PD ISO/TR 18160:2014

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Document management — Digital preservation — Analog recording to silver-gelatin microform

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The UK participation in its preparation was entrusted to Technical Committee IDT/1, Document Management Applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 87134 4

ICS 37.080

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 September 2014.

Amendments issued since publication

Date	Text affected

PD ISO/TR 18160:2014

TECHNICAL REPORT

ISO/TR 18160

First edition
2014-09-15

Document management — Digital preservation — Analog recording to silver-gelatin microform

Gestion des documents — Conservation numérique — Enregistrement analogique au microforme sur gélatine-argent

Reference number
ISO/TR 18160:2014(E)

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Published in Switzerland

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Foreword

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The committee responsible for this document is ISO/TC 171, *Document management applications*, Subcommittee SC 1, *Quality*.

Introduction

The perceived value of condensing information by optically filming documents, engineering drawings, and cartographic materials to microfilm has been well established along with a large collection of ISO standards that have provided standards and guidance for many years. As more and more information is generated in digital format, only concerns have arisen regarding preservation of digital data and images. History has shown that as long as preservation information is kept in analog format, the digital format becomes more usable, upgradable, and most importantly, safer. The National Micrographics Association (NMA) in 1943 started standardization of practices for the manufacture and use of microfilm, supplies, and equipment in conjunction with organizations such as, the National Bureau of Standards (later to become National Institute of Standards (NIST), National Archives of the US (NARA), Library of Congress (LOC), American National Standards Institute (ANSI), manufacturers such as, Eastman Kodak Company, 3M, Dupont, IBM, and many others.

These documents were introduced into the ISO environment and published as

— ISO 6199:2005, *Micrographics — Microfilming of documents on 16 mm and 35 mm silver-gelatin type microfilm — Operating procedures,* and

— ISO 9923:1994, *Micrographics — Transparent A6 microfiche — Image arrangements.*

In about 1960, Enterprise Report Management (ERM) recognized the value of directly recording computer data onto microfilm using Computer Output Microfilm (COM). These practices and documents all share the common practice of using optical techniques for information capture onto microfilm. The critical test element used in measuring quality in all these systems is based on the ISO test chart 3334 (see Figure 1).

These were introduced into ISO as

— ISO 8514-1:2000, *Micrographics — Alphanumeric computer output microforms — Quality control — Part 1: Characteristics of the test slide and test data,* and

— ISO 8514-2:2000, *Micrographics — Alphanumeric computer output microforms — Quality control — Part 2: Method.*

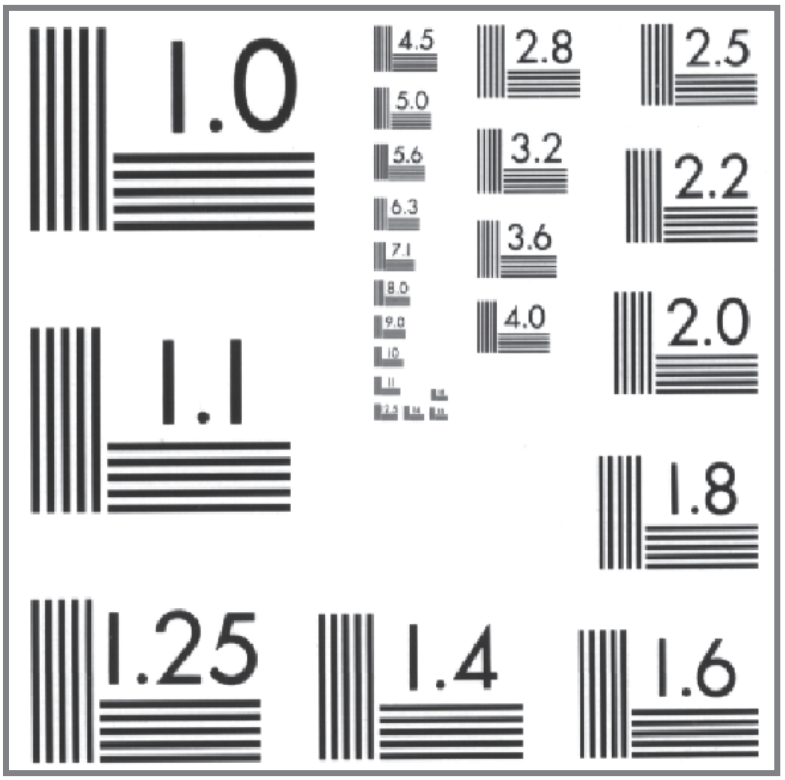

Figure 1 — Reproduction of ISO test chart 3334

The key features of this target are sets of five equally spaced lines and spaces that can be filmed at any optical reduction ratio; and by simply examining the resultant image, one can determine camera/film system resolution. The resolution is determined by multiplying the smallest readable element by the reduction ratio to determine line pairs per mm resolution.

In summary, there is a good body of standardized reference materials for measuring quality and ensuring good quality control for traditional optical microfilming or for recording digital data onto microfilm. ISO 11506 further demonstrated the value and gave some guidelines for formatting digital data and images to microfilm.

Document management — Digital preservation — Analog recording to silver-gelatin microform

1 Scope

This Technical Report recommends test methods for evaluating the consistency of the digital images recorded onto black and white silver microfilm using input from both digitally born documents as well as digital documents created from document scanners. Quality control procedures to be used for optimizing and maintaining output quality onto film over time are described. This Technical Report stresses the use of both commercial and ISO approved standard test targets.

The test methods are based on the visual examination of the output of office document scanners and digitally born test targets on film image recorders.

It is applicable to assessing the output quality of document scanners used in the office and film image recorders used to record the resultant scanned images to microfilm. Microforms can be any common formats including 16 mm, 35 mm, and 105 mm roll microfilm, as well as microfiche depending on the film image recorder capability.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6196 (all parts), *Micrographics — Vocabulary*

ISO 12651-1, *Electronic document management — Vocabulary — Part 1: Electronic document imaging*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6196 and ISO 12651-1 apply.

4 Document imaging

In the late 1980s, companies such as Anacomp Inc., Agfa Gevaert, and later on, Micrographic Technology Corporation [now Global Information Distributors (GlD)] introduced all points addressable imaging devices that no longer use fixed form slides, and thus, ISO 8514-1:2000 was no longer applicable. With the cooperation of manufacturers and users, ISO developed new standards for controlling quality produced on these all points addressable image recorders. These standards describe a digital target, which when called out by the software will write an image intended to verify the performance of the imaging device. This target is independent of the particular COM manufacturer as it is written from digital data only. The primary application of these devices at that time was still outputting Enterprise Report Management (ERM) data.

These were developed by ISO as

— ISO 14648-1:2001, *Micrographics — Quality control of COM recorders that generate images using a single internal display system — Part 1: Characteristics of the software test target,* and

— ISO 14648-2:2001, *Micrographics — Quality control of COM recorders that generate images using a single internal display system — Part 2: Method of use.*

5 Archive storage media

With the advent of document scanners in the 1980s, document imaging allowed users to convert paper documents to digital images, dramatically increasing the access and communicability of information. However, many commercial, government, and academic institutions still prefer or require permanent records to be on microfilm for permanent preservation. The need to store digital information has precipitated the development of many digital media types and systems. Experts quickly realized that a significant portion of this information would be subject to digital obsolescence, if not preserved carefully. Thus, conversion of these images to digital film can provide this insurance.

In 1995, the introduction of the Kodak Digital Science Document Archive Writer Model 4800 provided a cost efficient manner of capturing these scanned images to digital film as analog images. The image recorder offered rapid conversion of scanned documents to LE 500 (minimum life expectancy 500 years) standard silver-gelatin microfilm. ISO 18901:2010 provides specifications and test requirements to verify that the storage media meets the requirements for LE 500. The first question to be asked was, of course, how does one measure quality control this device? Multiple commercial image recorders now dot the industry and quality control standards are needed for the entire process including digitization of the original documents and quality control of the process of recording them on film.

A simple answer would be to use a digitally created target such as that described in ISO 14648-1:2001 and ISO 14648-2:2001, as referenced above, but users associate these standards with COM rather than document imaging. Kodak chose to introduce its own test target to test all elements of the image recorder and included such a target in the software to do so. This is similar to digital targets offered by Microsoft and printing device manufacturers. The software test target for digital film image recorders should be considered in a similar concept as the printer test image found in office printers. An example of a typical office printer target is shown in Figure 2.

Windows Printer Test Page

Congratulations!

If you can read this information, you have correctly installed your HP LaserJet 1200 Series PCL 5 on RBRESLAWSKI-T42.

The information below describes your printer driver and port settings.

```
Submitted Time: 1:37:46 PM 5/13/2014
Computer name:  RBRESLAWSKI-T42
Printer name:   HP LaserJet 1200 Series PCL 5
Printer model:  HP LaserJet 1200 Series PCL 5
Color support:  No
Port name(s):   DOT4_001
Data format:    RAW
Share name:
Location:
Comment:
Driver name:    UNIDRV.DLL
Data file:      HPMCPM25.GPD
Config file:    UNIDRVUI.DLL
Help file:      UNIDRV.HLP
Driver version: 6.00
Environment:    Windows x64

Additional files used by this driver:
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZLSLHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZSSLHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZUILHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPCDMCLH.DLL    (1, 0, 2, 24)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZ5RLHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZSMLHN.GPD
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZSTLHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPMCPD25.CFG
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZ5CLHN.INI
 C:\Windows\system32\spool\DRIVERS\x64\3\HPMCPDP5.XML
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZSCLHN.DTD
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZEVLHN.DLL    (61.053.25.9)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZIDR12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZINW12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZIPM12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZIPR12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZIPT12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPZISN12.DLL    (11,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBMIAPI.DLL    (2,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBMINI.DLL     (61.053.25.4)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBOID.DLL      (2,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBOIDPS.DLL    (2,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBPRO.DLL      (2,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPBPROPS.DLL    (2,2,2,31)
 C:\Windows\system32\spool\DRIVERS\x64\3\HPEACLHN.HPI
 C:\Windows\system32\spool\DRIVERS\x64\3\UNIRES.DLL      (6.1.7600.16385
(win7_rtm.090713-1255))
 C:\Windows\system32\spool\DRIVERS\x64\3\STDNAMES.GPD
 C:\Windows\system32\spool\DRIVERS\x64\3\STDDTYPE.GDL
 C:\Windows\system32\spool\DRIVERS\x64\3\STDSCHEM.GDL
 C:\Windows\system32\spool\DRIVERS\x64\3\STDSCHMX.GDL
```

Figure 2 — Windows XP printer test page

6 Document scanner setting and quality control

6.1 Digital imaging system quality control

Each element of the system should be critiqued and controlled individually and ultimately as a whole, by choosing the right test processes. Unlike traditional optical filming systems where capture and recording were combined in digital systems, the capture and recording (writing) steps can be and are separated. Verification of quality and recording of results along each step of the way are critical components of a full imaging system. Problems occur when improper targets are chosen for any part of the system.

The key steps are

— image creation - document scanner quality (see ISO 12653-1:2000),

— image recording - printer (film image recorder) quality (see ISO 14648-1:2001), and

— film processing quality (see ISO 6199:2005).

6.2 Image creation — document scanner setting and quality control — use of ISO test chart

6.2.1 General

Critical factors in producing quality images from document scanners include the following:

a) calibration (as required);

b) brightness/contrast;

c) resolution settings (DPI);

d) thresholding (when converting to black and white);

e) mechanical and operational issues.

6.2.2 Calibration

Calibration sets the parameters so that the image sensors know what is truly white and what is truly black. For colour or greyscale scanners, this is still important so that proper tone scale or image hue will be captured. The need for calibration varies from scanner to scanner between manufacturers and from model to model from any given manufacturer. For some, calibration is factory set and no user intervention is required. For others, daily calibration may be needed; and in some cases, the user interface will report a need for calibration to the operator.

6.2.3 Brightness/contrast

Brightness and contrast settings determine how bold or weak character or picture character will be. This setting may be somewhat dependent on the intended use of the digital image. If an image is to be used to create a permanent record on microfilm or for optical character recognition (OCR), one may want to set the brightness so that the characters are a little bolder compared to when the image will be used just for viewing on a monitor. This is because some loss may occur during the film writing; and since OCR converts to Bitonal during recognition, slightly bolder characters can yield better results.

6.2.4 Resolution settings (DPI)

Dots per inch (DPI) is a key factor in scanning documents. DPI basically determines the number of discrete sampling points a scanner uses to capture an image. The more the better for image quality, but file size becomes larger.

For preservation, OCR or film writing purposes the optimum resolution is 300 dpi. For documents with fine print or forms featuring descriptors in 4pt type size, the minimum resolution is 300 dpi. However, higher resolution such as 400 dpi or even 600 dpi may be necessary for this size font to be captured clearly. When considering higher resolutions, a balance needs to be struck between acceptable image clarity and file size.

6.2.5 Thresholding (if required for conversion to film)

Scanner sensor arrays are typically considered to be "8-bit" greyscale producing 256 levels of grey when capturing an image. For storage purposes, these are frequently converted to bitonal or binary images to reduce storage space, improve contrast, and prepare the images for many film image recorders. The midpoint of threshold is 128, but typically, a setting of about 160 to 180 will produce optimum results. Just as in the case of brightness control, there may be application specific needs that affect the optimum set point of thresholding. Slightly bolder characters typically have less loss in reproduction later on, especially if converting from digital to analog (film writing) and analog back to digital (film scanning). There also may be built-in image sharpening, despeckle, and possibly more tools in proprietary document capture software programs.

6.2.6 Mechanical and operational issues

Mechanical issues include monitoring the performance of the document scanner using standardized or reference test targets on a daily basis and keeping performance records. Image quality can be affected by a number of factors including normal wear of transport mechanisms, added features such as imprinters and ordinary dirt and dust build-up. Cleaning frequency may depend on the type and number of documents being scanned. Keep in mind that "dirt is the enemy". Black spots in images will appear as minus density spots or "dirt" when written to negative appearing film.

6.2.7 Typical document scanner quality control targets

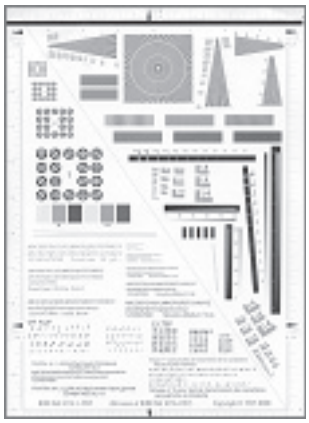

Figure 3 — Reproduction of ISO 12653-1 test image

This target may be used for both quantitative and qualitative control of the document scanners. This target is to be used for controlling the document scanner and not intended to then be written to film as a quantitative control factor for the film image recorders. Figure 3 image is also described in ISO 12653-1:2000.

7 Guidelines for image recording quality control

The use of standardized digitally created test targets is recommended for monitoring quality control of digital writing devices, such as either that provided by the image recorder manufacturer or the standardized target listed below.

ISO 14648-1:2001 or a document manufacturers digital test target.

Set the image recorder up at the correct density/contrast levels using a reference white target file. (It might be necessary to consult the manufacturer's guidelines.)

a) Commonly, this is in the range of 0,9 to 1,1; however, depending on the technology of the image recorder, higher background density up to 1,3 is acceptable. (True COM devices typically used higher background density guidelines as in ISO 14648).

b) Record a digital target to test the image recorder only. Do NOT use a scanned in resolution target for quality control of the image recorder.

c) Use scanned in test targets as additional comparative targets relevant to your application.

d) Targets should be recorded at the start of each roll and results recorded to measure consistency.

e) Record

   — density, and

   — resolution – smallest pattern resolved on user determined test elements.

8 Film process quality control

Film processing quality control is an essential element of producing high quality images regardless of the type of imaging system. For guidance, see ISO 6199:2005.

— critical elements of film processing quality control;

— temperature monitoring and charting;

— development time monitoring;

— density control – using either pre-exposed or user exposed step tests;

— recording step test reference density and charting for visualization. Starting point would be ±0,05 density units for processing control.

Annex A
(informative)

Targets

A.1 Optical versus digital targets

Many people think they can scan a standard optical resolution target, such as ISO test chart 3334 (see Figure 1) and then write it out onto the microfilm and "read" the resolution pattern as done traditionally with a microfilm camera. This is not possible due to misalignment of the scanner sensor arrays with the fixed spatial frequency of the test pattern. The misalignment of sensor and test pattern frequency is called digital aliasing.

For a discussion and examples of this issue, see AIIM/TR 26, Resolution as It Relates to Photographic and Electronic Imaging.

A.2 Quality control procedures

As in ISO 6199, it is recommended that the image recorder quality control target be included with each roll of film along with standard targeting, such as identification, density, operator declarations. A reference image of a document scanner target and a production scanner target should also be included. Consistent inclusion of each of these targets on every roll serves to provide a trail of evidence if film quality becomes an issue during inspection or at any later time.

A typical film header including required test targets might look as follows, see Figure A.1:

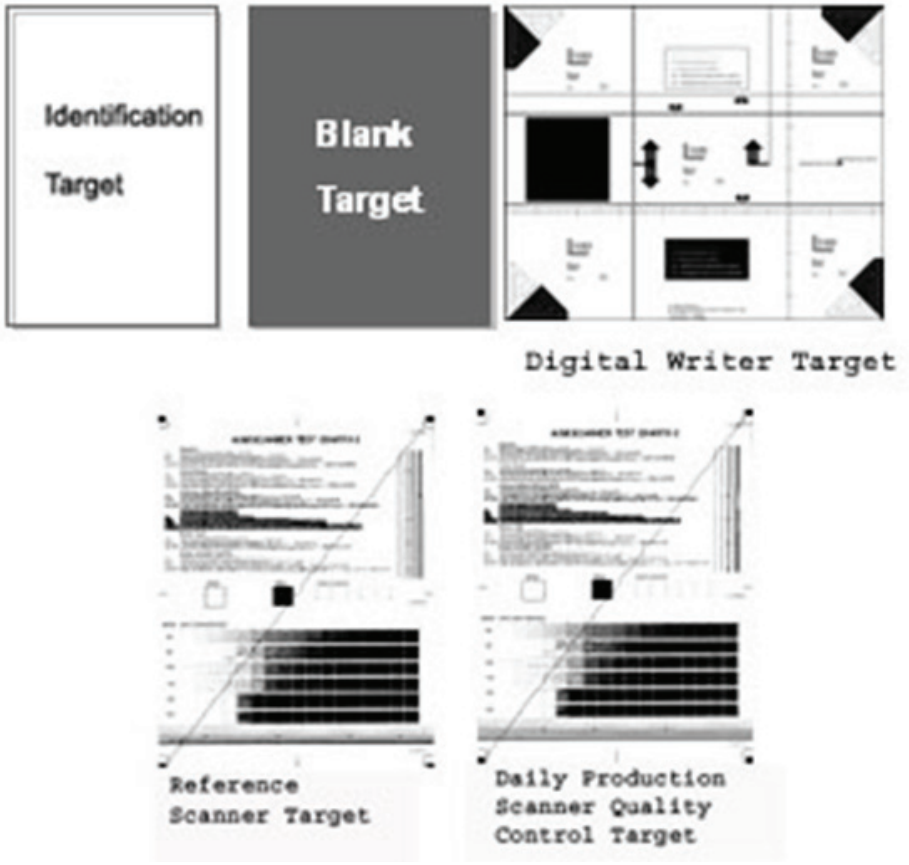

Figure A.1 — Typical film header

Bibliography

[1] ISO 6199:2005, *Micrographics — Microfilming of documents on 16 mm and 35 mm silver-gelatin type microfilm — Operating procedures*

[2] ISO 8514-1:2000, *Micrographics — Alphanumeric computer output microforms — Quality control — Part 1: Characteristics of the test slide and test data*

[3] ISO 12653-1:2000. *Electronic imaging – Test target for the black-and-white scanning of office documents – Part 1: Characteristics*

[4] ISO 14648-1:2001, *Micrographics — Quality control of COM recorders that generate images using a single internal display system — Part 1: Characteristics of the software test target*

[5] ISO 14648-2:2001, *Micrographics — Quality control of COM recorders that generate images using a single internal display system — Part 2: Method of use*

[6] ISO 18901:2010, *Imaging materials — Processed silver-gelatin-type black-and-white films — Specifications for stability*

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