

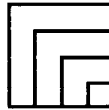
Standard Recommended Practice — Monitoring Image
Quality of Aperture Card Film Image Scanners

Standard

Approved As



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AIIM

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Standard for Information and Image Management —

Standard Recommended Practice — Monitoring Image Quality of Aperture Card Film Image Scanners

Association for Information and Image Management

Abstract

This standard recommended practice specifies procedures for quality control of images produced when aperture cards are scanned.

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Foreword (This foreword is not part of American National Standard for Information and Image Management, ANSI/AIIM MS50-1994 — Standard Recommended Practice for Monitoring Image Quality of Aperture Card Film Image Scanners.)

This standard recommended practice addresses procedures for establishing the quality control of electronic

images that are produced when aperture cards are scanned. It contains three informative annexes (A, B, and C), which are not to be considered part of this standard. Annex A (Scanner test results log) is a log sheet to be used to document various aspects of the quality control program. Annex B (Target manufacturer's details) contains eleven drawings (B-1 through B-11) of the aperture card, frame size, and image alignment (A-size, both landscape and portrait), and other aspects of the aperture card test images. This annex provides additional information about Test Targets Numbers 1, 2, 3, 4, and 5. Annex C (Threshold target) contains a description of a target that can be used to check scanner thresholding. The targets provided in these annexes are for informational purposes only. These targets are available through commercial sources.¹

This standard recommended practice is only directed toward successful calibration of the scanner. The ultimate user's image requirements are dependent upon the scanner and other system components, such as printers and monitors. The system's operator must establish and maintain similar procedures for each of the system components that affect the output image. Every scanner, including replacement scanners, must be calibrated. Some scanners have automatic image enhancement features; therefore it may be necessary to establish quality references to represent image enhanced output.

Test Target Numbers 1, 2, 3, 4, and 5, which are referred to in this standard, are aperture cards. The thresholding target, also an aperture card, is described in Annex C, an informative annex, which is not a part of this standard. Members of the AIIM C13 Electronic Imaging Standards Committee and the AIIM C13.1 Electronic Imaging/Aperture Card Scanning Committee acknowledge the efforts of Applied Image, Inc. of Rochester, New York, for the technical development of the targets. Following are descriptions of the targets.

Test Target No. 1: Frame size and image alignment target

Seven aperture cards

- A size and B size: 16X reduction ratio (four aperture cards, both landscape and portrait)
- C size: 16X reduction ratio (one aperture card, landscape)

1.Obtaining the test targets: Contact the Association for Information and Image Management (AIIM), Publications Sales, 1100 Wayne Avenue, Suite 1100, Silver Spring, Maryland 20910; (301) 587-8202; fax (301) 587-2711.

- D size: 24X reduction ratio (one aperture card, landscape)
- E size: 30X reduction ratio (one aperture card, landscape)

Test Target No. 2: Pestrecov star pattern and wedges
One aperture card
— Pestrecov star pattern and wedges

Test Target No. 3: Line widths
Five aperture cards
— A, B, C, D, and E size

Test Target No. 4: Focus check
One aperture card

Test Target No. 5: Typical engineering drawing
One aperture card

Threshold Target
One aperture card

Suggestions for improvement to this standard are welcome. They should be sent to the Chair, AIIM Standards Board, Association for Information and Image Management, 1100 Wayne Avenue, Silver Spring, MD 20910-5603.

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American National Standard for Information and Image Management —

Standard Recommended Practice — Monitoring Image Quality of Aperture Card Film Image Scanners: ANSI/AIIM MS50-1994

1 Scope and purpose

1.1 Scope

This standard recommended practice provides procedures for the ongoing control of image quality within a digital aperture card image management system. The objective is to provide a means of monitoring output image quality. Regular use of these recommended procedures should ensure continued maintenance of an established level of image quality.

The procedures covered in this standard recommended practice are designed for an operator and have two purposes:

1. To provide the operator with information needed to set up criteria for monitoring image quality.
2. To give the operator knowledge of what the scanner can do and, more importantly, what it will not do.

The targets, numbered 1, 2, 3, 4 and 5, are sufficiently detailed so that all scanners will fail at some point. The point of failure tells the user what kinds of things the scanner will not scan properly (for example, type size, etc.).

Once the absolute capabilities of a scanner are determined, the user needs to know the performance of the scanner today as compared to the last time the scanner was calibrated. This standard recommended practice points out the need for the regular assessment of a given scanner compared to its own best performance.

1.2 Purpose

The purpose of this standard is to provide a way of specifying and establishing procedures for quality control of images that are produced when aperture cards are scanned. Images of test targets and charts that can be used with the procedures are included.

2 Normative references

All standards are subject to revision. When the following documents are superseded by an approved revision, that revision may apply.

2.1 Referenced international standards

ISO 3272.1-1983 (R1989), Microfilming of technical drawings and other drawing office documents — Part 1: Operating procedures.

ISO 3272.2-1978, Microfilming of technical drawings and other drawing office documents — Part 2: Quality criteria and control.

ISO 3272.3-1975, Microcopying of technical drawings and other drawing office documents — Part 3: Unitized 35mm microfilm carriers.

ISO 3334-1991, ANSI/AIIM MS51-1991, Micrographics — ISO resolution test chart no. 2 — Description and use.

2.2 Related international standards

ISO 3078.1-1974, Technical drawings — Lettering — Part 1, Currently used characters.

ISO 7083-1983, Technical drawing — Symbols for geometrical tolerancing — Proportions and dimensions.

ISO 3272.4-1994, Microfilming of technical drawings and other drawings office documents — Part 4: Microfilming of drawings of special and exceptional elongated size.

2.3 Related American national standards

ANSI/AIIM MS39-1987, Recommended practice for operational procedures, quality control and inspection of graphic computer-output microforms.

ANSI/AIIM MS44-1988 (R1993), Recommended practice for quality control of image scanners.

ANSI/AIIM MS51-1991, ISO 3334-1991, Micrographics — ISO resolution test chart no. 2 — Description and use.

ASME Y14.2M-1992, Engineering drawings and related documentation practices — Line conventions and lettering.

2.4 Related publications

ANSI/AIIM TR2-1992, Technical Report for Information and Image Management — Glossary of Imaging Technology.

3 Definitions

The following definitions apply to terms that appear in this standard. Other terms are defined in ANSI/AIIM TR2, Technical Report for Information and Image Management — Glossary of Imaging Technology.

3.1 Aliasing: (1) Phenomenon in which a sampled signal is degraded by false lower frequency components, normally caused by sampling data at an insufficient rate; (2) Distortion of an image on a raster scan display caused when the detail of an image exceeds the resolution of the cathode ray tube (CRT); (3) Image defects generally caused by elements of a scanned image being smaller or not registered with the picture element.

3.2 Halftone: Technique of reproducing continuous-tone illustrations by photographing the image through an etched screen. **NOTE:** The finer the screen (measured in lines per inch or millimeter), the higher the quality of the resulting negative.

3.3 Image scanner: For the purpose of this document, a scanner or image scanner is a device that electronically captures data from an aperture card in a raster pattern and creates a digital file of the monochrome image of the document. Also see scanner, 3.9.

3.4 Moire: An image defect caused by interference of one pattern with another, which shows as a beat frequency between the two patterns.

3.5 Point: Also printer's point. Measure of type size in graphic arts type. Nominally 1/72 inches, precisely 0.013837 inches (0.3514598 mm).

3.6 Post-test: A verification test performed after the original documents are scanned.

3.7 Pre-test: A calibration or verification test performed before the original documents are scanned.

3.8 Rectangularity: A measure of the equality of the lengths of opposite sides of a rectangle and the correctness of the angles. With perfect rectangularity, the opposite sides will be of exactly equal length and the angles will be exactly 90 degrees.

3.9 Scanner: A device that converts a document into binary (digital) code by detecting and measuring the intensity of light reflected from paper or transmitted through microfilm.

3.10 Serif: In a typeface, the short decorative cross lines at the ends of the strokes in some characters. A typeface with no serifs on any characters is referred to as a sans-serif typeface.

3.11 Stair-stepping: See aliasing, 3.1.

3.12 Target: Any document or chart containing identification information, coding, or test charts.

3.13 Test chart: An image, comprised of different (or a number of the same) test targets, designed for test and evaluation of imaging systems.

3.14 Test element: An image designed for test and evaluation of imaging systems, e.g., a specific line of

type that is set in a particular point size, a specific collection of horizontal and vertical lines and spaces, a line that represents a specific frequency, i.e., 50 cycle/mm and 152.4 mm (6.0 inch) length.

3.15 Test pattern: An image that is comprised of a collection of test elements, (e.g., resolution test elements, frequency test elements) and that is designed for test and evaluation of imaging systems.

3.16 Test target: An image, comprised of test patterns and/or test elements, designed for test and evaluation of imaging systems.

4 Principles of image quality control

4.1 General

Image quality control is the term given to the procedures and techniques that are used to maintain consistency of output. Properly used, these procedures answer the question, "Is what I am producing today as good as the best I can produce?" The answer to this question is used to determine if production can continue or if a maintenance technician must be called.

A second question may also be answered — "Is what I am producing today as good as what I produced yesterday?" The answer can be used to show the variations of a piece of equipment while it is still within allowable performance limits.

4.2 Defining the need for image quality control

In the typical digital image management system, aperture cards are scanned and indexing information is entered. In some systems, the scanned image of the aperture card may never be examined until it is needed. Strict image quality control is required to assure that the images stored are of acceptable quality and are able to be located by way of the index.

If a scanner is not operating properly, a large number of useless images may be stored on the system. When the problem is discovered and corrected, the original documents will have to be scanned again. Procedures should be established so that any problems are discovered while the original documents are still available.

The image quality monitoring procedures described in this document allow the user to make sure that the system is performing today as well as it was when originally adjusted by the manufacturer and as approved by the user. Used on a regular basis, these procedures can assure users that the scanner will produce digital images of sufficient quality for their intended use.

4.3 Establishing a quality reference

It is extremely important to establish the definition of "good output" from a digital image management system. It is the nature of these systems that some images

(black-and-white text) will be more faithfully recorded than others (halftones, color, etc.). Comparing a current target image against a known reference allows a non-technical user to easily make judgments about system quality.

To establish a *quality reference*, the entire system must be working. The scanner should be adjusted to provide the best possible results for the type of material to be scanned. All of the targets, the five described in this practice (Figures 1 through 5) and all targets made by the user, should be scanned. The targets should be output to hard copy and carefully examined. If the quality of the targets is sufficient for normal use, the hard copies should be carefully preserved and the digital images may be stored on electronic media. All scanner adjustment settings should be noted on the hard copy. The result of this process becomes the *quality reference*.

If the normal use of the scanner is to scan all aperture cards in the order in which they come, without regard for content, then the scanner setup used for the *quality reference* should reflect the best compromise of settings for the different types of originals that will be encountered.

Some users change the scanner settings for each aperture card according to the content of the aperture card. Other users sort aperture cards according to scanner parameters, and change the scanner settings before each batch of aperture cards of the same type or have separate scanners for different types of aperture cards. In any of these cases, it is desirable to create a separate *quality reference set* for each type of aperture card that will be treated separately.

The user should be aware that any maintenance done to a scanner may affect the actual results of the user controllable settings. For this reason, any time the scanner is recalibrated by a technician, a test run of all targets should be made. Once a match for the original quality of the targets has been achieved, the new proper settings should be recorded. If the original quality of targets cannot be achieved, then either the scanner still has a problem, or the calibration was not performed properly. In either case, additional corrective maintenance is probably necessary. (A good general rule is to run the test targets before signing off on maintenance. It is easier to ask the technician to re-adjust the scanner immediately than it is to call the technician back when the next test is done before a scan batch.)

4.4 Pre- and post-testing

While it is desirable to make sure that every film image is scanned correctly, it is clearly not practical to do a test run before each aperture card to be scanned. When batches of similar aperture cards are to be scanned,

a good compromise is to do a test run before the batch, check that the scanner is properly set up and working, scan the batch, then do a test run after the batch to make sure the results are still acceptable. If the final pre-scan test run and the post-scan test run are the same, the scanner can be assumed to have been working properly during the whole scanning session (as long as the scanner adjustments were not touched during the scanning session). If the post-scan test image is not acceptable, the aperture card images in the scan batch should be examined to determine which, if any, must be scanned again.

Where the scanner is adjusted separately for each aperture card, the pre- and post-testing approach outlined will not work. One approach for this situation is to determine, by way of pre-testing, a small number of allowable settings that the scanner operator may use during the entire scanning session (one setting per aperture card type). This pre-testing will be done primarily with a user-created target. Following the scanning session, the operator should post-test with the same target, using the settings established in the pre-test run. Comparing the respective pre- and post-test runs will determine if the scanner has maintained its calibration, but cannot ensure that the proper settings were used for each document within the scanning session.

4.5 Record keeping

A record (log) of all test runs should be maintained. A test run will consist of all targets that are relevant to the type of original for which the scanner is being adjusted.

This record (log) provides management with the assurance that quality control procedures are being followed, but more importantly, allows a technician to spot a growing problem before it becomes too serious. (An example of this would be if the log showed that the threshold setting for a proper image was consistently changing in one direction, then a light source may be going bad.)

Figure 1, Test run log, is one example of the type of log that should be completed for each test run. If multiple test runs are required to produce a satisfactory image, each test run should be recorded to assist the technician. (Annex A, Scanner test results log, an informative annex, contains a blank log sheet, suitable for photocopying.) The number and type of settings will vary from scanner to scanner.

Date	Initials	Setting	Results
2/5	RTG	7 50 90	OK
2/6	JEN	12 50 95	Too Dark — NG
2/6	JEN	8 49 22	OK

Figure 1 — Test run log

5 Frequency of testing

How often test runs should be made depends on how much scanning will take place and the consequences of improperly scanning aperture cards.

The best security is provided by doing a test run before and after each batch of aperture cards scanned, where a batch is a number of aperture cards scanned with the same settings. This may be ten aperture cards or ten thousand aperture cards. However, the batch should be terminated at the end of a shift, and new test runs made, even if all aperture cards have not been scanned. If the pre- and post-test runs are acceptable, the scanned aperture cards will generally be acceptable.

If a scanner is known to be stable, the test runs after each batch can be eliminated. In this case, it may be desirable to print out and examine the last aperture card scanned to make sure it is acceptable. Testing only at the beginning and end of each scanning shift or work day may be acceptable in some operations, but this should be the minimum testing frequency.

Frequent testing is strongly recommended because it minimizes the risk of lost time or lost aperture cards. If frequent testing is not carried out, there is a risk of a misadjusted scanner creating images that are unusable and committing non-erasable storage to these images. By the time a scanner problem is detected, thousands of aperture cards may have been scanned and will have to be scanned again. A worse risk is incurred if original aperture cards are routinely destroyed after scanning.

6 Procedures for test run

Typically, a test run will include all six of the standard targets and whichever user-created targets are relevant to the type of original to be scanned. The procedures in Sections 6.1 to 6.7, should be followed.

6.1 Setup of scanner parameters

The scanner parameters should be set up to exactly match the original scan parameters established for the most recent *quality reference* for the type of aperture cards to be scanned.

In a situation where a scanner is known (via the log) to be drifting in calibration, it may be desirable to initially adjust the scanner to the settings that worked at the end of the most recent scan of the same type. This should be a temporary situation until the scanner can be fixed. Consistently operating in this mode indicates that either there is a problem with the scanner's stability or that the *quality reference set* does not reflect the proper settings.

IMPORTANT: For a test run that is a post-test of a batch of a consistent type (a test run made after the originals are scanned), **DO NOT** re-adjust the parameters because the point of a post-test is to make sure that everything worked correctly as set up.

6.2 Placement of target cards on the scanner

Target cards should be placed in the input hopper of the scanner.

6.3 Scanning

The test targets should be scanned using the same procedures used for normal aperture cards. Do not change any scanner settings between targets.

Typically, electronic images resulting from test scans are placed in temporary storage while the image is being printed and evaluated and while any technical problems disclosed by the test scans are rectified. After use, the electronic test images may be erased or stored to permanent memory for retention.

6.4 Examination of targets on screen

If the system provides the capability to view images on a screen (with acceptable resolution) the test targets may be examined on a screen. For some users this may be sufficient, and hard copy need not be produced. It is recommended that screen examination be used where possible until a satisfactory test run is achieved, with the final (successful) run being output to hard copy.

The user should be aware that both screen examination and paper examination may introduce distortion. If the printer used for output of test images is not aligned, or introduces image problems (wavy lines, dark spots, light spots, etc.), these may be erroneously attributed to the scanner. A cathode ray tube (CRT) may introduce distortion due to changing the aspect ratio of the image (a circle in the image appears to be oval), aliasing (thin lines disappear or appear jagged), or simply by having a resolution too low to show the detail of the image.

The main disadvantage of screen examination is that a user has no easy way to compare the current scan against the reference scan. While an experienced user should become accustomed to examination of the screen, the novice may have problems deciding if a given image is good enough to accept. Flipping back and forth between the test image and the *quality reference* image on the screen is much more difficult than placing two sheets of paper side-by-side for examination. If a system can display two pages at once, the user must decide if the screen images provide sufficient detail for evaluation.

A second major disadvantage of screen examination is that some displays do not permit display of a full page image at the full scanning resolution. Typical systems will either display a full page at reduced (sampled down) resolution, or will display a window into the page at full resolution. Neither of these alternatives is as good as looking at a printed page.

The user should refer to the manufacturer's installation and operating instructions for the display to assure that it is set up properly.

6.5 Printing of targets

It is recommended that the test scans be output to paper. This provides an end-to-end system check, allows a user to quickly ascertain that the output is acceptable, and provides a record that a maintenance technician can use when a problem is detected.

6.6 Determination of problem areas

If the printed output of a test run is not acceptable, the printer should be checked. This is done by calling up the digital image of the *quality reference* (known to be a good image) and printing it. If the output of the known good target(s) is not acceptable (is not as good as the hard copy kept on file), then the printer is probably at fault. If the output of the *quality reference* data is acceptable, then the scanner should be checked.

These targets were not designed to test storage media, such as optical disks, tapes, etc., or data compression/decompression functions of hardware or software. These storage media may be tested with standard tools, normally provided by the system vendor. Because these storage media are low-failure, and because failures in these systems usually produce images that are broken up rather than degraded, they should not be suspected of causing a system problem

until the printer and scanner adjustments have been eliminated as possible sources of the problem(s).

6.7 Record keeping

Each test run should be recorded on a log sheet. When a test run seems to point to an equipment problem, all settings used for the scan should be noted on the back of the printed output, and the document should be saved for the technician.

7 Target 1: Alignment target

The test frame in figure 2, Test target number 1, Frame size and image alignment target, consists of a rectangular grid. Diagonal lines connect the four corners of the frame and connect the midpoints of adjacent sides of the frame. To facilitate testing of scanned image size for various drawing sizes, the following set of seven cards is provided.

<u>Drawing Size</u>	<u>Reduction Ratio</u>
A Size Landscape	16X
A Size Portrait	16X
B Size Landscape	16X
B Size Portrait	16X
C Size Landscape	16X
D Size Landscape	24X
E Size Landscape	30X

The purpose of Test target Number 1, Frame size and image alignment target, is to allow a user to verify that an aperture card scanner is scanning the exact image on the aperture card. Various terms such as centering, size, orthogonality, and line straightness are used to label different components of this accurate image placement.