INTERNATIONAL STANDARD

ISO/IEC 19798

Second edition
2007-12-15

Method for the determination of toner cartridge yield for colour printers and multi-function devices that contain printer components

Méthode pour la détermination du rendement de cartouche de toner pour les imprimantes couleur et pour les dispositifs multifonctionnels qui contiennent des composants d'imprimantes

Reference number
ISO/IEC 19798:2007(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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.

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.

ISO/IEC 19798 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

This second edition cancels and replaces the first edition (ISO/IEC 19798:2006), of which it constitutes a minor revision.

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Introduction

The purpose of this International Standard is to provide a process for determining the cartridge page yield for a given colour electrophotographic printer model (i.e. all-in-one toner cartridges and toner cartridges without a photoconductor) using a standard office consumer type test suite. This test suite is not focused on printing of photographs, but is intended to be a sampling of typical office consumer pages.

This International Standard prescribes the following:

- the test method that manufacturers, test labs, etc. use to determine cartridge yield;
- the method for determination of declared yield values from the test results; and
- 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 judgment, or signalled with either of two phenomena: *fade* caused by depletion of the useable toner in the cartridge; or *automatic printing stop* caused by a toner out detection function.

This International Standard will be used for the measurement of one of the contributions to cost per page (CPP). This International Standard does not directly measure CPP, only the yield of the magenta, cyan, yellow and black toner cartridges. In most cases, these are not the only contributors to the CPP. It is beyond the scope of this document to provide a methodology for calculation of CPP.

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Method for the determination of toner cartridge yield for colour printers and multi-function devices that contain printer components

1 Scope

The scope of this International Standard is limited to evaluation of toner cartridge page yield for toner-containing cartridges (i.e. all-in-one toner cartridges and toner cartridges without a photoconductor) for colour electrophotographic printers. This International Standard 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 electrophotographic printer components.

This International Standard is only intended for the measurement of toner cartridge page yield when printing on plain paper using cyan, magenta, yellow and black toner cartridges. No other claims can be made from this testing regarding quality, reliability, etc.

This International Standard is not for use with printers whose minimum printable size is equal to or greater than A3 or for photo-only printers.

NOTE Application of this International Standard for yield measurement of toner replenishment systems (i.e. toner cartridge and bottle type systems where the toner reservoir is internal to the printing system and not user-replaceable) requires some procedural modifications specifically noted herein. This International Standard is intended for equipment used in the office space and does not apply to production volume or large format printing machines where the major cost of ownership is not caused by the consumable yield measured in 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 24712, *Colour test pages for the measurement of office equipment consumable yield*

ISO/IEC 19752, *Information technology — Method for the determination of toner cartridge yield for monochromatic electrophotographic printers and multi-function devices that contain printer components*

3 Terms and definitions

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

3.1
fade
phenomenon in which a noticeable reduction in density (increase in lightness) uniformity in the bars around sides of the diagnostic page occurs

NOTE 1 This does not have to be a distinct gap.

NOTE 2 In this test, fade is defined as a noticeably lighter area, 3 mm or greater located in the bars around the diagnostic page of the test suite. Generally, the lightening will occur parallel to the paper movement direction during printing. The determination of the change in lightness is to be made referenced to the 100th page (Diagnostic Page) printed for each cartridge in testing. For examples of fade, please consult Annex A.

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3.2
shake procedure
in the case that the cartridge user's manual instructs cartridge shaking and its method, shaking the cartridge is performed according to the manual instructions

NOTE If a shake procedure is used in testing it will be noted in the report.

3.3
toner low
warning generated by the printing system when it has determined that the amount of toner is such that a cartridge change may be required soon

NOTE It does not indicate that the system is out of toner.

3.4
toner out
signal generated by the printing system when the useable toner in the system is depleted and the printer will not continue printing without user intervention

NOTE For the purpose of this test, the toner out signal will only be used if it causes the printer to stop printing.

3.5
end of life
when the printer declares "toner out" or when fade is observed

NOTE 1 The general intent of this definition is to allow two shake procedures near end of life and to declare end of life at the first fade after the two shake procedures. Nominally, the shake procedures are to be executed at print fade. However, if the printer is equipped with a toner low device, then the first, second or both shake procedures can be executed at toner low instead of at fade as a convenience for the tester. If the cartridge user's guide does not specify a shake procedure, then the shake procedures are not performed and end of life occurs at the first fade. Any faded pages printed during the test are to be excluded from the cartridge page count.

NOTE 2 If the printer is equipped with a toner out device, then end of life occurs when the printer declares toner out. However, when fade occurs before toner out and no shake procedure is specified, then end of life is declared at the fade. If a shake procedure is specified for a printer with a toner out device, then up to two shake procedures can be executed as described in Note 1 when fade occurs before toner out. In this case, if fade occurs after two shake procedures but before toner out, then end of life is declared at the third fade. If toner out occurs at any time during testing, the cartridge is considered to be at end of life.

NOTE 3 When applied to replenishment systems (bulk toner replacement or multi-part toner systems), the intent of this definition is to declare a quasi-end of cartridge life at a regular predetermined point. If the printer is equipped with a toner low or toner out signal, these can be used as the point of quasi-end of life. In either case, the end of life condition chosen must be noted in the test report.

NOTE 4 When shake procedures have been performed during the test, the test report will note for both the first and second shake procedures whether they were done at toner low or at fade. Any faded pages printed during the test are to be excluded from the cartridge page count.

NOTE 5 Application of this definition may be clarified by reference to a flow chart and examples found in Annex B.

3.6
individual cartridge yield
value determined by counting the number of diagnostic pages (page 5 of the ISO/IEC 24712 test suite) printed between cartridge installation and end of life (as defined in 3.5) and multiplying by 5

NOTE If the printer stops due to toner out in the middle of a test page suite, the number of the diagnostic pages printed is counted. Then, the first diagnostic page of the suspended print job is included in the subsequent cartridge yield. The number of test page suites counted may contain some pages that show visible fade. To simplify the testing, determination of end of life is only made on the diagnostic page (page 5).

3.7
declared cartridge yield
value at or below the lower 90 % confidence bound as prescribed in 6.1 and 6.3

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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 will 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 will take precedence except if changes are recommended for printer or driver settings.

If the cartridges used in testing are toner replenishment or toner bottle types, then one set of toner cartridges will be used to end of life in each printer before the start of the test. The pages printed to deplete these priming cartridges do not have to be recorded and printing can be conducted at any environment. The priming cartridges are used to bring the printing system to a set toner level condition.

NOTE The cartridges used to bring the printing system to a set toner level condition do not have to start out full. For large capacity systems, using a complete cartridge could result in tens of thousands of pages printed just to bring the system to a set condition.

All image and print quality modifiers shall be at their factory pre-set configuration for the printer and default installed condition for the driver. If the printer and driver differ, then the driver defaults shall be used. Any user selectable toner conservation modes shall be disabled during testing. 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 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.

To assure that the test page is printed correctly, any page size modifiers such as *Fit to Page* and font substitution shall be turned off. If the option exists, rendering of graphics shall be performed by the printer, not the application software or operating system. The files 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 suite standard (ISO/IEC 24712). Page placement modifiers such as page centering can be used to place the image properly on the page. If available, any colour management shall be set to the printer and driver installed defaults. If there is a question about rendering settings affecting the yield, the setting shall be noted in the report.

NOTE The application software (i.e. Adobe Reader), printer driver and printer may have page size modifier functions, such as "Fit to Page". Make sure that all of these functions are disabled.

4.2 Sample size

The sample size shall be determined such that for each calculated yield value a minimum of nine physical cartridge sets are tested using a minimum of three printers. An equal number of cartridge sets must be tested on each printer. For example, three sets of cartridges could be tested on three printers with each printer using three sets of cartridges. In the case of a typical four colour printer with four single colour cartridges this would result in 36 cartridges being tested, 9 Black (K), 9 Cyan (C), 9 Magenta (M) and 9 Yellow (Y).

When testing additional engines and cartridges above the minimum, an effort shall be made to test 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 would be 48 (3 cartridges $\times$ 4 colours $\times$ 4 engines) for a four-cartridge system.

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 must be within their useful life as stated in their user's manual.

NOTE 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.

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4.3 Print mode

For reporting cartridge yield, the test will be run in semi-continuous simplex printing and set in the driver default print mode. Each copy of the test suite shall be printed as a separate five page print job. This shall allow for some intra-job calibration and/or servicing to take place. Pauses can take place due to paper refills and idle time due to end of work days. Every attempt shall be made to have printing be continuous at or near rated speed from the start of a cartridge to the end of cartridge life.

Colour electrophotographic printers commonly need to calibrate 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 calibration uses toner 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. Depending on use conditions, the yield experienced by a given customer may vary significantly from the yield measured by this test method.

4.4 Print environment

The temperature and humidity can have a profound effect on test results. For this reason, the test must 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 hour with readings recorded at least every 15 minutes, all running average temperatures are to be between 20.0 °C and 26.0 °C.

Relative Humidity: Testing room average 50 % ± 10 % RH

Readings to be made with a running average of 1 hour with readings recorded at least every 15 minutes, all running average RHs are to be between 35 % and 65 %.

EXAMPLE An example of the calculation of the temperature is shown below for temperature readings taken on 15-minute intervals for the testing of one cartridge.

	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	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 at $T_i = (t_{i-3} + t_{i-2} + t_{i-1} + t_i)/4$

Testing Room Average = $(t_1 + t_2 + \ldots + t_{12})/12$

From this 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 both temperature and RH 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 and humidity shall be reported for each cartridge tested. Please see Annex C for an 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 for a minimum of 8 hours. Before acclimation, packaging and shipping materials shall be opened with care taken to prevent damage to the cartridges during acclimation. Paper may be acclimated in the ream wrapper.

Any water condensation must be avoided when printer, paper and cartridges are carried in the test environment.

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4.5 Paper

The paper used in this test shall represent a common medium weight paper and must conform to the printer's list of approved papers. The paper manufacturer, weight and size, A4 or equivalent, used in the test will be noted on the report. If auto media detection is available on the printer, it shall be disabled and the media type set to plain paper. The auto-detect process can have an effect on the yield performance.

4.6 Maintenance

Printer maintenance shall be performed per the printer and cartridge user's manual.

NOTE Examples of common maintenance performed during testing could include: Replacement of transfer belts or fuser units.

4.7 Test files

The test files are outlined and specified in ISO/IEC 24712. The test must be conducted using the most recent official electronic test files as the input. The most recent official file can be located at http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html. Failure to use the exact file specifications will invalidate test results. In addition to the test files a publicly available PDF Reader will be used in conjunction with the printer driver to generate the printer input and send the files directly to the printer. The method used for connection between the host computer and the printer shall be recorded on the test report. For automated testing, a pre-generated print file can be used if the results are equivalent to direct printing methods. This will be recorded on the test report. The version of the test file, the printer driver version and the PDF Reader version will be included in the test report. Before starting the test, a sample file set shall be printed to check the image and assure the proper size. The proper size for each of the pages in the test suite is specified in ISO/IEC 24712.

NOTE There are several of PDF reader versions available; each version can have an impact on the yield results. It is recommended that the latest version of the chosen PDF reader be used for testing.

To reduce test variability due to other programs, it is recommended that test file generation be conducted on a printer with a "clean" install of the operating system with only the printer driver, PDF reader and any test control software installed. Testing has shown that old installed drivers from the same or different printers can affect the yield results.

NOTE To aid in counting and tracking pages, a header or footer can be added to the test page. Every attempt shall be made to reduce the size of this addition to minimize the effect on calculated yield. If this information is included in the test pages, it shall be documented in the test report.

The host computer environment such as Operating System (OS), RAM size, CPU type and application software may affect the yield test results, the computer environment recommended by the printer's user manual shall be used for the test. All of this information will be recorded on the test report.

5 Test methodology

5.1 Testing procedure

1) Install at least three printers following the user's manual. If the cartridge used in testing is a toner replenishment or toner bottle type, then one toner cartridge set will be used to end of life in each printer before the start of the test as described in section 4.1. The pages printed to deplete this priming cartridge do not have to be recorded and printing can be conducted at any environment.

2) Remove all packaging material from a new complete set of cartridges. Install all new cartridges for yield testing following the installation guide. If there is a contradiction between the printer and cartridge manuals for the cartridge installation, the cartridge manual will take precedence except if changes are recommended for printer or driver settings, such as directions to change printer settings.

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3) Begin test and start tracking the number of test page suites printed on each test cartridge.

4) When the 100th page (Diagnostic Page) is printed for the first set of cartridges, save the diagnostic page for use as the fade reference.

5) When End of Life is reached on any cartridge, record Individual Cartridge Page Yield as described in section 3.6.

6) Remove the depleted cartridge. Replace depleted cartridge with new. Repeat steps 3, 4 and 5 for all remaining test cartridges. Testing must continue using additional cartridges until a minimum of 9 (three cartridges of each colour on three printers) of each cartridge being measured has been tested. This might result in use of more than three of each cartridge.

5.2 Procedure for handling a defective cartridge or printer

During testing, a failure of the cartridge or printer may occur. This will be handled in the following manner. Cartridge failures are defined as occurrences of problems that would result in replacement of the toner cartridge before end of life. Examples of this could be Optical Photo-Conductor damage, excessive toner leakage, structural failure, etc. Printer failures are defined as non-user clearable errors that prevent normal printer operation from occurring. An example of this might be the failure of the laser beam on the printer.

5.2.1 Defective cartridge

In the case of a defective cartridge, the number of the test suite printed and reason for failure will be recorded on the report. The cartridge will then be replaced with a new cartridge and the testing continued. For this test, early end-of-life is not sufficient cause for classifying a cartridge as defective. For the purposes of yield calculation, the defective cartridge will not be used. For the test to be considered valid, at least 36 (9 Cyan, 9 Magenta, 9 Yellow and 9 Black) cartridges must be run to end of life as defined in Section 3.5.

5.2.2 Defective printer

In the case of a defective printer, the printer shall be repaired or replaced and new cartridges shall be used for subsequent testing. On the report, the number of the test suite printed by the cartridges will be recorded and it noted that the cartridges were replaced due to printer failure. The failure of the printer will be noted and the replacement printer serial number recorded. For the test to be considered valid, at least three set of each cartridge per engine must be run to End of Life as defined in Section 3.5. The yield data obtained before printer failure cannot be used for yield calculation unless it can be proved that the printer failure did not affect the previously tested cartridges. This justification will be recorded in the test report.

6 Determination of the yield value and declaration

6.1 Determination of the declared yield value

An average and a standard deviation will be obtained from the test runs (e.g. n = 9).

Sample Average for a given cartridge, $\overline{X} = \sum_{i=1}^{n} \frac{x_i}{n}$

Sample Standard Deviation for a given cartridge, $s = \sqrt{\sum_{i=1}^{n} \frac{\left(x_i - \overline{X}\right)^2}{(n-1)}}$

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Where

x_i Is the individual cartridge yield defined in section 3.6 (i.e. the number of standard test page suites printed between cartridge installation and End of Life multiplied by 5)

n Is the sample size. In this example, n = 9. (Generally, n shall be greater than or equal to 9)

It can be stated with 90% confidence that the true average yield of the cartridge is within the following values:

$$\text{Lower Confidence Bound} = \bar{X} - \left(t_{\alpha,n-1}\right) * \frac{s}{\sqrt{n}}$$

$$\text{Upper Confidence Bound} = \bar{X} + \left(t_{\alpha,n-1}\right) * \frac{s}{\sqrt{n}}$$

Where

$t_{\alpha,n-1}$ Can be found on a Students' t-Distribution Table with $n-1$ degrees of freedom (df or 'ν') and an α of 0.1. (in this example, $n-1 = 9 - 1 = 8$) This provides a 2-tailed confidence interval with 90% confidence. This specific t-statistic for 8 degrees of freedom, and 90 % confidence is $t_{\alpha,n-1} = 1.860$. This can be used in the above calculation, only. A different sample size and/or different confidence interval will yield a different $t_{\alpha,n-1}$.

The declared value shall be determined so that it's at or below the calculated lower 90% confidence value.

6.2 Test data reporting

The data shall be reported as exemplified in Annex C. The report shall be made available if requested.

6.3 Declaration of the yield

LCBs are computed for each cartridge colour. Declared yield can be based either on the individual LCBs for each colour or based on a combined yield as discussed below.

Because of differences in colourant hue and colour balance optimization among printer manufacturers, the test pages used in this international standard will not be colour balanced for all printers. In acknowledgement of this fact, when cyan, magenta, and yellow are in separate cartridges that are intended to have equal capacities, their yields can be reported using a single value computed using yields for all of the individual colourants. This value is to be called the "composite yield" and is defined below:

$$CY = \frac{3}{\left(\frac{1}{Ycyan} + \frac{1}{Ymagenta} + \frac{1}{Yyellow}\right)}$$

Where:

CY = composite yield

Yn = 90 % lower confidence bound (LCB) of the page yield of colour n

This calculation provides a cost neutral result when all colourants are priced the same on a per cartridge basis.

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Example:

From testing:

Cyan Cartridge 90 %	LCB = 4 500 pages
Magenta Cartridge 90 %	LCB = 5 800 pages
Yellow Cartridge 90 %	LCB = 5 000 pages
Black Cartridge 90 %	LCB = 11 000 pages

$$CY = \frac{3}{\left(\frac{1}{4\,500} + \frac{1}{5\,800} + \frac{1}{5\,000}\right)} = 5\,045 \text{ pages}$$

For colour cartridges:

Declared yield can be based either on the individual LCBs for each colour or based on the composite yield. The 2 options for declaration of yield for this example are:

Individual Yield Method

Average Continuous Cyan Cartridge Yield	Up to 4 500 pages
Average Continuous Magenta Cartridge Yield	Up to 5 800 pages
Average Continuous Yellow Cartridge Yield	Up to 5 000 pages
Average Continuous Black Cartridge Yield	Up to 11 000 pages

Composite Yield Method

Average Continuous Composite CMY Cartridge Yield	Up to 5 045pages
Average Continuous Black Cartridge Yield	Up to 11 000 pages

Note that yield for the black cartridge is always declared based on its individual LCB.

When a toner cartridge yield is declared in the user's manual, marketing materials or packaging, the following minimum information shall be included:

- Description that the declared yield value has been determined in accordance with ISO/IEC 19798
- Declared yield value of the cartridge
- If a cartridge can be used in multiple printers one of the following must be reported:
  - The combination of tested printer and cartridges
  - The minimum yield of all tested printers
  - The range of yields from all tested printers – must have reference to actual printer/cartridge performance available

Recommended Example:

In the case where the Cyan, Magenta and Yellow cartridges are the same physical size:

When cartridge XXX is used in printer YYY:

Toner Cartridge yield:

Average Continuous Composite CMY Cartridge Yield	5 045 standard pages
Average Continuous K Cartridge Yield	11 000 standard pages

Declared yield value in accordance with ISO/IEC 19798

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Annex A
(informative)

Examples of fade

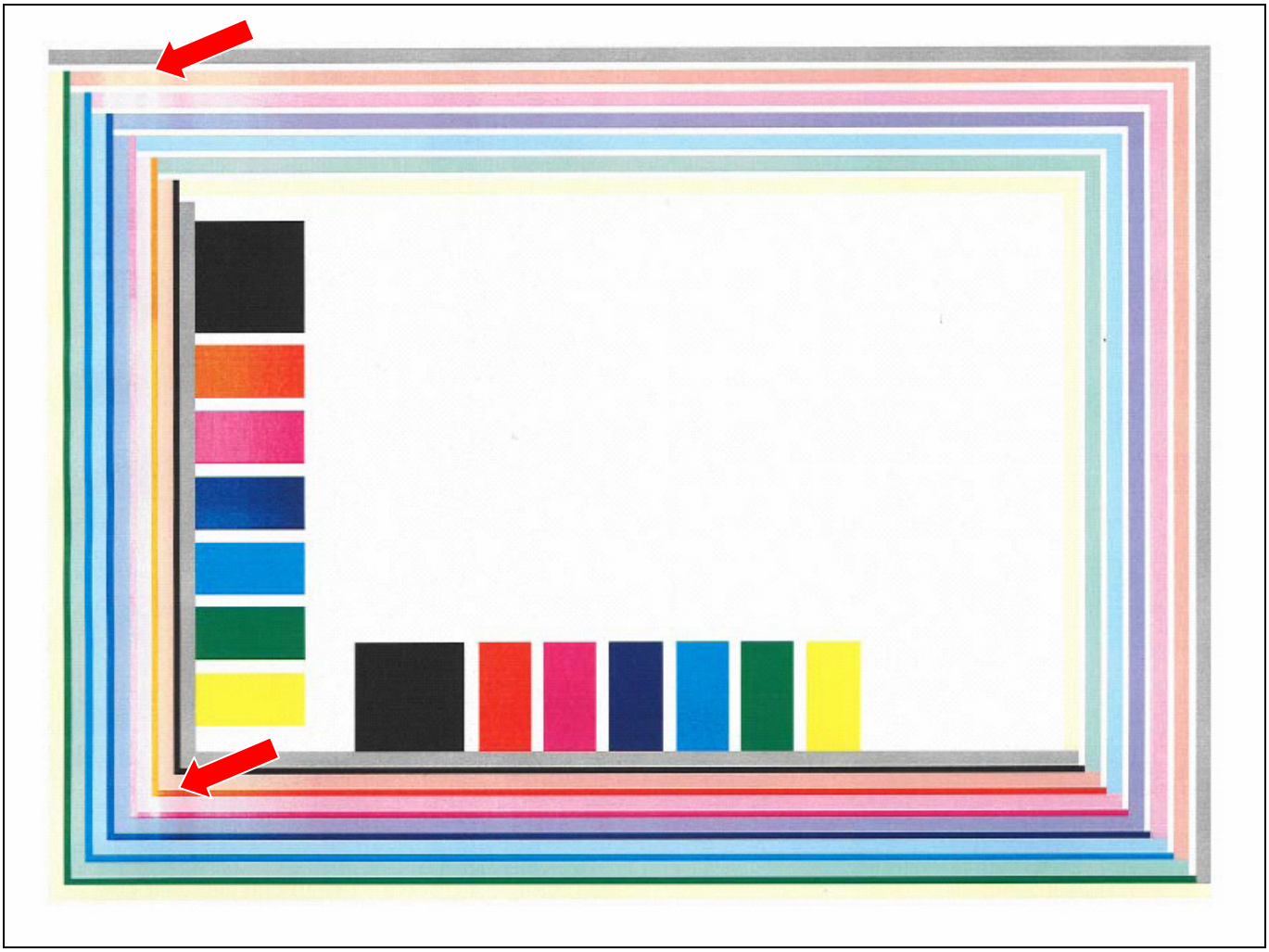

Figure A.1 — Examples of fade

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Annex B
(informative)

Flow chart

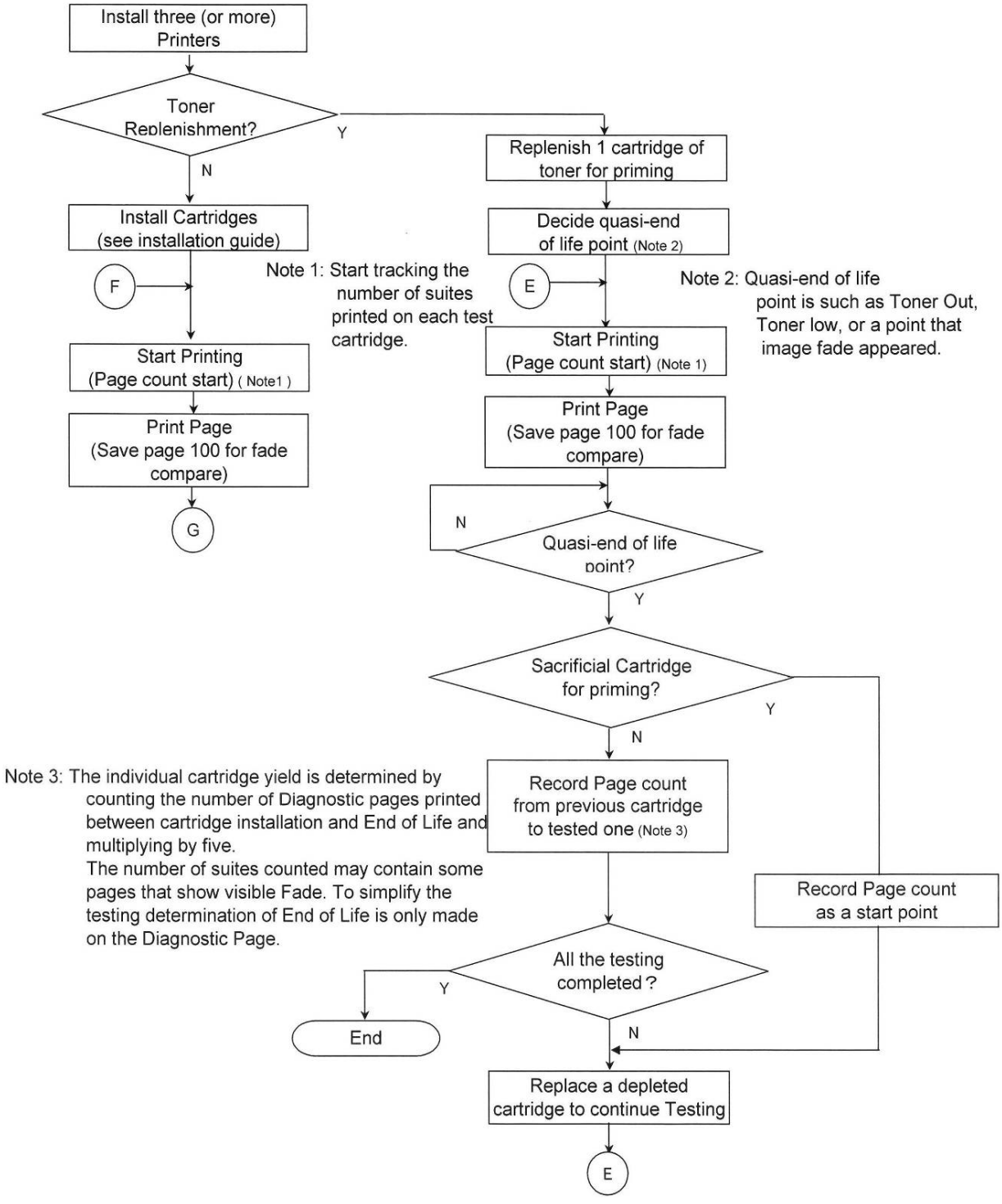

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Figure B.1 — Flow chart

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Annex C
(normative)

Sample reporting form

Declaration of yield:

When cartridge XXX is used in printer YYY:	
Toner Cartridge yield:	
Average Continuous Composite CMY Cartridge Yield	5 045 standard pages
Average Continuous K Cartridge Yield	11 000 standard pages
Declared yield value in accordance with ISO/IEC 19798	

90 % Lower Confidence	Cyan Cartridge	= 4 500 pages
	Magenta Cartridge	= 5 800 pages
	Yellow Cartridge	= 5 000 pages
	Black Cartridge	= 11 000 pages

Date Tested: 2005/10/20 – 2005/10/30

For questions concerning testing contact:

Cartridge Testing Associates

123 Electrophotographic Lane

Toner, IL 87484

Number of Cartridges used in testing:	C = 19, M = 19, Y = 18, K = 9
Number of Cartridges used in calculations:	C = 18, M = 18, Y = 18, K = 9
Type of Cartridge:	All-in-one
Shake Procedure Used?	No
Print mode:	Continuous
Number of engines used in testing:	3
Media Used:	HiRight 20lb Copy paper
Paper Size:	A4
Paper feed orientation:	Short edge feed
Computer Model:	VectorPC 7155
Driver Version:	Printmat driver Version 1.03b
Operating System:	Linux Build 1001
Application Software:	Acrobat version 6.01
Test Page Version:	Version 200601
Power (off/on) everyday?:	Yes

Cartridge testing data:

--`,,```,,,,````-`-`,,`,,`,`,,`---
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Printer #1: AAAA69675

			Temperature				Humidity			
		Cartridge No.	Avg	Max	Min	Avg	Max	Min	Cartridge yield	Cartridge used in calculation
1st set	C									
	M									
	Y									
	K									
2nd set	C									
	M									
	Y									
	K									
3rd set	C									
	M									
	Y									
	K									
4th set	C									
	M									
	Y									
	K									
5th set	C									
	M									
	Y									
	K									
6th set	C									
	M									
	Y									
	K									
7th set	C									
	M									
	Y									
	K									

Printer #2: BBBB69675

			Temperature				Humidity			
		Cartridge No.	Avg	Max	Min	Avg	Max	Min	Cartridge yield	Cartridge used in calculation
1st set	C									
	M									
	Y									
	K									
2nd set	C									
	M									
	Y									
	K									
3rd set	C									
	M									
	Y									
	K									
4th set	C									
	M									
	Y									
	K									
5th set	C									
	M									
	Y									
	K									
6th set	C									
	M									
	Y									
	K									
7th set	C									
	M									
	Y									
	K									

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Printer #3: CCCC69675

			Temperature			Humidity				
		Cartridge No.	Avg	Max	Min	Avg	Max	Min	Cartridge yield	Cartridge used in calculation
1st set	C									
	M									
	Y									
	K									
2nd set	C									
	M									
	Y									
	K									
3rd set	C									
	M									
	Y									
	K									
4th set	C									
	M									
	Y									
	K									
5th set	C									
	M									
	Y									
	K									
6th set	C									
	M									
	Y									
	K									
7th set	C									
	M									
	Y									
	K									

Summary

	Cartridge No.	C	M	Y	K		Cartridge No.	C	M	Y	K		Cartridge No.	C	M	Y	K
Printer #1	1					Printer #2	1					Printer #3	1				
	2						2						2				
	3						3						3				
	4						4						4				
	5						5						5				
	6						6						6				
	7						7						7				
	8						8						8				
	9						9						9				
	10						10						10				
	11						11						11				
	12						12						12				
	13						13						13				
	14						14						14				
	15						15						15				
	16						16						16				
	17						17						17				
	18						18						18				
	19						19						19				
	20						20						20				

	Type	C	M	Y	K
	Total				
	Avg.				
	St. Dev.				
	90%CB				

Comments: (As Required):

Cartridge AD499444 was stopped after 2 158 pages of testing due to failure of printer ABA6686-996. It was not used in yield calculations. The printer was repaired and reused for remaining cartridge tests.

Cartridge SE989395 was stopped after 2 340 pages of testing due to toner leakage. It was not used in calculations.

Density was lower on the first ~50 pages of each cartridge then got darker and remained the same till the end of life. Second fade occurred quickly after the first in most cases.

No print quality modifiers were used.

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Annex D
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Method for comparison of colour to ISO/IEC 19752

It is a benefit to customers to be able to compare page yield across technologies. ISO/IEC JTC1 SC28 has developed the colour test pages in ISO/IEC 24712 to be used in both colour inkjet printers and colour electrophotographic printers. In addition, ISO/IEC 19752 defines a monochrome test page that could be use to test yield of colour inkjet and colour electrophotographic printers in situations where monochrome text is printed predominantly or comparisons need to be made between colour and monochrome printers. This is not meant to take the place of testing black yield using ISO/IEC 24712, but to be in addition to testing with ISO/IEC 24712.

Similar parameters outlined in ISO/IEC 19798 for set-up, sample size, end of life determination, and yield determination can be applied to both the mono test page and the colour test pages. The exceptions are as follows:

Section 4.1 Set-up

> All image and print quality modifiers shall be at their factory pre-set configuration for the printer and default-installed condition for the driver with the following exceptions. If a “Black Only” or “Text Only” mode is available, it shall be enabled. The selection of this modifier must be noted on the test report. If the printer and driver settings differ, then the driver defaults shall be used. Any user selectable toner conservation modes (e.g. draft) shall be disabled during testing.

In yield reporting, it is imperative that the test pages are clearly defined, whether it is the Colour Test pages under ISO/IEC 24712 or the Monochrome Electrophotographic Test Page under ISO/IEC 19752. Comparisons can only be made if the same test page or test suite is used. In addition, this reporting of monochrome yield cannot take the place of yield reporting for Black as defined in ISO/IEC 19798. This method can only be used to provide additional information and not take the place of yields determined by ISO/IEC 19798.

When an toner cartridge yield is declared in the user’s manual, marketing materials or packaging, the following minimum information shall be included:

- Results derived from testing using ISO/IEC 19798
- Description that the additional yield values have been determined using the procedure defined in ISO/IEC 19798 using the test page defined in ISO/IEC 19752
- That the value obtained was using continuous printing

Example:

When tested in printer YYY:

Toner Cartridge yield:

Average C Cartridge Yield	5 020 standard pages
Average M Cartridge Yield	5 150 standard pages
Average Y Cartridge Yield	4 890 standard pages
Average K Cartridge Yield	11 000 standard pages

Values obtained by continuous printing
Declared yield value in accordance with ISO/IEC 19798

Using the test page defined in ISO/IEC 19752 provides the following results

Average K Cartridge Yield	12 000 standard pages

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ICS 37.100.10

Price based on 15 pages

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