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Information technology — Automatic identification and data capture techniques — Quality test specification for rewritable hybrid media data carriers

Technologies de l'information — Techniques automatiques d'identification et de capture des données — Spécification d'essai qualitatif pour porteurs de données de milieux hybrides

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

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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ISO/IEC 29133 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Introduction

Traditionally, linear bar codes and two-dimensional symbols have been considered as write once/read many times (WORM) technologies. The advent of Rewritable Media, which can completely change the displayed information, provides applications with an opportunity to erase previously encoded data carriers and human readable data and to overwrite this with new data. There is a requirement to ensure that Rewritable Media can be fully integrated with pre-existing WORM applications.

Additionally, Rewritable Media can be combined with rewritable RFID (radio frequency identification) technologies to create what is called a Rewritable Hybrid Media product. In this form, the characteristics of the optical data carrier and RFID data carrier can be used in an integrated manner in business applications. Because the rewriting procedure for each technology is different, there is a requirement to ensure that this data is synchronised, not necessarily to be identical, on each rewriting cycle.

Because the Rewritable Media and RFID tags can be re-used for a number of cycles, they can contribute to environmental improvement as they produce a smaller carbon footprint over their lifetime than current systems that use paper and card-based products. Also, by combining Rewritable Media with RFID, the number of single-use RFID labels can be reduced.

Manufacturers of bar code equipment and RFID equipment, and the users of both these data capture technologies, require publicly available standard test specifications for the objective assessment of the quality of Rewritable Hybrid Media and its component parts. Such standards can be referred to when developing equipment and application standards, or determining the quality of the data carriers. Such test specifications form the basis for development of measuring equipment for process control and quality assurance purposes during the rewriting process as well as afterwards. This International Standard provides requirements and guidelines to achieve a specified quality requirement for applications making use of Rewritable Hybrid Media. These requirements also address the fact that any batch of Rewritable Hybrid Media is heterogeneous, with some items that are relatively new being intermixed with other items that have been erased and re-written many times. Procedures outlined in this International Standard ensure, irrespective of the age and number of cycles achieved by an item of Rewritable Hybrid Media, that the minimum required quality output is maintained.

The bar code symbol needs to be produced in such a way as to be reliably decoded at the point of use, if it is to fulfil its basic objective as a machine-readable data carrier. Similarly, the RFID tag needs to be encoded in a correct manner to be reliably read at the point of use.

This International Standard specifies the overall quality process and associated methodology for Rewritable Hybrid Media. This International Standard determines quality characteristics to ensure that various types of product combination and integrated Rewritable Hybrid Media system can be implemented in a reliable and robust manner.

This International Standard contributes to the interoperability of data carriers and devices that support this technology. In addition, as the Rewritable Media technology develops, this International Standard will provide a benchmark to assess whether the new developments are capable of being applied in a manner compatible with existing data carriers.

Information technology — Automatic identification and data capture techniques — Quality test specification for rewritable hybrid media data carriers

1 Scope

This International Standard specifies methodologies to be used for the conformance of rewritable hybrid media data carriers, which combine RFID tag technology with linear and/or two-dimensional bar code symbologies that are written to an erasable substrate. Three main product configuration types are addressed within this International Standard:

- Rewritable Media, which supports the rewriting of linear or two-dimensional symbols;
- Rewritable Hybrid Media, which integrates the Rewritable Media with an RFID tag;
- Rewritable Media combined with RFID technology that are physically separate data carriers but still require their data encoding processes to be integrated as part of a Rewritable Hybrid Media system.

In particular, this International Standard

- defines the base requirements for Rewritable Media and Rewritable Media devices (see 6.2),
- defines additional methods for process control of the Rewritable Media over multiple erasure and rewrite cycles (see 6.4),
- defines reference standards for evaluating the RFID tag component (see 7.2 and 7.3),
- defines additional methods for process control of the RFID component over multiple erasure and rewrite cycles (see 7.4),
- provides information to ensure that the data encoded in the bar code symbology and RFID data carrier are synchronous, i.e. are derived from the same source data set (see Clause 8).

NOTE Depending on the application, the encoded data can be identical or different (e.g. one data carrier could provide additional data).

Because of the interdependency between the Rewritable Hybrid Media and the rewrite device used to create the optical image, the entire Rewritable Hybrid Media system needs to be taken into account to define conformance. Therefore, there is a requirement to define the capability of achieving a given print quality grade as defined in relevant standards. This Rewritable Hybrid Media system approach has the additional advantage of not being prescriptive on the types of media and "print" technologies that may be used now or developed in future. As long as a print technology/media combination meets the print quality grades, it can be considered conformant with this International Standard.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

ISO/IEC 15416 *Information technology — Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols*

ISO/IEC 15419, *Information technology — Automatic identification and data capture techniques — Bar code digital imaging and printing performance testing*

ISO/IEC 19762-1, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*

ISO/IEC 19762-2, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 2: Optically readable media (ORM)*

ISO/IEC 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762-1, ISO/IEC 19762-2, ISO/IEC 19762-3 and the following apply.

3.1
Rewritable Hybrid Media
combination of Rewritable Media and an RFID tag in an integrated product

3.2
Rewritable Media
substrate, consisting of a protective layer, optical imaging layer and base material, that enables repeated writing and erasing of optical data including bar code symbologies and eye readable data

3.3
Rewritable Hybrid Media system
system comprising the Rewritable Hybrid Media data carriers, the process control to achieve verifiable data carrier conformance, and the data integrity between the bar code and RFID components, whether these are integrated or separate data carriers

4 Symbols and abbreviations

nm	nanometre
R_{max}	Maximum reflectance value
R_{min}	Minimum reflectance value

5 Hybrid media functions and process description

Rewritable Media is a substrate that enables repeated writing and erasing of optical data including bar code symbologies and eye readable data. This is achieved by incorporating an optical imaging layer in the media substrate. The process of erasing and then rewriting is normally achieved in a device that combines the functions, or in separate devices addressing each process.

Other than the system meeting the basic conformance requirements specified in Clause 6, this International Standard places no constraints on the type of media substrate nor the "printing" process. Example technologies are described in Annex A.

The Rewritable Hybrid Media allows applications to exploit the benefits of optical and radio frequency technologies in innovative ways. A key advantage is that the media device can be reused for multiple cycles.

6 Conformance tests for the Rewritable Media system

6.1 General

This clause applies equally to Rewritable Media when used alone or as a component of Rewritable Hybrid Media.

A Rewritable Media system shall consist of Rewritable Media products and a device capable of erasing the media and rewriting this with a new set of barcode(s) and eye readable data. The following sub-clause specifies procedures for making conformance claims for the Rewritable Media product and capabilities of the Rewritable Media device. Additional sub-clauses define factors that need to be taken into account for process control purposes; and finally a range of process control methods are defined, increasing in sophistication.

6.2 Product conformance

Manufacturers of Rewritable Media products and of Rewritable Media devices are expected to carry out type testing of their product to enable application designers and users to select appropriate products. Any conformance claims shall be expressed as an overall minimum print quality grade:

— using the procedures specified in ISO/IEC 15419

— declared using the procedures of ISO/IEC 15416 for linear bar codes and identifying the symbology and X dimension used for testing purposes,

— declared using the procedures of ISO/IEC 15415 for two-dimensional symbols and identifying the symbology and X dimension used for testing purposes,

— based on the initial (first) print impression on the Rewritable Media product, i.e. using previously blank stock,

— based on a stated number of erase and re-print cycles, where the number of cycles is declared by the manufacturer of the Rewritable Media product,

— declaring the wavelength(s) of light at which the grade was determined,

— declaring the scanning aperture used in the test.

6.2.1 Tests and declarations by the Rewritable Media manufacturer

The Rewritable Media manufacturer may select any Rewritable Media device for the product tests. This device should be identified by brand and model code in the test report. The test report shall address all the points listed in 6.2 and otherwise be in compliance with ISO/IEC 15419.

6.2.2 Tests and declarations by the Rewritable Media device manufacturer

The Rewritable Media device manufacturer may select any Rewritable Media for the device tests. This media should be identified by brand and product code in the test report. The test report shall address all the points listed in 6.2 and otherwise be in compliance with ISO/IEC 15419.

6.3 Process control factors

Because of the nature of Rewritable Media, considerations other than the methodology defined in ISO/IEC 15416 for linear bar code and ISO/IEC 15415 for two-dimensional bar codes need to be taken into account. These are defined in the following sub-clauses.

6.3.1 Minimum overall grade

When the methodology defined in ISO/IEC 15416 is used to evaluate linear bar codes or ISO/IEC 15415 is used to evaluate two-dimensional symbols, the minimum overall print quality grade for successive print cycle images shall be as specified by the application.

6.3.2 Symbol Contrast grading and application standards

Some Rewritable Media may not achieve the highest Symbol Contrast (SC) grades. Therefore, if the application requires a grade level of 3 (B) or higher, additional advice should be provided in application standards to specify an acceptable grade for SC separate from but in addition to an overall symbol grade without SC included in the calculation of Symbol Grade.

6.3.3 Modulation grading and application standards

Some Rewritable Media may not achieve the highest Modulation grades. Therefore, if the application requires a grade level of 3 (B) or higher, additional advice should be provided in application standards to specify an acceptable grade for Modulation separate from but in addition to an overall symbol grade without Modulation included in the calculation of Symbol Grade.

6.3.4 Minimum reflectance requirements

To enable the use of the process control method defined in 6.4, a minimum reflectance value of the substrate (R_{max}) shall be specified by the application (see 6.4.2). This is to ensure that Symbol Contrast and Modulation requirements can be achieved.

6.3.5 Wavelength of light

Because of the nature of the make-up of the Rewritable Media, reflectance measures can vary significantly, depending on the wavelength of light at which the scanner operates. Given that this varies between brands and models of scanner and the technology used for the optical systems, applications should give some consideration to the wavelength of light that is suitable for scanning purposes.

ISO/IEC 15415 provides detailed advice that applies in this International Standard equally to linear and two-dimensional symbols that are printed on Rewritable Media. ISO/IEC 15415 advises that measurements to be made using light of the same characteristics as those in the intended scanning environment.

The process control testing (see 6.4) should be undertaken at a wavelength of light specified by the application. If the application does not specify the wavelength, the default value is 660 nm.

6.4 Process control methods

6.4.1 Process control considerations

6.4.1.1 ISO/IEC 15416 process control

ISO/IEC 15416 has an informative annex addressing process control requirements. The procedures defined in that annex are not appropriate for Rewritable Media, because they apply to a situation where successive symbols are being produced using a substrate that is reasonably consistent between impressions (i.e. they form a homogeneous set). The ISO/IEC 15416 process control methods are designed to monitor and control drift in a homogeneous set. In contrast, the process used to erase and rewrite Rewritable Media can have successive media components that might have been recycled many or few times in a completely random mix (i.e. they form a heterogeneous set). In addition, Rewritable Media is affected not only by the number of erase and re-write cycles but also unexpected damage and the usage conditions, etc.

A more appropriate process control methodology for Rewritable Media is defined in 6.4.1.2.

6.4.1.2 Heterogeneity

The nature of Rewritable Media is that it will deteriorate over time based on a complex set of causes. A basic cause is the number of rewrite cycles, but deterioration can be accelerated due to adverse environmental conditions to which the media is exposed when in use as a data carrier during the application cycle (e.g. if it is exposed to higher than average heat). Because batches of Rewritable Media that are being processed for rewriting are likely to be heterogeneous with each item of Rewritable Media presenting a different state of quality, it is difficult to predict the presence of items that might no longer be suitable for rewriting.

6.4.1.3 Sample size considerations

Whereas with a homogenous set it is possible to apply sophisticated tests to a small sample, for Rewritable Hybrid Media it is more appropriate to apply simple tests on a larger sample or on all items. The following sub-clauses identify a range of tests of increasing sophistication. Therefore, the extent that they can be applied will range from the possibility of testing a small sample size to a full inspection.

6.4.2 Reflectance test

A simple test that can be applied is a reflectance test of the background colour of the substrate.

A basic test should be applied to each item of Rewritable Media as it is presented to the erase and rewrite cycle, based on the reflectance of the substrate (R_{max}). The application should set the threshold relative to the reflectance of new media. The default threshold is a decrease of 10% for the reflectance of the substrate (R_{max}) (e.g. for new media with Rmax equal to 0,83 the reflectance test threshold is ≥ 0,75 for each rewrite cycle).

Any item of Rewritable Media that fails this reflectance test should be subjected to the requirements defined in ISO/IEC 15416 and/or ISO/IEC 15415.

6.4.3 Symbol contrast test

A better assessment of the suitability of Rewritable Media for re-use can be achieved by incorporating a Symbol Contrast calculation based on the highest and lowest reflectance value of any scan line through the Rewritable Media. This test could be applied to an item of Rewritable Media prior to erasure. If the calculated Symbol Contrast is below that defined for the application, the item of Rewritable Media should be subjected to the requirements defined in ISO/IEC 15416 and/or ISO/IEC 15415.

Instead of measuring the Symbol Contrast on a random selection of graphical images (some of which might, or might not, be bar codes) an alternative procedure can be considered. If the application standard provides sufficient label area, a set of special marks can be printed on each rewrite of the cycle. Annex B shows a possible structure that alternates between cycles so that readings can be taken prior to erasure to decide whether the Rewritable Media item is rejected or retained for further use.

NOTE Although the evaluation process is intended to measure Symbol Contrast, it could also be applied to the reflectance test defined in 6.4.2.

6.4.4 Additional process control method to estimate the end of life

Another relatively simple test could be applied using the sum of the two variations in reflectance, see Annex C.

6.4.5 Symbol verification

Symbol verification should be applied on a sample basis after printing with the primary intention of monitoring symbol quality and/or the print process, rather than detecting whether any item of Rewritable Media has reached the end of its useful life.

NOTE Symbol verification on a sample basis should not be applied prior to erasure, because it will contribute little to the overall quality of the system.

7 Conformance tests for RFID tag component

7.1 General

This clause applies equally to an RFID tag that is integrated as a component of Rewritable Hybrid Media or when it is a physically separate data carrier in a Rewritable Hybrid Media system.

The following sub-clause specifies procedures for making conformance claims for the RFID tag. Additional sub-clauses define factors that need to be taken into account for process control purposes; and finally a range of process control methods are defined, ranging in sophistication.

7.2 Product conformance

The RFID tags used for the Rewritable Hybrid Media application should be based on an appropriate technology defined in a particular Part of ISO/IEC 18000, specifically identifying the mode or type of air interface protocol being used.

Manufacturers of RFID tags used in Rewritable Hybrid Media products are expected to carry out type testing of their product to enable application designers and users to select appropriate products. The test procedures defined in ISO/IEC TR 18047 define a functional test for the tag. Only tags that pass the functional tests for the particular air interface protocol shall be used as components of the Rewritable Hybrid Media product. Such tests should be supported by a manufacturer's certificate, providing details that the test procedures have been carried out.

7.3 RFID performance testing

ISO/IEC 18046 defines test procedures for measuring the performance of RFID tags. To comply fully with ISO/IEC 18046, the test measurement sites are required to be one of the following: an anechoic chamber or an anechoic chamber with a ground plane, or an Open Area Test Site (OATS) to the prescribed specification.

For the purpose of this International Standard, ISO/IEC 18046 should only be used for type testing RFID products to enable them to be compared with the performance requirements for the application.

For the purpose of this International Standard, there are no requirements to determine whether successive cycles of processing the Rewritable Hybrid Media change the performance capability of the RFID tag component. However, some process control tests are defined in 7.4.

7.4 Process control methods

If the RFID tag supports the function described in the following sub-clauses (7.4.1, 7.4.2, and 7.4.3) and the function is required in the application, then the following process control methods shall be applied.

7.4.1 Reading from and writing to the tag

The fundamental requirement for the RFID tag is that it shall be possible to read the previous cycle's data from the RFID tag and overwrite it with new data. If either of these functions is not possible, it could indicate that the tag has been damaged, or some other RFID tag feature set in a manner that makes it impossible to perform the normal overwriting cycle. For example, additional or alternative passwords could have been invoked on the RFID tag during the application cycle.

Any tag that fails this test shall be rejected and no longer be part of the Rewritable Hybrid Media system.

7.4.2 Locked memory test

A number of RFID tags provide the facility that enables selected parts of the memory to be locked in accordance with the requirements of the application. Therefore, based on the application standard, it is possible to identify data that should be locked and data that should remain unlocked and therefore for it to be possible to over-write with data relevant to the application. During the read cycle before rewriting, if part of the memory is found to be locked in a manner not prescribed by the application, then the RFID tag shall be rejected and removed from the Rewritable Hybrid Media system.

NOTE The simplest implementation of Rewritable Hybrid Media is if all of the RFID tags are fully compliant with a given product specification. If RFID tags with different locking capabilities, which are still compliant with a basic air interface protocol, are intermixed then applying this type of acceptance / rejection procedure is not possible.

7.4.3 Sensor functions

Some RFID tags incorporate an integrated sensor(s). The particular air interface protocol standards in the ISO/IEC 18000 series identify which interface protocols support this functionality.

If an RFID tag supports sensors, the following procedures shall be applied to determine whether the RFID tag can be rewritten or shall be rejected:

1) If the power of the battery supporting the sensor is indicated to be low, then the RFID tag shall be temporarily rejected from the rewriting process. The battery condition can then be assessed separately from the rewriting procedure and the RFID tag re-introduced to the Rewritable Hybrid Media process if the battery can be re-charged or replaced.

   NOTE Only some RFID sensor-tags are capable of having their battery changed.

2) If a sensor is indicating that any of its alarms are in a 'triggered' status, then the RFID tag shall be temporarily rejected from the rewriting process. The sensor can then be subjected to a further off-line test procedure to establish whether the alarms can be re-set so that the RFID tag can be re-introduced to the Rewritable Hybrid Media process.

   NOTE Some sensors are capable of reconfiguration and having their alarms reset.

3) If the application requires that event records from the previous application cycle are processed and erased before the rewrite procedure, an additional sample check can be applied by selectively reading from this part of the sensor memory. If any data is found on one sensor in a batch, then the batch should be separated for checking and reprocessing offline to ensure that previous event records have been erased.

Some sensors (described as simple sensors in ISO/IEC 24753) are not capable of being re-configured if any of the alarms associated with the sensor have been triggered. Any item of Rewritable Hybrid Media containing an RFID simple sensor whose alarm is triggered shall be rejected.

8 Conformance considerations to integrate the different data carrier technologies

8.1 Overview

This clause applies when integrating RFID data carriers with a linear bar code symbology and/or a two-dimensional symbology. The integration issues have to address the fundamental differences in the technologies. The optical technologies associated with this International Standard are completely erased and re-written on each cycle. In contrast, RFID supports selective reading, writing and locking. The use of RFID requires additional control procedures to ensure that each successive cycle is still compliant with the basic application requirements.

8.2 Data and memory mapping considerations

Even if the RFID tag is intended to have the same data encoding as on a linear bar code or on a two-dimensional symbol, it is highly unlikely that the encoding rules for the different technologies will be the same. In addition, encoding may differ between different tag architectures that are compliant with a particular type or mode as defined in the ISO/IEC 18000 series of standards.

Given that these basic differences, combined with the fact that different aspects of the technologies can be utilised by an application, the application designer needs to give consideration to requirements and integration issues.

ISO/IEC 15962 defines a set of encoding rules that can be applied to many of the ISO/IEC 18000 series of air interface protocols and tag architectures. Given that the data requirement should be specified in an application, the RFID encoding rule can be used to model a typical encoding on the selected type of RFID tag. This modelling process should take into account the application's requirement for some data elements to be locked, for some data elements to be variable length, and even for some to be optional. The process should produce a series of typical memory maps that determine the number of bytes to be encoded and any variations in encoded memory size. This information can be used to determine some of the process settings and conformance requirements for Rewritable Hybrid Media that are discussed in more detail in 8.3 and 8.4.

8.3 Processing the RFID air interface commands

There are significant differences between the commands and functions from one ISO/IEC 18000 mode or type to another. What might not be so obvious are the differences within a particular mode or type that still achieve conformance with the relevant Part of ISO/IEC 18000. These differences can apply to the set of commands that can be invoked on an individual RFID tag.

Where there is a choice of air interface commands, these should be selected to minimise the total process time. It should then be possible to determine the process time for a read and over-write cycle of the RFID.

8.4 Locking of data on the RFID tag

From a business perspective, particular data elements can be specified to be locked. The encoding rules convert the raw input into a sequence of encoded bytes that are block aligned to meet the tag architecture requirements. The locked blocks can therefore be identified using the modelling procedure described (see 8.2).

During the re-writing process, any locked block cannot generally be changed. When an RFID tag as part of an item of Rewritable Hybrid Media is presented for reuse, only the agreed blocks shall be locked. If any other part of the memory is locked, then the RFID tag component shall be considered in error and rejected from further use as part of the Rewritable Hybrid Media system.

8.5 Erase and rewrite cycle: RFID implications

Unlike the process for the optical media, where the complete image is erased and then re-written, this procedure is probably the least efficient to employ for the RFID component. The RFID erasure process actually calls for re-writing the tag with null bits and then the re-writing process calls for data to be written to meet the application's requirements for the next cycle.

Irrespective of whether data is locked or not, the most efficient procedure to adopt with RFID is to identify the actual blocks that need to be changed and invoke air interface write commands to change only these blocks. To achieve this for encoding the RFID data for the next cycle, it is useful to have the read and write cycle in that sequence and close together. By reading all of the data from the RFID tag, the application can then decide what data needs to be changed. Encoding rules, such as those defined in ISO/IEC 15962, can then identify only those addressable blocks that need to be changed.

8.6 RFID and sensors

An emerging standardised option for RFID is for sensors to be incorporated with the RFID data carrier. Detailed form factors of RFID sensors need to be taken into consideration for label design considerations.

The RFID sensors have their own encoding rules and procedures for erasing and re-configuring parameters. An assumption is made that sensors integrated within Rewritable Hybrid Media are generally capable of being reconfigured. Such sensors require any previous event history to be erased, and such a process can take place independently from the erase and rewrite process for the optical data on the Rewritable Media. However, if the application calls for a sensor to be reconfigured within the erase rewrite cycle, then the process time for this needs to be considered in the overall transaction time.

Reconfiguring the sensor as part of the Rewritable Hybrid Media process shall only be undertaken if the application explicitly calls for this. The reason for this is that once a sensor is reconfigured, it begins to sample the environment for the characteristics that it is designed to monitor. Configuring too early can result in distorted sensor history.

NOTE The general rule with reconfiguring sensors is to do so close to a production or distribution point, whichever is more appropriate for instigating the monitoring in a subsequent uncontrolled environment.

8.7 Co-ordinating the data flows

The re-encoding process for the RFID tag and the erase / re-write process for the optical data carriers should be co-ordinated in an integrated process. This process should include certain quality checking, as discussed in Clauses 6 and 7.

This International Standard places no constraints on whether the RFID read and write process should be before or after the erase and re-write of the bar code symbologies. This is a matter of product design and implementation. However, Annex D defines flowcharts that illustrate some typical procedures. Device manufactures should consider implementing some of the procedures in such a manner that they are applied automatically.

Annex A
(informative)

Example of Rewritable Hybrid Media Data Carrier

A.1 Placing the technology in context

Rewritable Media enables optical data carriers to encode different data on repeated cycles of the media through erase and rewrite cycles. This is achieved by a complete erasure of previously printed bar codes overwriting of a new symbol. Rewritable Hybrid Media adds RFID to the product configuration. The RFID component can be selectively rewritten depending on the capabilities of the particular air interface protocol.

The technology is part of a family of technologies that support optically and RFID readable data. The two areas that are relevant to this International Standard are shown in Figure A.1 — ISO/IEC 29133 in relation to other rewritable and AIDC technologies.

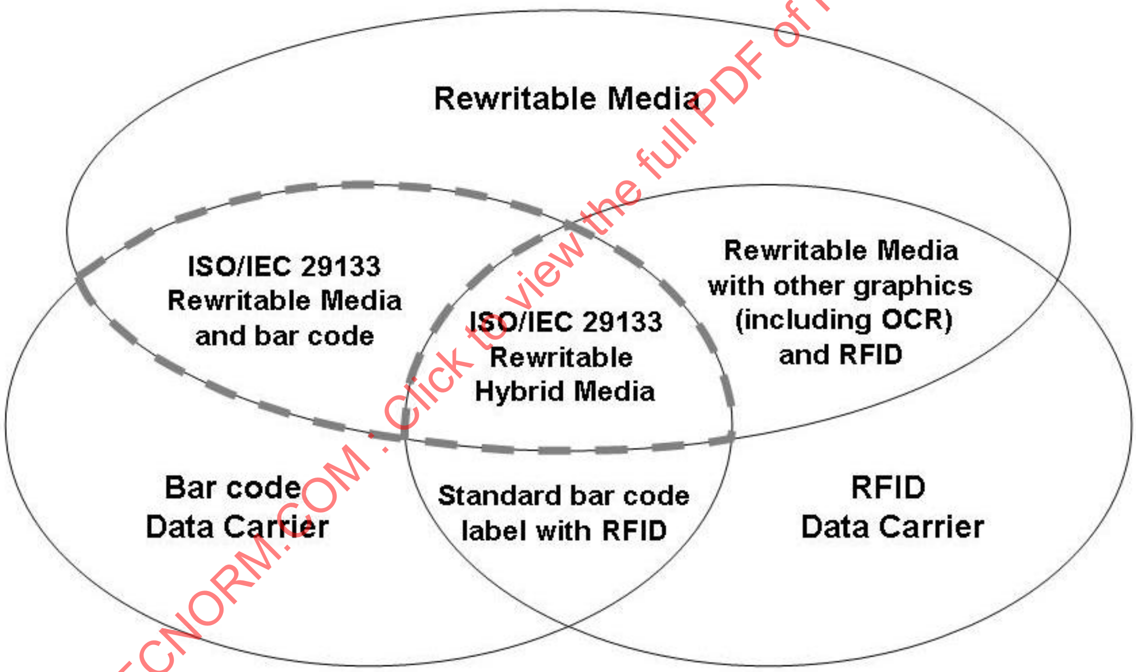

Figure A.1 — ISO/IEC 29133 in relation to other rewritable and AIDC technologies

A.2 Thermal rewritable technology

In the broad sense, Rewritable Hybrid Media is defined as a portable input-output substrate which is an integration of the function of machine-readable digital data carrier and the function of human (eye)-readable rewritable substrate. Among the rewritable substrates are the so-called electric paper technologies such as thermal rewritable, electrophoretic type and liquid crystal type, etc.

Of these the combination of the thermal rewritable technology to print bar codes when combined with RFID is known as Rewritable Hybrid Media. The general process is illustrated in Figure A.2 — Changes of state achieved by Rewritable Hybrid Media, which shows the change of state between the erase and rewrite cycles.

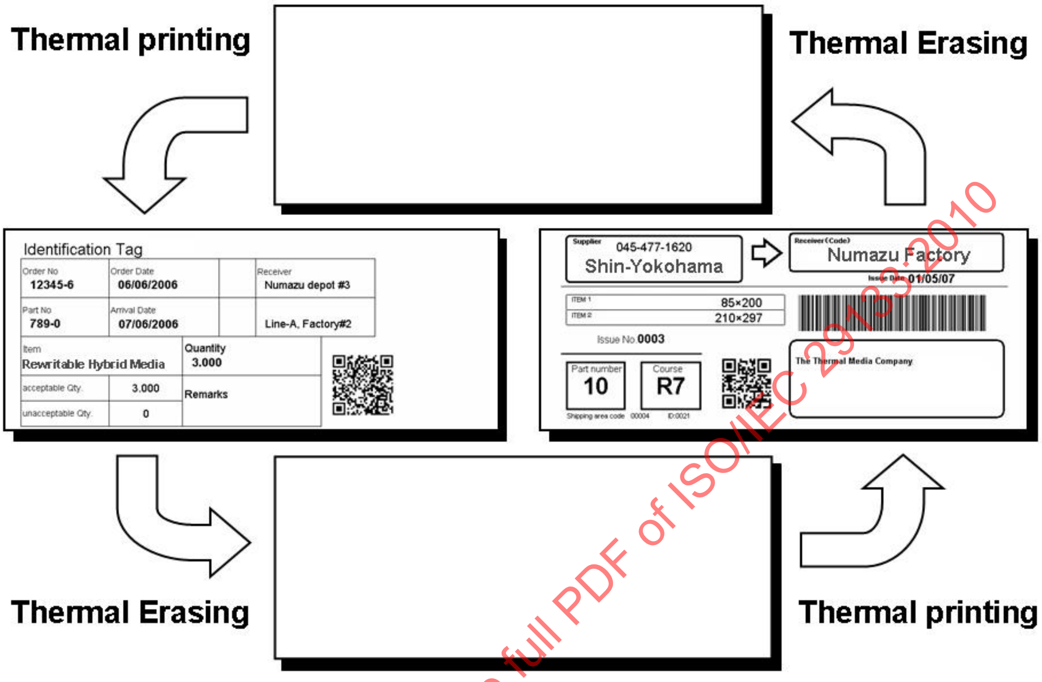

Figure A.2 — Changes of state achieved by Rewritable Hybrid Media

An example of the thermal rewriting technology is based on Leuco dyes. The process is illustrated in Figure A.3 — Molecular and thermodynamic process based on a Leuco dye material, which shows the changes that are made to the recording layer at various stages in the cycle.

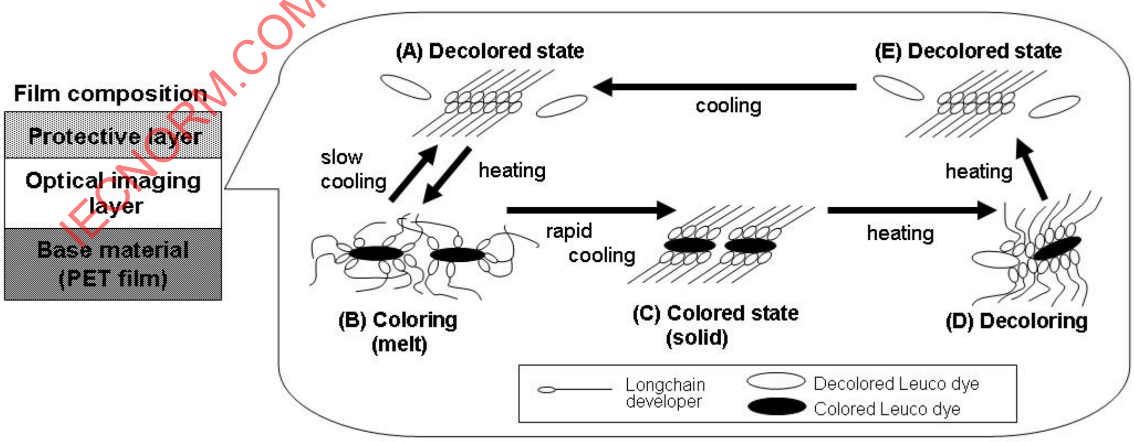

Figure A.3 — Molecular and thermodynamic process based on a Leuco dye material

Annex B
(informative)

In-line quality evaluation mechanism

B.1 Overview

This annex specifies two quality assessment patterns that are reproduced alternatively on each rewrite cycle. The annex also specifies an inline quality evaluation process based on these patterns.

This pattern (see B.2) and the procedure (see B.3) are recommended to enable printer-encoder equipment to incorporate the assessment mechanism in a consistent manner. If a different pattern or different reflectance values are defined to meet application requirements, a customised printer might be required.

B.2 The quality assessment patterns

The quality assessment patterns are illustrated in Figure B.1 — Quality assessment pattern.

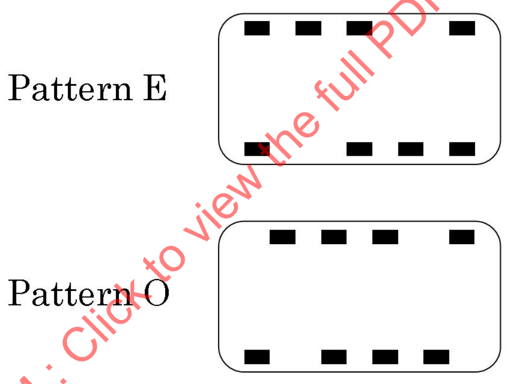

Figure B.1 — Quality assessment pattern

This figure shows that by placing the pattern on each long edge, that the erasing and rewriting procedure is orientation free. The leading black block is in the same position on pattern E and on pattern O. An un-printed area then follows. The next three black blocks are offset between pattern E and pattern O. This means that on each alternative printing cycle previously unprinted media is printed in black and previously printed media is left un-printed. Over a number of cycles the reflectance from the substrate is expected to reduce, and by measuring the reflectance in the various zones, it is possible to evaluate media degradation against a given threshold.

B.3 The evaluation set-up on the printer-encoder

The set-up with a simple reflectance sensor, or symbol contrast sensor, located immediately before the erasing process is illustrated in Figure B.2 — Device set-up. As the Rewritable Media is transported forward, the reflectance of the black and white areas is measured. If the reflectance of the light background (or the symbol contrast, if this is calculated) is below the threshold, the piece of media is rejected and removed from use. The implementation process for removing rejected media is outside the scope of this International Standard.

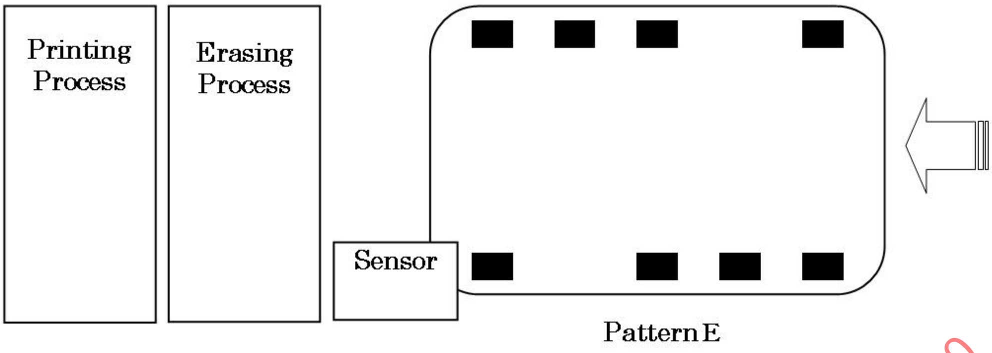

Figure B.2 — Device set-up

In addition to taking the reflectance measurements, the sensor and associated logic on the printer-encoder shall also be capable of distinguishing between pattern E and pattern O. As the media passes through the sensor process, the pattern code is stored in the printer memory. Then after the erasing process, the printing process rewrites using the alternative pattern. Thus, each piece of Rewritable Hybrid Media switches successively from pattern E to O, and from O to E.

The specification for the reflectance sensor is as follows:

– Wavelength of light source:	650 nm
– Measurement aperture:	0,2 mm diameter
– Calibration:	The reflectance of a barium sulphate or magnesium oxide reference sample complying with the requirements of ISO 7724, which shall be taken as 100%
– Reflectance accuracy:	R_{max} = ±5% , R_{min} = ±3%

Annex C
(informative)

Process control method to estimate the end of life

This annex describes a useful process control method for Rewritable Media evaluation. This process can show various aspects of degradation of the media. After repeated printing and erasing, the Rewritable Media quality deteriorates to a degree that should be judged “no further use”. This process is not meant to replace ISO/IEC 15415 and/or ISO/IEC 15416 quality determination as defined in this International Standard.

The process control method described in this annex is useful to users in indicating the “end of life” for the Rewritable Media.

Rewritable Media features the following characteristics:

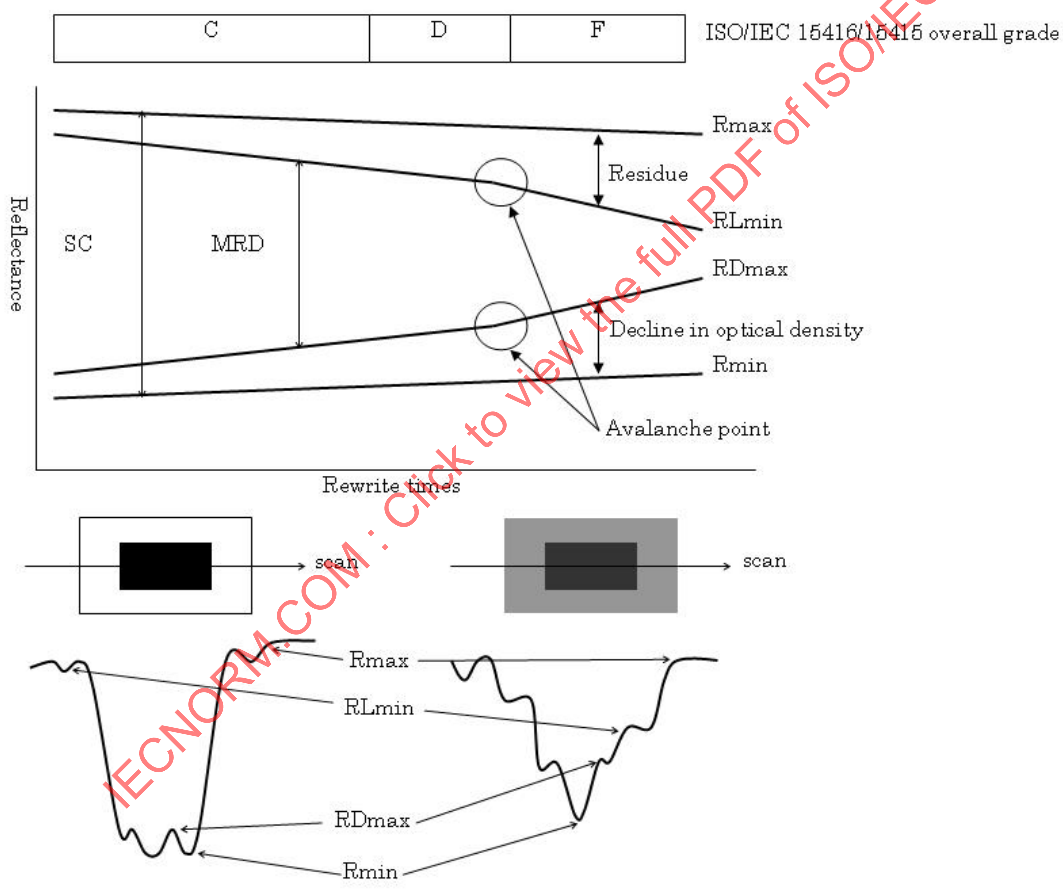

Figure C.1 — Changes in symbol grade over the Rewritable Media life cycle

Figure C.1 — Changes in symbol grade over the Rewritable Media life cycle shows that the change between RL_{min} and RD_{max} is typically larger than that of R_{max} and R_{min}.

The effect of residue plus the decline in optical density can be compared with the read rate on a barcode reader as shown in Figure C.2 — Comparison of residue plus decline in optical density with the bar code read rate.

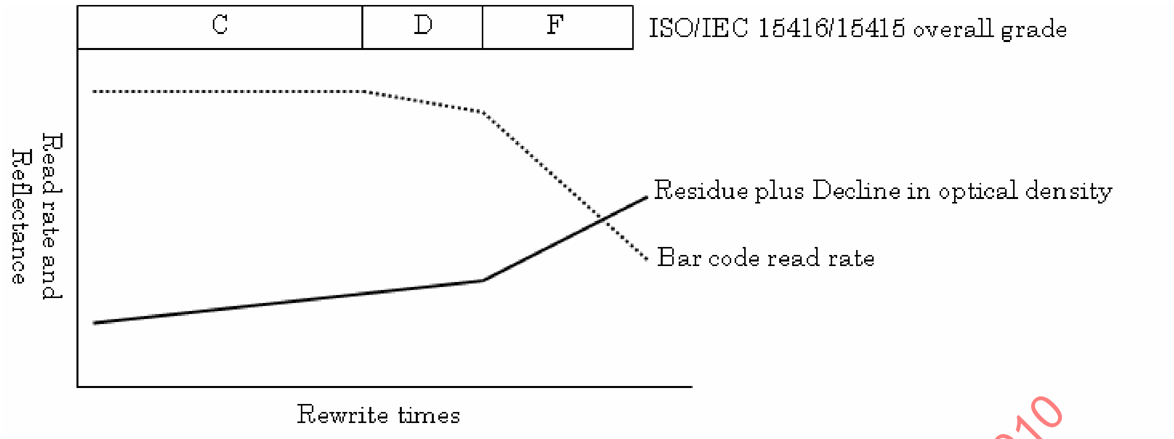

Figure C.2 — Comparison of residue plus decline in optical density with the bar code read rate

The figure indicates a strong correlation between bar code read rate and residue plus decline in optical density.

Annex D
(informative)

Operational flowcharts

D.1 The flowcharts

This annex defines, from a device perspective, examples of flowcharts and processes to ensure the co-ordination of the RFID read/overwrite process with the optical erase and rewrite process. The application is responsible for ensuring that data synchronisation is maintained.

The following example flowcharts illustrate acceptable sequences of the processes. The processes are defined in D.2. The process with the RFID processes being completed before the erasing of the optical media and rewriting process is shown in Figure D.1 — Flowchart showing all RFID processes before all optical processes.

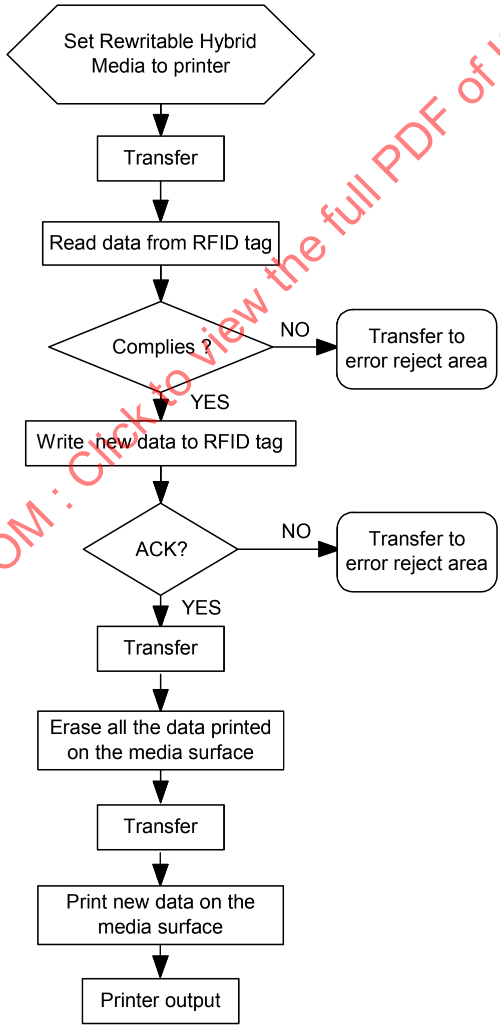

Figure D.1 — Flowchart showing all RFID processes before all optical processes

