INTERNATIONAL STANDARD

ISO 24711

Fourth edition

Information technology — Office equipment — Method for the determination of ink cartridge yield for colour inkjet printers and multi-function devices that contain printer components

PROOF/ÉPREUVE

Reference number
ISO 24711:2020(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Test parameters and conditions **3**
4.1 Set up 3
4.2 Sample size 4
4.3 Print mode 5
4.4 Print environment 5
4.5 Paper 6
4.6 Maintenance 6
4.7 Test file 6
5 Test methodology **6**
5.1 Testing procedure 6
5.1.1 Flow chart 6
5.1.2 Preparation 7
5.1.3 Installation of test cartridges 7
5.1.4 Testing 7
5.1.5 End of cartridge life procedure 7
5.2 Procedure for handling streaks 8
5.2.1 Over view 8
5.2.2 Nozzle cleaning 8
5.3 Procedure for handling a defective cartridge, printhead or printer failure 9
5.3.1 General 9
5.3.2 Defective cartridge 9
5.3.3 Defective printhead 9
5.3.4 Defective printer 9
6 Determination of the declared yield value and declaration **9**
6.1 Yield of primary cartridges 9
6.2 Yield of supplemental cartridges 10
6.3 Test data reporting 12
6.4 Declaration of the yield 12
Annex A (informative) **Examples of fade** **17**
Annex B (informative) **Examples of streaks** **18**
Annex C (normative) **Test reporting form** **19**
Annex D (informative) **Process flowchart** **23**
Annex E (normative) **Method for comparison of inkjet performance to ISO/IEC 19752** **27**
Bibliography **29**

Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

This fourth edition cancels and replaces the third edition (ISO/IEC 24711:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

— printer setting was corrected from duplex to simplex mode in Clause 4.1;

— the status of Annex E was changed from informative to normative to have consistency with ISO/IEC 19798;

— ISO/IEC 29142-1 has been added to the Bibliography;

— editorial changes were applied.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The purpose of this document is to provide a process for determining the ink cartridge yield for a given colour inkjet print system (i.e. integrated ink cartridges and ink cartridges without integrated printheads) using a standard consumer type test page suite. In the case where a cartridge set can be used in multiple printer models, only one yield test needs to be performed as long as the difference between printer models does not impact yield.

NOTE A cartridge supplier may choose to use more than one market identifier for a single physical cartridge. In this case, only one yield test is required as long as there are no differences in the cartridges other than market identifiers.

This document prescribes the following:

— the test method that manufacturers, test laboratories, etc. use to determine ink cartridge yield;

— the method for determination of declared yield values from the test results;

— the appropriate method of describing the yield of cartridges in documentation supplied to the consumer by the manufacturer.

The cartridge yield is determined by an end-of-life judgement, or signalled with either of two phenomena: *fade,* caused by depletion of ink in the cartridge, or *automatic printing stop*, caused by an ink out detection function. It is envisioned that one of the uses of this document is for the calculation of cost per page (CPP). While this document measures a portion of this cost, it is not used as the sole component of CPP calculation. Additional factors are considered for CPP calculations. It is beyond the scope of this document to provide a methodology for calculation of CPP.

Information technology — Office equipment — Method for the determination of ink cartridge yield for colour inkjet printers and multi-function devices that contain printer components

1 Scope

The scope of this document is limited to evaluation of ink cartridge page yield for ink-containing cartridges (i.e. integrated ink cartridges and ink cartridges without integrated printheads) for colour inkjet print systems. This document can also be applied to the printer component of any multifunctional device that has a digital input printing path, including multi-function devices that contain inkjet printer components. Both liquid and solid ink products can be tested using this document.

This document is only intended for the measurement of ink cartridge page yield when printing on plain paper. No other claims can be made from this testing regarding quality, reliability, etc.

This document can be used to measure the yield of any cartridge that is used in a significant amount during the printing of the test page suite defined in ISO/IEC 24712.

This document is not for use with printers whose minimum printable size is equal to or greater than A3 or for printers designed or configured to print photos (for example, maximum printable size less than A4 or a printer configuration intended for photo-only printing). In addition, it only applies to drop-on-demand printing systems.

NOTE Integrated ink cartridges is a cartridge that includes at least: an ink containment part, an ink deposition mechanism and an ink transport part (see ISO/IEC 29142-1).

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.

ISO/IEC 24712, *Colour test pages for measurement of office equipment consumable yield*

ISO/IEC 29102, *Information technology — Office equipment — Method for the determination of ink cartridge photo yield for colour printing with inkjet printers and multi-function devices that contain inkjet printer components*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
fade
phenomenon in which a significant reduction in uniformity occurs due to ink depletion

Note 1 to entry: In this test, fade is defined by a significant increase in lightness, L^*, or a decrease in density on the bands surrounding the edge of the last page in the *test page suite* (3.8) (diagnostic page). This decrease in density does not have to occur completely across the page. This comparison is made using the second diagnostic test page generated during testing (the 10th page printed). For examples of fade, please consult Figure A.1.

Note 2 to entry: In some printer systems, fade can occur prematurely due to the way that ink is provided to the printing system. If a printer exhibits fade, a five-minute pause is allowed to provide for recovery of the ink delivery system and printing may continue. If fade appears on the next suite, then the cartridge is judged at *end of life* (3.7) and the additional diagnostic page printed is not counted in the yield calculation. If fade does not appear on the next diagnostic page, then printing can continue until the next fade or *ink out* (3.6) is encountered and the additional diagnostic pages shall be counted.

3.2
streak
very thin line of colour, other than intended in the bands surrounding the edge of the last page in the *test page suite* (3.8)

Note 1 to entry: The last page in the test suite is also called the diagnostic page.

Note 2 to entry: Streaks differ from *fade* (3.1) in the width and severity of increase in lightness, L^*, or reduction in density. Streaks can appear for a number of reasons, thermal issues and clogged nozzles being two of the main causes. If these streaks occur in three consecutive diagnostic pages, then a *streak removal operation* (3.3) is required. Comparisons are made using the phenomena sample provided in Figure B.1.

Note 3 to entry: This term is usually used in plural form.

3.3
streak removal operation
procedure used to restore the print performance by removing *streaks* (3.2)

Note 1 to entry: If streaks are observed on three consecutive diagnostic pages, first the printer can be left idle for five minutes. Then an additional three *test page suites* (3.8) are printed. If the streaks are still observed, then a streak removal operation is conducted according to the latest printer manufacturer documentation. Due to the significant amount of ink that is used for cleaning, the maximum permissible number of times that the streak removal operation can be used on a given cartridge is prescribed in 5.2.2.

Note 2 to entry: All test page suites printed during this process are included in the page count for determining the yield.

3.4
printhead alignment operation
function that aligns newly installed printheads

Note 1 to entry: If it is mandatory according to the latest printer manufacturer documentation, this operation is performed during testing. The pages used in the alignment procedure are not counted in the measurement of yield.

3.5
ink low
warning generated by the printing system when it has determined that the amount of ink is such that a cartridge change is required soon

Note 1 to entry: It does not indicate that the system is out of ink.

3.6
ink out
signal generated by the printing system when the useable ink in the system is depleted and the printer stops printing

3.7
end of life
condition determined by one of two mechanisms: *fade* (3.1) or *ink out* (3.6)

Note 1 to entry: For cartridges with more than one colour of ink in a single cartridge, end of life is defined when the first colour within the cartridge exhibits fade or ink out. In the event that the printer can continue printing after ink out is reported, the cartridge is still considered at end of life.

3.8
test page suite
series of five pages defined in ISO/IEC 24712 that are printed consecutively as a single job, ending with a diagnostic page

3.9
individual cartridge yield
value determined by counting the number of diagnostic pages (last page of the ISO/IEC 24712 test page suite) printed between cartridge installation and *end of life* (3.7) and multiplying by five

Note 1 to entry: If the printer stops due to *ink out* (3.6) in the middle of a *test page suite* (3.8), the number of the diagnostic pages printed is counted. Then, the first diagnostic page of the remaining print job is included in the subsequent cartridge yield.

Note 2 to entry: The number of test page suites counted can contain some pages that show visible *fade* (3.1). To simplify the testing, determination of end of life is only made on the diagnostic page (last page of the ISO/IEC 24712 test page suite).

3.10
declared cartridge yield
at or below the lower 90 % confidence bound of the mean as prescribed in 6.1 and 6.2

3.11
primary cartridge
cartridge containing full density black, cyan, magenta or yellow ink or a combination of full density cyan, magenta and yellow

Note 1 to entry: These colours represent the primary inks used in a traditional four-colour printing process.

3.12
proxy cartridge
primary cartridge (3.11) to be utilized for estimating yield of *supplemental cartridges* (3.13)

3.13
supplemental cartridge
cartridge other than the full density cyan, magenta, yellow and black cartridges

Note 1 to entry: The determination of yield for a supplemental cartridge is made according to 6.2.

4 Test parameters and conditions

4.1 Set up

Place the printer on a horizontal surface and set up the printer according to the installation guide provided in the printer user's manual. Use the most recent printer driver available from the manufacturer's website or the supplied driver with the printer. The driver version shall be specified on the test report. Cartridge installation shall be completed following the instructions in the cartridge installation guide. If there is a contradiction between the printer and cartridge manuals for the cartridge installation, the cartridge manual shall take precedence except if changes are recommended for printer or driver settings.

At the start of the test, all printers shall be set up using a set of priming cartridges to ensure that the ink used in testing is primarily for printing, not for initial priming/cleaning. After the printer is set up

according to the manufacturers' instructions, the priming cartridges shall be used to print a minimum of 25 pages, five cycles of the standard test page suite. The priming cartridges shall be removed and replaced with new cartridges that are used for testing yield. The pages printed during this step are not counted towards yield. Even if required by the printer, printhead alignment does not have to be performed on the priming cartridges. The number of pages used in the priming operation shall be included in the test report. The replacement of the priming cartridges with the first test cartridges may be done all at once or staggered individually. If done all at once, all test cartridges begin with test page suite number 1 and continue until end of life. If the staggered start method is used, the test page suite number shall be tracked separately for each cartridge. The test start method shall be included in the test report.

All image and print quality modifiers shall be at their factory preset configuration for the printer and default-installed condition for the driver. If auto media detection is available on the printer, it shall be disabled and media-type set to plain paper. This is to avoid inaccurate sensing of the media. If the printer and driver settings differ, then the driver defaults shall be used. Any user selectable ink conservation modes, (e.g. draft) shall be disabled during testing.

For printers that default to duplex printing, the default shall be overridden and the printer shall be set to simplex for yield testing.

To ensure that the test page suite is printed correctly, any page size modifiers such as "Fit to Page" and font substitution shall be turned off. The file shall be printed using the fonts embedded in the file and shall be printed on the page in a size corresponding to the dimensions in the test page suite standard (ISO/IEC 24712). Page placement modifiers such as page centring can be used to place the image properly on the page.

To facilitate automated testing, the test page suite may be pre-generated using the printer driver. This is often accomplished using a print to file command. This method is only valid if it does not affect the measured yield. If a pre-generated file is used, it shall be noted on the test report.

If the printer under test uses an internal PDF interpreter, it is ok to use it as long as the printer defaults are set to not substitute fonts. If the internal interpreter is used, this shall be noted on the report.

The application software (for example, Adobe Acrobat Reader[1)]), printer driver and printer can have page size modifier functions, such as Fit to Page. Make sure that all of these functions are disabled.

4.2 Sample size

Inkjet cartridges are designed in two common styles, single colour and multi-colour. The sample size shall be determined such that for each calculated yield value, a minimum of three physical cartridges are tested in each of three printers. In the case of a typical four-colour printer with four single primary colour cartridges this would result in 36 cartridges being tested, nine black (K), nine cyan (C), nine magenta (M) and nine yellow (Y). For a typical multicolour cartridge system where one cartridge contains C, M and Y, and another cartridge contains K, the testing would use 18 total cartridges, nine black and nine CMY.

In some printer configurations, supplemental cartridges can be installed. Please see the procedure in 6.2 for details on the treatment of supplemental cartridges.

When testing additional engines and cartridges above the minimum, an effort shall be made to test an equal number of cartridges on each engine. For example, if an additional engine were to be tested then the minimum number of cartridges to be tested shall be 48 (3 cartridges × 4 colours × 4 printers) for a four-cartridge system.

1) Adobe Acrobat Reader is the trade name of a product supplied by Adobe Systems Incorporated. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

When testing cartridges for a commercially available product, it is recommended that cartridges and printers be procured from various sources or sampled from different production lots. The printers and cartridges shall be within their useful life as stated in their user's manual.

It is recommended that additional engines and/or cartridges be used in testing to allow for the possibility of a cartridge and/or printer failure during testing.

4.3 Print mode

For reporting cartridge yield, the test shall be run in semi-continuous simplex printing and set in the driver default print mode at or near rated print speed. Each copy of the test page suite shall be printed as a separate five-page print job. This allows for some intra-job servicing and calibration to take place. Additional pauses can take place due to paper refills and idle time due to end of workdays.

NOTE 1 This does not mean that the printer is required to stop between printed jobs.

Colour inkjet printers commonly need to service the printing system after a number of prints, or when the device has been powered down or not used for a given amount of time. This servicing uses ink that could have been used to print additional pages. It is realized that customers do not normally print in a continuous fashion, but these changes are made to decrease testing time and increase the repeatability of the testing process.

NOTE 2 Depending on the use conditions, the yield experienced by a given user can vary significantly from the yield measured by this test method.

4.4 Print environment

The temperature can have a profound effect on test results. For this reason, the test shall be carried out according to the following test conditions:

— temperature: testing room average 23,0 °C ± 2 °C;

— readings to be made with a running average of 1 h with readings recorded at least every 15 min, all running average temperatures shall be between 20,0 °C and 26,0 °C.

EXAMPLE An example of the calculation of the temperature is shown in Table 1 for temperature readings taken on 15-min intervals for the testing of one cartridge.

Table 1 — Running temperature calculation example

Values in Celsius

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	**Testing room average**
Temperature	24,0	23,4	20,5	24,2	23,6	22,0	25,5	24,7	22,1	20,8	22,0	23,5	23,0
Running average T_i	N/A	N/A	N/A	23,0	22,9	22,6	23,8	24,0	23,6	23,3	22,4	22,1	

Running average $T_i = (T_{i-3}+T_{i-2}+T_{i-1}+T_i)/4$

Testing room average = $(T_1+T_2+ \ldots +T_{12})/12$

From these formulae, the testing room average would be 23,0 °C, the maximum running average reading 24,0 °C and the minimum running average reading 22,1 °C. These values can be found highlighted in the table of temperature measurements. It shall be noted that the testing room average for temperature are averages of all measurements, not the running averages.

Environmental conditions shall be included in the test report. The maximum and minimum running averages for temperature shall be reported for each cartridge tested. Please see Annex C for a sample reporting form.

All materials shall be temperature acclimated to the test room environment. Prior to testing, the printer, paper and cartridges shall be acclimated to the above conditions. Before acclimation, packaging and