This Recommendation covers:

- an overview of printed label symbology methods
- recommendations for printed label methods for rare metals in ICT goods
- a communication process for printed labels providing information on rare metals in ICT goods.

2 References

The following ITU-T Recommendations and other references contain provisions, which through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1100] Recommendation ITU-T L.1100 (2012), *Procedure for recycling rare metals in information and communication technology goods*.

[ITU-T L.1101] Recommendation ITU-T L.1101 (2014), *Measurement methods to characterize rare metals in information and communication technology goods*.

[ITU-T L.1400] Recommendation ITU-T L.1400 (2011), *Overview and general principles of methodologies for assessing the environmental impact of information and communication technologies*.

[ISO/IEC 8859-1] ISO/IEC 8859-1:2003, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 information and communication technology (ICT) goods [ITU-T L.1400]: The tangible products deriving from, or making use of technologies devoted to, or concerned with (a) the study and application of data and the processing thereof; i.e., the automatic acquisition, storage, manipulation (including transformation), management, movement, control, display, switching, interchange, transmission or reception of a diversity of data; (b) the development and use of the

hardware, software, and procedures associated with this delivery; and (c) the representation, transfer, interpretation, and processing of data among persons, places, and machines, noting that the meaning assigned to the data must be preserved during these operations.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 parts-per notations: A science and engineering unit to describe amounts of material quantities. Commonly used parts-per notations are weight percent (wt%, 1/100), parts-per-thousand (‰, $1/10^3$), parts-per-million (ppm, $1/10^6$), parts-per-billion (ppb, $1/10^9$) and parts-per-trillion (ppt, $1/10^{12}$).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ASCII	American Standard Code for Information Interchange
EAN	European Article Number
ICT	Information and Communication Technology
ISBN	International Standard Book Number
ITF	Interleaved Two of Five
PDF	Portable Data File
QR	Quick Response
UCC	Uniform Code Council
UPC	Universal Product Code

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The keywords "can optionally" and "may" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 Introduction to printed label method types

6.1 One-dimensional codes

There are many different types of one-dimensional code. A 1D barcode or one-dimensional code is so called because of the way the barcode is read. One-dimensional codes represent data by varying the widths and spaces of parallel lines. They are made by translating characters into a combination of narrow and wide bars which should then be displayed. Special types of "guard" patterns are used to indicate the start and end of the barcode to the scanner. The different types of one-dimensional code are briefly summarized as follows:

a) EAN-8 is a barcode and is derived from the longer European article number (EAN) code. It is used on cigarettes, pencils (though rarely) and chewing gum packets.

b) Code 39 specification defines 43 characters, consisting of upper-case letters (A through Z), numeric digits (0 through 9) and a number of special characters (-, ., $, /, +, %, and space). An additional character (denoted '*') is used for both start and stop delimiters.

c) Code 39 Extended was developed to provide a means of encoding additional characters that are not normally part of the Code 39 character set (lower-case characters and symbols).

d) ITF14 is a 14-digit barcode. It usually contains a top and bottom bar (sometimes rectangle) called the bearers bar. These bars make sure that the barcode is read completely. The first number is typically an arbitrary number between 0 and 7, the next number is a zero, the following 11 numbers are the first 11 numbers on a Universal Product Code (UPC) barcode and the last number is a check digit.

e) Code 128 is a very high-density barcode. It is used for alphanumeric or numeric-only barcodes. It can encode all 128 characters.

f) UPC A is primarily used for consumer goods and is comprised of 12 numeric digits. The first digit at the start represents the number system used. The next 5 digits specifically assigned by the Uniform Code Council (UCC) represent the manufacturer. Whereas the next 5 digits are for different products and are assigned by the manufacturer. The final digit is a check digit.

g) UPC E barcode contains 11 digits and always starts with 0. UPC E has a similar use to UPC A. Generally it is used where UPC A barcode is too wide for the application.

h) EAN 13 is used primarily in manufacturing industry and comprises 13 characters.

i) CODE 11 (USD 8) is primarily used for telecommunication devices and is comprised of numeric digits only.

j) Bookland (ISBN) is a special form of EAN 13 code. Its primary use is to encode the international standard book number (ISBN) on magazines and books.

6.2 Two-dimensional codes

Considering the candidate methods for describing information in a type of printable label, it is desirable to use two-dimensional codes such as quick response (QR) code, PDF417, DataMatrix, and Maxicode, which can be attached to the product easily. These four methods are briefly summarized as follows:

a) QR code has a larger capacity for recoding data of 4 296 characters with a densification and error correcting function and is designed to utilize the whole 256 byte ASCII character set as well as Kanji.

b) PDF417 consists of four bars and 17 space-included modules. The data capacity is of 1 850 characters.

c) DataMatrix is a high density 2 dimensional barcode that can encode up to 3 116 characters from the entire 256 byte ASCII character set. Compared with PDF417 barcode the DataMatrix is able to achieve higher data capacity.

d) Maxicode is made by 1-inch arrangement of 866 interlocking hexagons, storing 93 characters.

QR code can include lots of data including characters and therefore is a most suitable and efficient method for storing and encoding the rare metals information. Therefore, a convention is provided in this Recommendation by which the recycling information will be recorded using the QR code.

7 Label printing method to provide recycling information on rare metals

7.1 Label printing method for ICT goods on rare metals

7.1.1 Importance of recycling rare metals contained in ICT goods

Owing to their excellent inherent properties, rare metals are essential ingredients to achieve high functionality and performance in many ICT goods. ICT industries have become so dependent on rare metals that they are considered as a "backbone of industry". There is no standard definition for rare metals. Depending upon the geographical location, criticality, demand and other different scenarios, different countries may have different metal groups considered as rare. [ITU-T L.1100] can be referred to in order to obtain more information on typical rare metal groups and the recycling of rare metals from ICT goods.

Despite having a key role in improving the performance of ICT goods, the amount of rare metals available naturally is not sufficient to meet industrial demands. Considering this fact, many countries are preparing policies to ensure a stable supply of rare metals such as overseas resource development, recycling promotion, alternative material development, saving rare metals for emergencies, export control policies, etc. These countries consider that this stable supply of rare metal materials is significant for maintaining and strengthening the ICT industry's competitiveness worldwide. Tens of millions of ICT goods are collected annually as waste and recycling rare metals from this ICT goods waste provides huge opportunities for collecting expensive rare metals.

7.1.2 Communication of recycling information

It is important to be able to figure out which rare metals and what quantity of rare metals is contained in each ICT good in order to find out whether or not the recycling process is economically and technically feasible.

7.1.3 Encoding scheme of recycling information on rare metals

This clause explains how information on rare metals contained in ICT goods could be exchanged with the help of printed QR code labels. As explained above, the use of QR codes is an easy and efficient way to obtain rare metals information from ICT goods for recycling purposes. Without this information, recycling industries have to use trial and error methods that consume a lot of time, energy, money and manpower. The QR code label method is therefore a cost-efficient way to overcome these problems.

All related information is required to be encoded in plain text in accordance with [ISO/IEC 8859-1]. As illustrated by examples in Appendix II of [ITU-T L.1100], when creating a QR code label, there are two kinds of information to be encoded. The first type of information, presented below, is information on the manufacturing and certification history and ICT good itself:

a) Manufacturer

b) Model name

c) Model number

d) Certification authority

e) Certification number

f) Issue date

Where:

The manufacturer means the producer of merchandise for use or sale using labour and machines, tools, chemical and biological processing, or formulation.

The model name is the name of the product given by manufacturer.

The model number is an identifier of a product given by its manufacturer.

The certification authority is a witness that is an authority about the model and its quality. This authority confirms that the quality of the product is in accordance with a defined set of standards.

The certification number is a number to indicate production quality.

The issue date is the date on which the quality was assessed and the certificate was issued.

Only the information about the model name and model number is required to be encoded through the QR code because this data is very useful for recycling companies when selecting appropriate recycling methods.

For the other type of information to be encoded, tables such as those shown as examples in Appendix II of [ITU-T L.1100] may be distinguished according to element composition such as "Alkaline earth metal", "Iron group" or "High fusion point metal" and may also contain the following information:

a) Part name

b) Manufacturer information

c) Total number of elements

d) Unit of measurement

e) Composition of the elements ("1. Alkaline earth", "2. Metalloid", "3. Iron group", "4. Boron group", "5. High fusion point metal", "6. Rare earth", "7. Platinum group", "8. Others")

Where:

The part name is the technical name of the individual part of the ICT good.

The manufacturer information is the data that includes company name, production country, etc.

The total number of elements refers to how many elements are present in this specific ICT good.

The unit of measurement is defined and adopted by convention or by law and is used as a standard for measurement of the same physical quantity.

The composition of the elements shows the quantity of each element present in the good. This information is categorized in different groups of elements and is based on the specific chemical and physical properties of each element.

Only the information about elements is required to be encoded in the QR code because this information will help the company decide whether to recycle a particular element from this ICT good or not.

Consequently following four items of data are included in the QR code:

a) 1st row: "`Manufacturer:`"

b) 2nd row: "`Model Name:`"

c) 3rd row: "`Model Number:`"

d) From 4th row: "`Composition of Elements:`" Composition of the elements, each according to the element groups

These recycling information items are required to be encoded through the QR code according to the following set of rules:

a) The "`Manufacturer:`" is given by the manufacturer itself and is required to be encoded by referring to [ISO/IEC 8859-1] for global recycling applicability (for example, "`Manufacturer: ABC Electronics`".

b) The "`Model name:`" is given by the manufacturer and is required to be encoded by referring to [ISO/IEC 8859-1] for global recycling applicability (for example, "`Model Name: Laptop 10`").

c) The "`Model number:`" is given by the manufacturer and is required to be encoded by referring to [ISO/IEC 8859-1] for global recycling applicability (for example, "`Model Number: DEF-123-GH`").

d) The "`Composition of Elements:`" includes all the element groups line by line as follows and is required to be encoded by referring to [ISO/IEC 8859-1]:

```
1. Alkaline Earth:
2. Metalloid:
3. Iron Group:
4. Boron Group:
5. High Fusion Point Metal:
6. Rare Earth:
7. Platinum Group:
8. Others:
```

e) For each element group, rare metals information is required to consist of the element name, the quantity and the unit without delimiter. The element name from the periodic table has two letters where it is noted that the names of all elements are capitalized, the unit is a single letter indicator as indicated by the encoding symbol in Table 1 and element names and units are fixed in size. The quantity information however is variable in size and is required to be numerical digits including a decimal point if needed and not to exceed 1 000 because parts-per notation is required to apply to the quantity (for example, "`Li1000y`" is not allowed, but rather, "`Li1x`" is required to be specified). If there are multiple elements, they are separated by a space (for example, "`Li80x Be200y Ti10.3w`"). If there is no element, "`None`" is required to be specified.

Table 1 – Parts-per notations and their encoding symbol

Parts-per notation	Definition	Encoding symbol
wt%	1/100	`v`
‰	1/1 000 ($1/10^3$)	`w`
ppm	1/(1 000 000) ($1/10^6$)	`x`
ppb	1/(1 000 000 000) ($1/10^9$)	`y`
ppt	1/(1 000 000 000 000) ($1/10^{12}$)	`z`

For example, when the measured device includes 80 ppm of Li, the element is required to be encoded as "`Li80x`" which can be decoded as shown in Table 2.

Table 2 – Decoding result

Element	Quantity	Unit
Li	80	ppm

When the measured device includes 80 ppm of Li and 200 ppb of Be, the elements are required to be encoded as "`Li80x Be200y`" which can be decoded as shown in Table 3.

Table 3 – Decoding result

Element	Quantity	Unit
Li	80	ppm
Be	200	ppb

Figure 1 provides an example QR code label which contains rare metals information.

Figure 1 – An example QR code containing information on rare metals

Figure 1 provides the following rare metals information after decoding the code image:

```
Manufacturer: ABC Electronics
Model Name: Laptop 10
Model Number: DEF-123-GH
Composition of Elements:
1. Alkaline Earth: Ba6.14w
2. Metalloid: Ge290w
3. Iron Group: None
4. Boron Group: None
5. High Fusion Point Metal: Ti10.3w Cr1.075w Mn17.8w
6. Rare Earth: None
7. Platinum Group: Rh1.6w Pd1.5w
8. Others: Br29.5w Cl1.49w Sn16.3w K90w Pb10w Sb41.5w Zn14.16w Al47.4w
Fe76.8w Na1.58w Si91.4w Ag1.053w Au70x Cu29.8w Ni2.04w
```

This rare metals information can be interpreted as in Table 4 with reference to Table II.7 in Appendix II of [ITU-T L.1100].

Table 4 – Composition of rare metals by interpretation and reference to Appendix II of [ITU-T L.1100]

Element	Composition (ppm)
Br	29 500
Cl	1 490
Ge	< 290 000
K	< 90 000
Pb	10 000
Sb	4 150
Zn	14 160
Al	47 400
Ba	6 140
Cr	1 075
Fe	76 800
Mn	17 800
Na	1 580
Si	91 400
Ti	< 10 300
Ag	1 053
Au	70
Cu	29 800
Ni	2 040
Pd	< 1 500
Rh	< 1 600
Sn	16 300

7.2 Communication process for printed labels providing information on rare metals in ICT goods

The ICT goods manufacturing industries may choose to follow the process of communication of printed labels providing information on rare metals in ICT goods, as shown in Figure 2. In this case, the recycling industry could obtain more reliable and specific information on the rare metals to be recycled. This information is very useful selecting appropriate recycling methods.

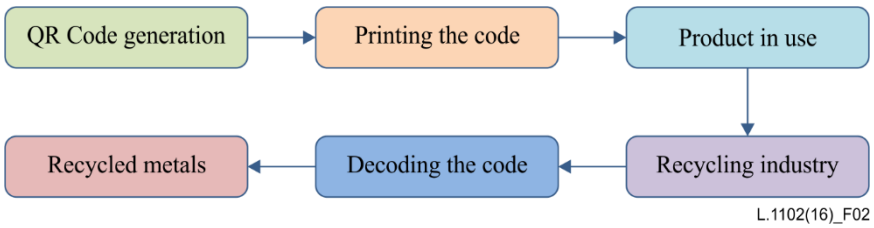

Figure 2 – Flowchart of a communication process for printed labels

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