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Document Name: AIMM MS1: Recommended Practice for Alphanumeric Computer-Output Microforms--Operational Practices for Inspection and Quality Control

CFR Section(s): 36 CFR 1238.14(c)

Standards Body: Association for Information and Image Management

Official Incorporator:
THE EXECUTIVE DIRECTOR
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

ANSI/AIIM MS1-1996

Standard Recommended Practice for Alphanumeric Computer–Output Microforms–Operational Practices for Inspection and Quality Control

Approved As

American National Standards Institute (ANSI) Standard

August 8, 1996

ANSI/AIIM MS1-1996

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ISBN 0-89258-129-8
Printed in the United States of America

Standard for Information and Image Management —

Standard Recommended Practice for Alphanumeric Computer–Output Microforms — Operational Practices for Inspection and Quality Control

Association for Information and Image Management International

Abstract:

This standard provides guidelines and recommended practices for the quality control of Computer Output Microfilm (COM) produced on recorders using fixed "Hard" form slides. Quality control procedures, recommended criteria, and corrective guidance are provided.

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Foreword (This foreword is not part of American National *Standard for Information and Image Management — Recommended practice for alphanumeric computer-output microforms — Operational practices for inspection and quality control, ANSI/AIIM MS1-1996*).

This standard is a revision of ANSI/AIIM MS1-1988. The revision is necessary because new standards have been issued and referenced standards have been changed since the previous edition of MS1. In addition, other changes have been made to improve the presentation of information. No major technical changes have been made. The clauses on image life have been revised to reflect changes to the expected life of different media, including a new life expectancy for thermally processed silver film. The method for quality control remains the same. Use of the method described in this document has proven to be effective in establishing and controlling quality limits. Further, the method has been relatively easy to institute and use.

This standard is a companion to ANSI/AIIM MS39. Whereas ANSI/AIIM MS39 covers standards for graphic computer-output microfilm (COM) quality, this standard covers alphanumeric COM quality.

In order to maintain a historic perspective, much of the information published in the foreword of the original standard, ANSI/AIIM MS1-1981, is reprinted here.

As the use of computer-output microfilm continued to grow in the 1970s and as the applications became more sophisticated, it became obvious the community needed to establish useful methods for prescribing film and image quality for achieving consistent, acceptable results. Also it was recognized that the requirements for COM recorders functioning principally as computer line printer equivalents (alphanumeric) were significantly different in several aspects from the requirements for graphic COM recorders (such as those used in generating engineering drawings and graphic arts output). Although both types of recorders have certain characteristics in common, graphic recorders must accurately produce geometric shapes, graphs, and three-dimensional views along with dimensions and multiple size characters. The principal concerns with alphanumeric recorders, however, are legibility and the duplication characteristics of printed text.

After evaluating user requirements, the COM Quality Standards Committee concluded that a quality standard for alphanumeric COM was not feasible and that a recommended practice would fully satisfy user needs. This recommended practice addresses equipment, supplies, and operational procedures related to alphanumeric COM used for business and government records. Included are recommendations related to

- legibility,
- first-generation camera films and subsequent-generation duplicating films,
- film processing,
- form slide quality (including original artwork),
- image density,
- film stability,
- film storage.

A test method for use in establishing and maintaining consistent image quality is included. Specifications for the form slide used to test for image quality are given in *ANSI/AIIM MS28, Alphanumeric COM quality test slide.*

This recommended practice is not intended to be an all-inclusive quality control document. Its purpose is to supply information useful in maintaining the quality of alphanumeric COM. For general and more inclusive quality control information covering first-generation and duplicate microforms, the user should refer to *ANSI/AIIM MS23, Practice for operational procedures/inspection and quality control of first generation, silver-gelatin microfilm of documents* and *ANSI/AIIM MS43, Recommended practice for operational procedures/inspection and* *quality control of duplicate microforms of documents and from COM.*

This recommended practice is confined to effective reduction ratios up to and including 1:48. Because reduction ratios higher than 1:48 have not yet been standardized, this recommended practice does not address quality considerations for such image sizes.

Of singular importance in alphanumeric COM filming is the legibility of the information supplied to users. Obviously, if the information is not legible, it has no value. So, the most important guidelines to establish are for legibility, with less emphasis on other characteristics. Because consideration of all possible COM systems and system configurations is virtually impossible, this recommended practice attempts to create general guidelines that can significantly increase the probability of consistently acceptable results.

When microfilming hardcopy documents, planetary and rotary camera test targets are used to monitor resolution and density. In COM recorders that use a form slide containing fixed data, resolution targets are used in the form slide to establish optimum focus, but they do not provide a measure of character resolution or legibility obtained from the image generator. Although character quality from the image generator cannot be measured using resolution targets, the characters can be compared to an image of a reference form slide in the same frame to establish a relative quality level. After evaluating several methods for establishing quality limits for COM images, it was concluded that the use of the sans serif characters E and H provided the easiest means for establishing and maintaining quality. The characters E and H were chosen because they contain both horizontal and vertical lines common to most fonts used in COM regardless of the method of character generation. Although there may be differences in aspect ratio (character height to width ratio) and the location of the central horizontal lines in various COM recorders, the similarities are adequate for benchmark comparisons. The letters E and H represent simple shapes that are very easy to compare; however, the more complex and similar symbols such as % and @, B and 8, S and 5, Z and 7, and M and W need to be examined and proper records kept to assure adequate legibility.

Proper COM performance requires controlling both character and background optical density to ensure satisfactory duplication of the camera film. This recommended practice gives values covering line and background densities for both first generation camera film and subsequent generation duplicate film.

The COM quality test form slide used in this recommended practice contains density squares large enough to allow measurement of the film density using an ordinary densitometer equipped with a 1 mm aperture. Although measurement of the large area density does not determine character line density, it is very useful in maintaining consistent exposure from the form slide. The form slide exposure can then be compared to the exposure from the image generator to maintain proper exposure of the alphanumeric characters.

This recommended practice also includes guidelines for the preparation of the various form slides used to record fixed data. These guidelines should be followed if satisfactory results are expected. The most common cause of unsatisfactory COM output, and the most frequent image-quality complaint of users, is the use of improperly designed form slides.

Any suggestions for improving this recommended practice are welcome and should be sent to the Chair, AIIM Standards Board, Association for Information and Image Management International, 1100 Wayne Avenue, Suite 1100, Silver Spring, Maryland 20910-5603.

At the time this revised recommended practice was approved, the AIIM Standards Board had the following members:

Committee C23, Micrographics Technology, had the following members at the time it approved this revised recommended practice:

Name of Representative	Organization Represented
Bob Brasier	Anacomp
Robert Breslawski	Eastman Kodak Company
Scott E. Case	Boeing Computer Services
Larry Cruse	University of California
Harold H. Dorfman	Dorfman Associates
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American National Standard for Information and Image Management

Recommended Practice for Alphanumeric Computer-Output Microforms Operational Practices for Inspection and Quality Control, ANSI/AIIM MS1-1996

1 Scope

This recommended practice describes operational and quality control guidelines for alphanumeric computer-output microfilm (COM) recorders and microforms using black-and-white film as well as duplicates made from such films. The scope of this recommended practice is limited to images of line printer equivalent output only, such as those used for business and government records. The scope is further limited to COM recorders using a form slide for recording fixed data. As such, it does not cover COM recorders using so-called software forms.

This recommended practice covers microforms containing data generated by dynamic energy sources, such as cathode ray tubes, lasers, and light emitting diodes; and fixed data, such as that contained on a form slide, with effective reduction ratios up to and including 1:48. The subjects covered include a method for comparing the legibility of the dynamic information to that contained in an image of the alphanumeric COM quality test form slide when exposed on the same frame and duplicated onto silver, diazo, or vesicular films. The films, film processing, film storage, film density practices and guidelines for preparing form slide artwork and form slides are also discussed.

This standard does not cover COM recorders generating images from bitmaps or data streams incorporating images, variable fonts, graphics, or imbedded objects.

2 Normative references

2.1 Referenced American national standards

ANSI IT9.1:1992, Imaging media (film) — Silver-gelatin type — Specifications for stability.

ANSI IT9.2:1991, Imaging media — Processed photographic films, plates, and papers — Filing enclosures and containers for storage.

ANSI IT9.5:1992, Imaging media (film) — Ammonia-processed diazo films — Specifications for stability.

ANSI IT9.6:1993, Imaging media — Photographic films — Specification for safety film.

ANSI/NAPM IT9.11:1993, Imaging media — Processed safety photographic film — Storage.

ANSI/NAPM IT9.12:1995, Imaging material — Processed photographic vesicular film — Specifications for stability.

ANSI/ISO 417:1993 (ANSI/NAPM IT9.17:1993), Photography — Determination of residual thiosulfate and other related chemicals in processed photographic materials — Methods of using iodine-amylose, methylene blue and silver sulfide.

ANSI/ISO 5-2:1991, Photography — Density measurements — Part 2: Geometric conditions for transmission density.

ANSI/ISO 5-3:1984, Photography — Density measurements — Part 3: Spectral conditions.

ANSI/ISO 3334:1989 (ANSI/AIIM MS51:1991), Micrographics — ISO resolution test chart No. 2 — Description and use in photographic documentary reproduction.

ANSI/AIIM MS23:1991, Information and image management — Microfilm of documents — Operational procedures/inspection and quality control of first generation, silver-gelatin microfilm of documents.

ANSI/AIIM MS28:1996, Information and image management — Micrographics — Alphanumeric COM quality test slide.

ANSI/AIIM MS43:1988 (A1991), Information and image management — Recommended practice for operational procedures/inspection and quality control of duplicate microforms of documents and from COM.

2.2 Related publications

ANSI/AIIM TR2:1992, Technical Report for the Association for Information and Image Management — Glossary of imaging technology.

AIIM TR3:1981, Technical Report for the Association for Information and Image Management — Thermally processed silver microfilm.

3 Definition

The following definition applies to terms used in this standard. Other terms pertaining to this document shall be defined as stated in *ANSI/AIIM TR2, Technical Report for the Association for Information and Image Management — Glossary of imaging technology.*

3.1 Silver-gelatin film Wet-processed, silver-halide film with silver as the image-forming material and with a gelatin binder (matrix).

4 Microfilm types

4.1 General

The most commonly used first-generation microfilms are silver-gelatin film and thermally processed silver film. Duplicating films are diazo, vesicular, and silver-gelatin. See figure 1 for COM-generation terminology.

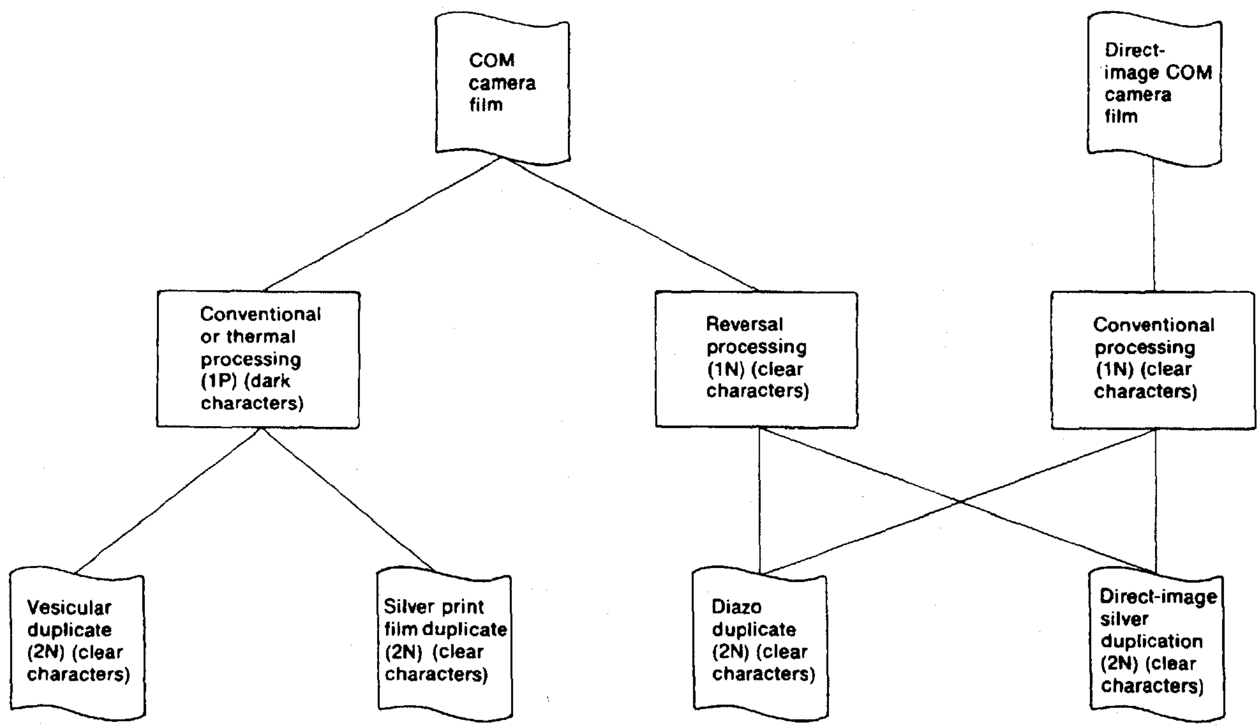

Figure 1 — COM-generation terminology

Microfilm generally consists of a photosensitive emulsion coated onto a flexible base material, which may be either acetate or polyester. The base may range in thickness from 0.06 mm to 0.18 mm (0.0024 in to 0.0071 in). The thinner base (0.06 mm) is used primarily in roll film systems, including cassettes and cartridges, but the COM recorder may require that a thick base film be used for the original and thin base for duplicates. Thicker base is more commonly used for sheet film or microfiche in recorders using on-line processing of silver-gelatin microfiche.

4.2 Silver-gelatin film

Silver-gelatin film, which is similar in may respects to black-and-white film used in conventional photography, is characterized by high light sensitivity and the use of wet processing. Depending on the processing method, silver-gelatin film may yield either a positive-appearing (1P) or negative-appearing (1N) image. Autopositive (direct-image) COM film produces a negative-appearing image with conventional processing.

Silver-gelatin films have sufficient resolution to yield high quality images with the appropriate density and contrast at effective reductions up to and including 1:48 when properly exposed and processed. They are suitable for producing high-quality duplicates. Silver-gelatin print and duplicating films may also be used to make duplicate microforms.

4.3 Thermally processed silver film

Thermally processed silver film is less sensitive to light than the silver-gelatin film normally used in COM recording, but it shows significantly greater light sensitivity than diazo or vesicular films. After exposure, the film is developed by the application of heat for a few seconds. Thermally processed COM silver films produce positive-appearing images with sufficient resolution and contrast to yield high-quality images at reductions up to 1:48 and are adequate for producing high-quality duplicates.

4.4 Diazo film

Diazo microfilm is used for making duplicate microforms. The film is exposed by contact printing, using high-intensity ultraviolet radiation such as that obtained with mercury, metal halide mercury, or xenon flash lamps. Because of its low sensitivity to visible light, diazo film can be handled in normal room light for short periods, as when loading it into a duplicator, without affecting the image properties.

Diazo films are direct image duplicating films and maintain image polarity. A negative-appearing master (1N) produces a negative-appearing diazo duplicate (2N). Development usually occurs by passing the film through a heated chamber containing aqueous ammonia or by subjecting it to anhydrous ammonia under pressure. Both methods form diazo dye images. Some diazo films can be developed by heat alone, although they are not typically used in COM duplicate production.

Blue, blue/black, and black high-contrast diazo films are commonly used for COM duplication. Although film choice is a matter of user preference, users should first examine the film in a reader, because the reader and film combination can affect the quality of the image displayed. Diazo film maintains very high resolution with medium or high contrast and can yield excellent images at effective reductions up to and including 1:48.

4.5 Vesicular film

Vesicular film, like diazo, is used for making duplicate microforms. It is exposed by contact printing, using high-intensity ultraviolet light. Its sensitivity to ultraviolet light is greater than that of diazo film. Its low sensitivity to visible light allows it to be handled in normal room light for short periods, as when loading it into a duplicator, without affecting the image properties.

Most vesicular films change image polarity. A positive-appearing master produces a negative-appearing duplicate. Vesicular film is developed by heat. It is available in a variety of visual background colors but generally appears neutral on a reader screen.

Vesicular film optical density is achieved primarily by scattering light rather than by absorbing it; therefore, density as seen in a reader is more important than visual diffuse density. Although the visual diffuse density may be low, the projection density achieved using vesicular film usually is equal to or greater than that of diazo film in readers. Vesicular film has a lower limiting resolution than diazo film, but it has higher contrast and can yield very good images at effective reductions up to and including 1:48.

5 Film processing

5.1 General

Camera film processing is one of the most important steps in producing consistent, high-quality microfilm. The same care must be taken in film processing as was taken when recording the data with the COM recorder.

5.2 Silver-gelatin film processors

A silver-gelatin film processor is a mechanical device which transports the film through a series of chemical baths and through washing and drying stages to produce the final photographic image. High quality is generally includes:

- repeatable density from roll-to-roll and from day-to-day
- uniform density having minimal streaks or mottle
- complete edge-to-edge processing
- thorough fixing and washing if LE100 or LE500 permanence is required
- proper drying without underdrying or overdrying and without the presence of water droplets
- freedom from scratches, light leaks, pin holes, chemical stains, dust, chemical residue, water spots, and physical deformation.

5.2.1 Off-line film processors

In these systems, film processing represents a separate operation. Off-line automated film processors are not connected directly to the COM recorder. The film processor transports the film, typically in roll form, through tanks of active processing chemicals and wash water. The processing sequence depends on the type of processing used and on the processor configuration. After processing, the film is automatically dried and mechanically wound onto a take-up reel. These processors may use a continuous threading leader and trailer to pull the film through the processor, or have a self-threading transport which does not require a leader or continuous threading. Automatic processors usually provide a transport speed, i.e., processing time control and temperature control for the various solutions and the drying chamber. Proper chemical activity is typically maintained by continuous replenishment or replacing chemicals after a specific time has elapsed or a specific quantity of film has been processed.

5.2.2 Inline film processors

An inline film processor is directly connected to the COM recorder and is generally an integral part of the equipment. Unlike off-line processors, inline processors typically transport a precut piece of film through a series of active processing chemicals and wash water. After processing, the film is dried automatically and is ready for use when the processing is completed. This type of processor is usually operated at a fixed speed and temperature, and does not require that chemicals be continuously replenished to maintain proper chemical activity. However, chemicals are changed after a fixed amount of film has been processed or after a fixed number of operating hours. Control of film quality is usually obtained by comparison of the output with a reference sample (or samples) having known properties such as those described in clauses 5.3 and 7.

5.3 Process control

5.3.1 Off-line processors

Controlling film processing through process-control procedures is one of the most important aspects of maintaining uniform COM output. Processors must be monitored on a regular basis to ensure consistent quality. Process-control strips, also called sensitometric strips, should be used frequently. At a minimum, process-control strips should be used at the start of processing each day, after changing chemicals, and whenever the output film fails to meet the established quality level. Lack of proper process-control procedures is one, if not the major, factor in poor quality output.

Process-control strips should be the same type of emulsion as the microfilm being used, and it is preferable for users to expose their own process-control strips. If a sensitometer for exposing control strips is not available, pre-exposed control strips usually can be obtained from the film supplier.

Process control strips consist of successive steps of differing exposure that become steps of differing density after processing. After processing, the densities of the steps on the process-control strip are measured using a densitometer. When conventional processing is used to produce positive-appearing COM images, two steps are usually monitored: the minimum density and the density step recommended for the particular application.

When producing negative appearing original masters from full reversal processing, or an autopositive film in a conventional process, the values to monitor are the maximum density, the minimum density, and the step representing a density of approximately 0.2 above the minimum density.

In addition to measuring the various density values, proper quality control requires the maintenance of a film processor control log. When using the log, it is necessary to establish control limits, including a range of density values representing acceptable limits for a particular situation. Limits rather than precise values are needed because normal variations occur in film processing. The particular example shown in figure 2 uses conventional processing, producing a positive-appearing image. The control regions represent the base-plus-fog-level, a density of 1.0, (which approximates character density), and the maximum density. In reversal processing, or when using a direct reversal film, different values would be chosen, such as maximum density and a low density approximately 0.2 above base-plus-fog. An intermediate density could also be chosen for completeness. The steps other than maximum density and minimum density that come closest to the desired density levels should be selected as references, because it is doubtful that the exact densities desired would be present on the control strips.

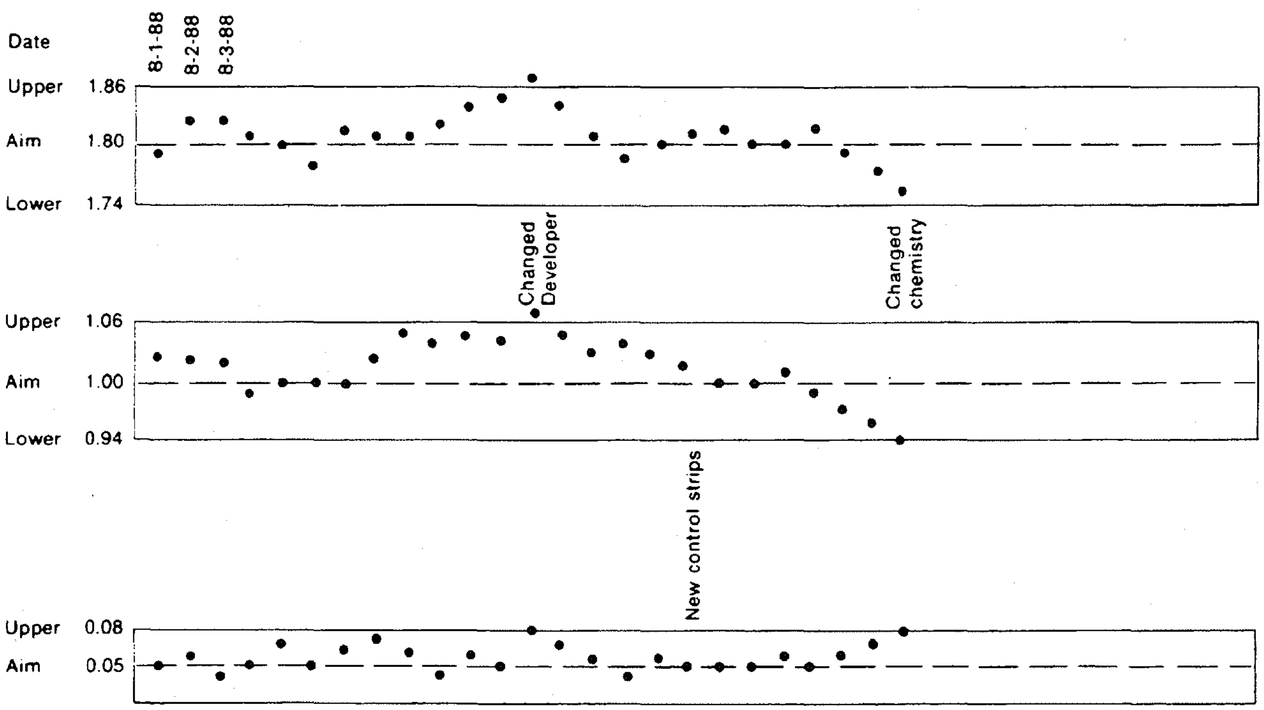

Figure 2 — Film processor control log

To establish process-control limits, it may be possible to obtain information from the film manufacturer. However, because of the wide variety of film processors and processing chemistry available, it is generally necessary to establish the values experimentally. One method used is to process at least 20 control strips over a short period of time — a day or two at the most. All control strips for this test should come from the same roll of film or at least from rolls of the same batch number. The densities of the steps used on the control strips should be measured and recorded.

Once the data is obtained, it can be used to establish an average or aim value for each control point. The aim value may be used to establish control limits. To do this, the limits for each control value should be set at plus or minus 2 sigma from the mean. Two sigma units can be used as requiring a retest and corrective action, and three sigma limits as a sign to stop production.

The sigma value is obtained as follows.

a) Determine the average density for each control step. This is obtained by adding all of the values for each control step and then dividing the total by the number of readings.

b) Subtract each value obtained at a given control level from the average obtained.

c) Square each of the plus and minus values, which will yield a series of positive numbers.

d) Add the series of numbers.

e) Divide the result by the number of samples.

f) Determine the square root of the value obtained.

This figure represents sigma for the sample, often called the standard deviation. Twice this value should be added to and subtracted from the aim value, thereby establishing control limits. It is not necessary to establish a lower limit for minimum density or an upper limit for maximum density of the process-control strips. The following equation gives the mathematical expression for determining sigma.

$$\sigma = \sqrt{\frac{\sum_1^n \left(x - x_i\right)^2}{n}}$$

Whenever a new roll of film is used for making process-control strips, a crossover should be established by processing, in the same run, three or four process-control strips made from the new roll of film and three or four from the old roll. The densities of the control steps from both control sets should be measured and averaged, and the difference in their average densities determined. New aim points should be established by raising or lowering the values by the difference in the densities measured. For instance, if the density of the old process-control strips had an aim value of 1.00 and in this test the average was 1.04 and the process-control strips from the new roll measured an average of 1.09, then the new aim point and control limits must be increased by 0.05. This gives a new lower limit of 0.99, an aim point of 1.05, and an upper limit of 1.11.

In routine use, process-control strips should be processed one or more times a day or whenever a processor problem is suspected. If the first process-control strip shows any points outside the established limits, a second strip should be processed to ascertain whether it is a processor problem or an aberration. If the second process-control strip is also outside the control limits, the cause should be determined. The problem may be due to improper development time, temperature, or a change in the processing chemicals caused by under replenishment or improper mixing ratios of replenishers from concentrate solutions. If the development time and temperature are set properly, then the processing chemical activity probably has changed. In this case, the chemicals, usually the developer, should be replaced.

5.3.2 Inline processors

With inline processors, the use of standard process-control strips is usually not possible. These processors operate at fixed speeds and temperatures, and the processing chemistry is usually premixed. Speeds and temperatures can degrade over time, and should be calibrated periodically. The use of standard process-control strips may serve no practical purpose, but the formslide method recommended in this document and the film density should serve as sufficient methods of monitoring output.

The alphanumeric COM quality test form slide described in clause 7 may be used as an alternative method to monitor processor operation. Using this form slide assumes that the light output from the forms illuminator does not change noticeably between chemical changes.

The method for using the form slide is similar to that for using process-control strips, except that different density values may be involved. First, the form slide should be exposed at the setting used in normal production. At least four or five frames should be exposed in order to obtain an average exposure, because minor exposure variations may occur from frame to frame. After exposure and processing, three densities should be measured: those obtained from the two density test areas along with the background density, which may be obtained from an unexposed portion of the film.

The values of significance when using the form slide to control density depend on whether a positive-appearing or negative-appearing image is being generated. With positive-appearing images, the minimum density remains almost constant throughout the chemistry life while the mid-range and upper densities gradually decrease. These mid-range and upper densities should be used for process control. The mid-range control limit is the one of greatest importance. The lower control limit may be established experimentally by conducting the test just before the recommended chemical change or when the COM output, in the user's opinion, is marginally acceptable.

With negative-appearing images, the background density and the mid-range or intermediate densities are most important. Depending on the film used and the processing conditions, different controls limits may be required. The user can establish these by measuring the densities using fresh chemistry and again when marginally acceptable results are obtained.

5.4 Silver-gelatin film processing: General

The film supplier's recommendations should be followed for film processing. Although special circumstances may require departure from the recommended conditions, in general it will not be possible to maintain proper process control if the process conditions depart significantly from those recommended.

When practical, adding a silver recovery unit to the processor is recommended, particularly when conventional processing to yield a positive-appearing image is used. A silver recovery unit may be useful for two reasons. First, if a large quantity of film is processed, recovering silver from the fixing bath can yield a source of income that may more than pay for the cost of the silver recovery unit and the associated labor costs over a period of time. Second, local, state, and federal environmental restrictions regarding disposal of photographic chemicals, particularly heavy metals such as silver and chromium, make it necessary to reduce the concentrations to acceptable levels before discharging the effluent into a sanitary sewer.

5.4.1 Chemicals

The chemicals used in the system must be compatible with the film and processor. Follow the film manufacturer's or chemical supplier's recommendations on the correct use of the chemicals, especially with regard to dilution ratios and replenishment rates, if you expect consistent results. Consider the advantages and disadvantages of chemical concentrates versus premixed chemicals. Automated chemical mixers and replenishers can be used to provide the same conveniences as premixed chemicals. The recommended frequency of chemical change should be followed. Using process-control strips will assist in monitoring these requirements.

5.4.2 Washing

The processor should provide adequate washing and temperature control for the intended use of the film. In particular, the washing should be sufficient to reduce the residual thiosulfate level to a value suitable for the film keeping requirements. Users should check the quality of water in their locality. Very hard water may need to be treated before being used, while excessively soft water may lead to abrasion and reticulation or both. The practical limits on water hardness are 16 milligrams to 150 milligrams per liter (parts per million) or 0.9 grains to 8.8 grains per U.S. gallon, when measured as calcium carbonate. Most large city water supplies necessitate the use of filters to keep the photographic processor free of dirt. When the requirement is microfilm with life expectancies of 500 or 100 years, it may be necessary to use a flow regulator, or flow meter, with pressure-balancing valves to monitor the rate at which water enters the processor. The ideal pH range for wash water is 7.0 to 8.5.

5.4.3 Drying

Follow film and processor suppliers' recommendations for drying film. The following precautions apply primarily to large processors. Air filters are used to ensure that the air used is free of dust and dirt particles, and must be changed according to manufacturer's recommendations or as dictated by the air purity in the surrounding area. Although adequate drying is essential to prevent film from sticking together, care should be taken to prevent overdrying; otherwise the film may become brittle or exhibit excessive curl. Drying time depends on relative humidity, temperature of the drying air, moisture content of the film, and film type. For polyester-based films, set the dryer temperature 3 °C to 6 °C higher than the temperature at which the films emerge nominally dry to the touch. The polyester base does not absorb water and, if not thoroughly dried, will stick together. Drying cabinets should be grounded to prevent the buildup of static electricity.

5.5 Conventional film processing: Silver-gelatin

Conventional processing of most silver-gelatin films requires a chemical bath to develop the latent image formed during exposure; a second bath to dissolve, or fix, the unexposed silver-halide grains; a wash step to remove residual chemicals; and, finally, a drying step. The development stage is the most critical step in this process. To achieve consistent results, carefully control development time, temperature, agitation, and the chemical activity of the developer bath. Chemical activity frequently is maintained by using a replenishment system that adds fresh chemicals while the film is being processed. In some systems, chemicals are replaced periodically rather than being replenished. In these systems the chemicals are usually changed after a fixed period of time or after a prescribed quantity of film has been processed.

Variations in development time, temperature, agitation, and chemical replenishment rate and concentration will influence the characteristics of the developed film. Conventional processing produces a positive-appearing (1P) COM image with most films. There are direct image films which produce a negative-appearing (1N) COM image. These films use conventional processing chemicals while reversing the image, eliminating the need for chromium bleaches that may be subject to regulations restricting their use. These films also allow the use of diazo duplicating films to create second generation negative copies.

5.6 Reversal processing: Silver-gelatin

In full-reversal processing, the film is first developed to produce a positive-appearing (1P) silver image using the same first step as in conventional processing. The film next passes through a bleach and clearing bath that removes the developed silver image, leaving clear image areas. The remaining silver halide, which is still light sensitive, is reexposed and redeveloped to produce a dark background and a negative appearing (1N) image. Finally the film is fixed to remove any remaining silver halide and thoroughly washed. In some systems the redevelopment and fixing steps are combined. Reversal processing is commonly used when duplicating with diazo film because it will yield a negative-appearing image in the duplicate, which is generally preferred. However, the use of bleaches in full reversal processing may be subject to local, state, and federal restrictions.

In some processors, the redevelopment and fixing steps are eliminated to produce partial-reversal, or halide-reversal, processing. Until small, full-reversal processors were readily available, this method was used when duplicating onto diazo film.

The halide-reversal process has some disadvantages. The silver-halide background changes tone in a reader, and a more specular light source is required for duplication and reading in order to obtain sufficient contrast. The halide-reversal process is not used very often. Halide-reversal (partial-reversal) processing uses silver-gelatin emulsions maintaining image polarity. While this process is in limited use, when it is employed users should be aware that it may yield non-permanent images.

6 Permanence of microforms

6.1 General

The useful life of computer-output microfilm depends on the following classifications of film stability. The classifications apply only to storage copies of film. Storage copies should never be used as work copies where use may subject them to abrasion, dirt, physical damage, or environmental changes, making them unfit for preservation. When there is a need for more than a very occasional reference to a film copy intended for long term retention, a duplicate work copy (or an intermediate print master) should be made.

6.2 Life expectancy ratings

Recent studies of the image stability of currently available image storage media have resulted in a change to the method of designating how long a given film can be expected to be useful for the retrieval of information from the system used to produce, store and retrieve information. These films have been subjected to accelerated aging tests to determine their life expectancy, and have been given Life Expectancy (LE) ratings, expressed in years. For example, a film with a LE100 rating can be expected to be useful for a minimum of 100 years. Information requiring permanent storage should be stored on films with an LE500 rating, and may need to be duplicated onto another medium with a similar life of 500 years. The ratings for the different microfilms currently available are as follows.

6.2.1 LE500 microforms

At present, only wet-processed, silver-gelatin films coated on a polyester base may be considered suitable for the storage of records having value for 500 years or permanently. No other storage medium has been classified as a LE500 rating or higher at this time. In order to be classified as LE500 microfilm, the silver-gelatin film must meet the requirements of ANSI IT9.1 and must be processed and stored properly under the conditions specified in ANSI IT9.11, using enclosures described in ANSI IT9.2. After film processing, the residual thiosulfate must not exceed 0.014 grams per square meter but should be greater than zero. The level of residual thiosulfate may be determined by following the methylene-blue test method described in ANSI/ISO 417. In full-reversal processing, the film must pass through a thiosulfate fixing bath and must be washed satisfactorily to be considered LE500. Testing for residual thiosulfate ions must be conducted within two weeks of processing using a clear area of the film. Halide-reversal film does not satisfy LE500 processing requirements.

6.2.2 LE100 microforms

LE100 film has a useful life of at least 100 years. In order to be classified as LE100 microfilm, the silver-gelatin film must meet the requirements of ANSI IT9.1 and must be processed and stored properly under the conditions specified in ANSI IT9.11, using enclosures described in ANSI IT9.2. Microfilms currently designated as capable of meeting the requirements for the LE100 rating which meet the above requirements are listed below.

6.2.2.1 Silver gelatin films on an acetate base Silver gelatin films coated on cellulose acetate support meeting the requirements of ANSI IT9.1, processed and stored under proper conditions specified in ANSI IT9.11, using enclosures described in ANSI IT9.2 are suitable for LE100 storage. Although cellulose acetate based microfilms are not currently manufactured in significant quality, significant amounts of existing stored rolls must be considered.

6.2.2.2 Thermally processed silver microfilms Recent studies of thermally processed silver microfilms have indicated that some may be suitable for LE100 storage. Such films must meet the requirements of ANSI IT9.19. The film supplier can provide data on the keeping characteristics of specific products.

6.2.2.3 Diazo duplicating films Diazo films that meet the requirements of ANSI IT9.5 are suitable for LE100 rating.. The film supplier can provide data on the keeping characteristics of specific products.

6.2.2.4 Vesicular duplicating films Vesicular microfilms meeting the requirements of ANSI IT9.12 are suitable for LE100 storage. The film supplier can provide data on the keeping characteristics of specific products.

7 Alphanumeric COM quality test form slide

The alphanumeric COM quality test form slide described in this clause and illustrated in figure 3 was designed to assist users in establishing and maintaining the quality of the output from the COM recorder. For this form slide to be of maximum use, the film processor must be operating properly and yield process-control strips with densities within the established limits. See ANSI/AIIM MS28.

Evaluating COM image quality is not as simple as evaluating the results from source-document cameras, principally because alphanumeric-only COM recorders cannot generate patterns equivalent to the ISO Test Chart No. 2 (described in ANSI/ISO 3334). Although use of the alphanumeric COM quality test form slide does not provide quantitative values of quality, it does permit users to establish and maintain the quality level required for the particular application.

The resolution test charts on the form slide are used to evaluate the quality of the image of the form slide on film. The quality, i.e., resolution, of this image is a measure of the performance of the optical system, film, and processing. It does not provide information about the quality of characters from the image generator. An additional function of the resolution test targets is to permit the user to evaluate the loss that occurs when making duplicate copies.

The artwork from which the alphanumeric COM quality test form slide is made consists of a high quality object. Because it is used to measure system quality, the artwork exceeds the specifications contained in 15.3. In addition, the test slide contains information that goes beyond the limits recommended for form slides used in normal production of COM output. This has been done because the test slide is intended to determine the performance limits of the system.

The test slide artwork contains five identical test patterns located at the center and four corners of the form. It also contains two areas called density squares, which are 100 mm (3.94 in) on a side. The density square on the right, which would be a clear area on the test slide, is used to measure maximum density with positive-appearing images and minimum density with negative-appearing images. The density square on the left contains a 65 line per in, 50 percent transmission halftone screen pattern, which is used to measure an intermediate density with both positive and negative appearing images. This halftone pattern, which on the final image on film appears as a neutral gray because the system cannot resolve the halftone dots, provides a means for controlling the exposure level of the COM recorder. Two resolution targets, made in accordance with the specifications in ANSI/ISO 3334, are included for use in optimizing and checking the optical focus of the form slide image.

Each of the five test patterns contains an array of 20 pairs of characters, the letters E and H. Each pair of characters is identified by a grid coordinate position, rows A through D vertically and columns 1 through 5 horizontally. Each pair of character dimensions, based on a full size computer page of 335 mm by 270 mm (13.2 in by 10.6 in), changes progressively in the following manner. Horizontally, the left pair of characters in each row is 2.0 mm high and increases in size by 0.2 mm with each successive pair, so that the pairs in column 5 are 2.8 mm high. The stated character height is measured from the center line of the upper bar of the character E to the center line of the lower bar.

Vertically, the characters vary in line width. All characters in each row have the same line width regardless of character height. The top row (A) has line widths of 0.28 mm; the second row (B), 0.35 mm; the third row (C), 0.48 mm; and the bottom row (D), 0.70 mm.

Two character spaces are provided between characters horizontally and one line between characters vertically to facilitate the aligning of image generator characters with the form slide. The location of each form slide character, based on 132 characters per line and 64 lines per page, is shown in figure 4. Rows 49 and 50 are reserved for generating the user's entire character set.

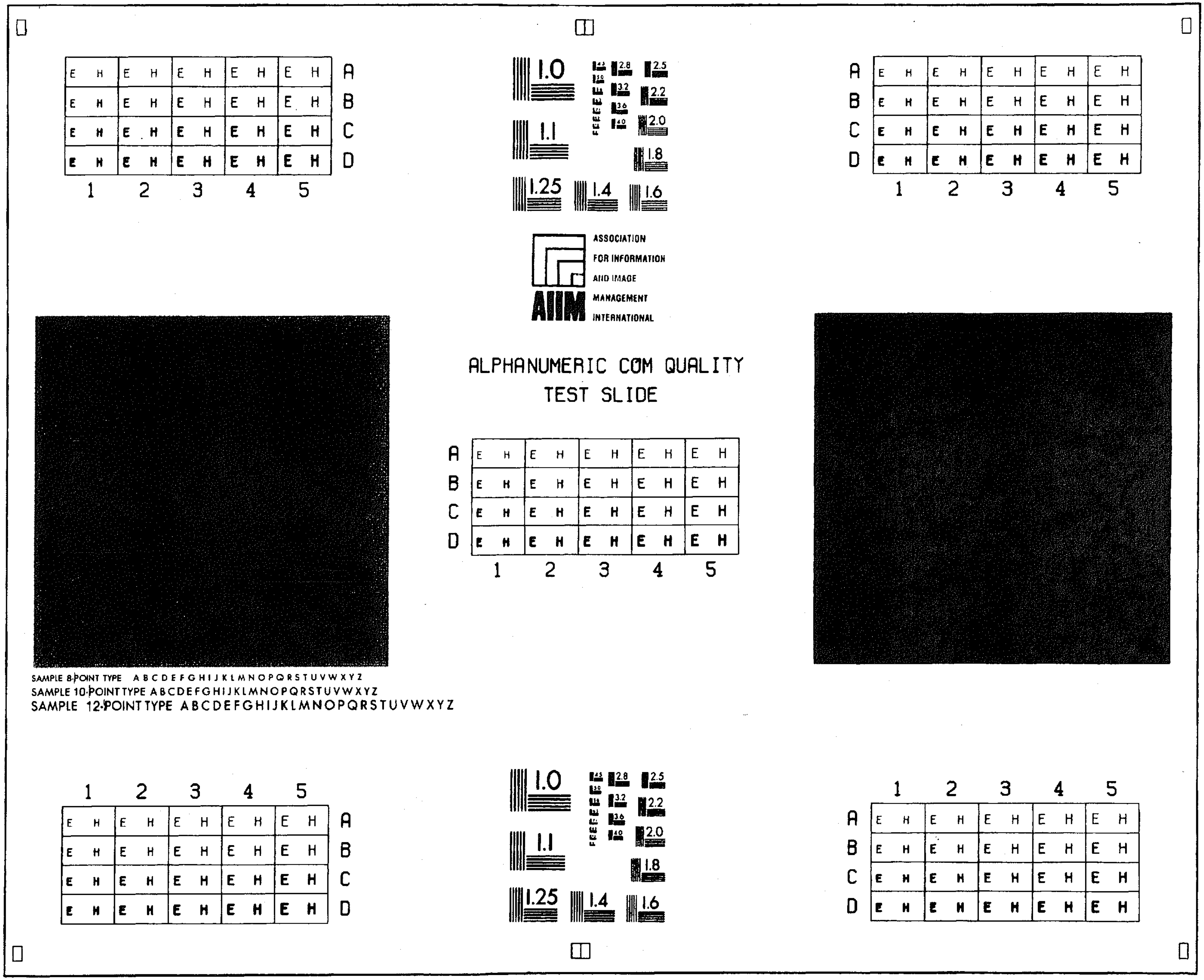

Figure 3 — Artwork for alphanumeric COM quality test slide

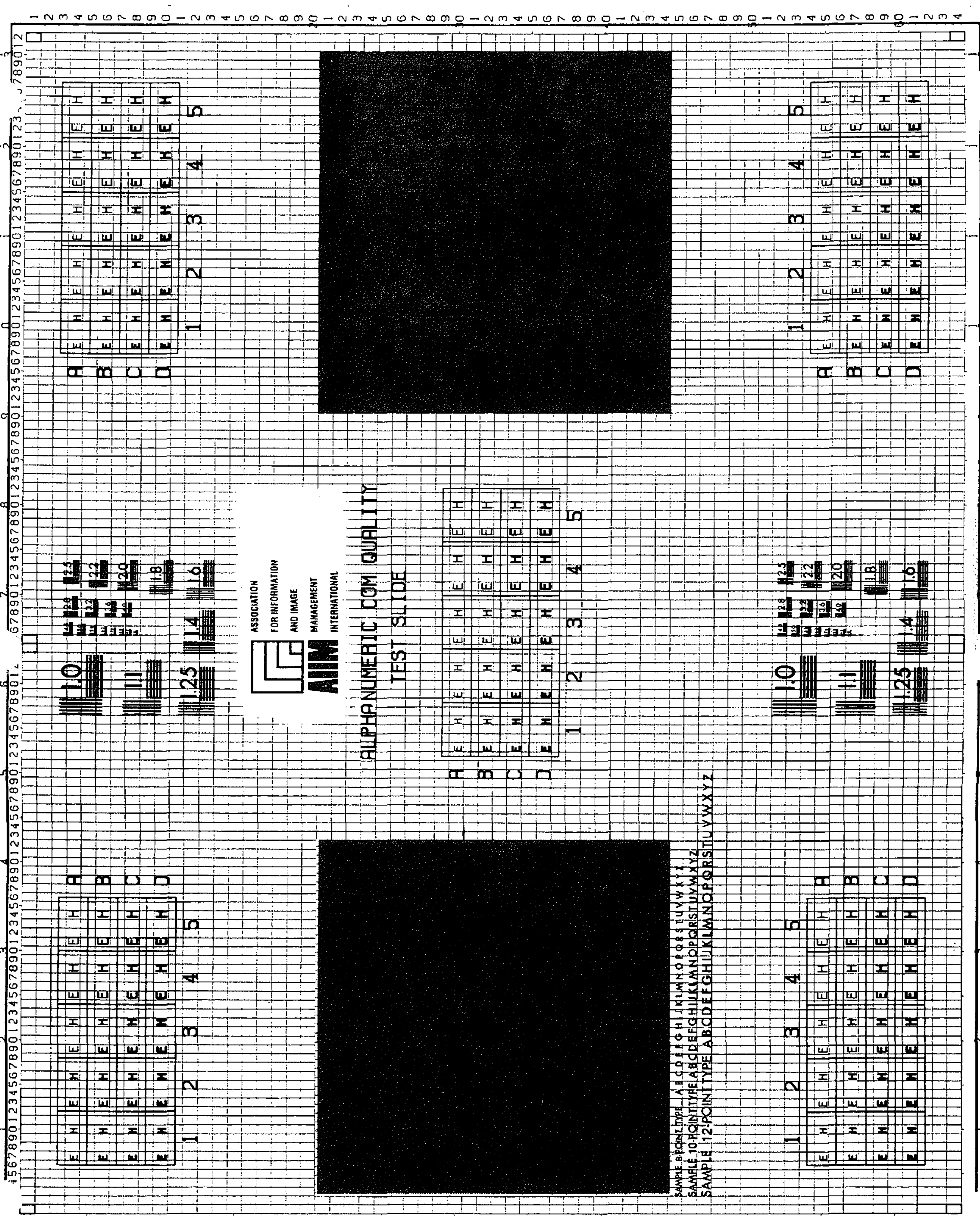

Figure 2. Form-slide layout (Not to scale).

8 Legibility test

8.1 General

The following legibility test is intended for a COM recorder that is not optimally adjusted. If the recorder is producing acceptable output, then the test described in 8.2 may not be required, except that sample output should be generated and evaluated for use as a reference in future tests. Film processing must be in control when this test is conducted.

8.2 Initial test and reference sample

Using the image generator, a test program is generated to produce the same characters used in the five test patterns, but displaced one character to the right. For instance, an E will be located at row 4, column 8; and H at row 4, column 11; an E at row 4, column 14, etc. In addition, two lines containing all of the alphanumeric and special symbols used should be displayed along rows 49 and 50. Aligning the form slide and image generator display can be facilitated by generating a reference character, of the user's choice, in each of the four corners of the page and at positions 64 and 65 of the first and last rows and aligning these with the character boxes located on the form slide.

If the optical system in the COM unit has not been preset to yield optimum focus, this procedure can be accomplished by using the form slide in the alignment mode and by adjusting the lens for maximum resolution at the image plane using the resolution test targets on the form slide. Normally, this adjustment, if needed, should be performed by the COM manufacturer's customer service engineer.

After proper focus and alignment, several frames of the form slide should be exposed, with the settings recorded, at various form slide exposure levels. The film should be processed and examined, preferably using a microscope at a magnification of approximately 100x. If a microscope is not available, a microfilm reader may be used. The exposure level chosen should be that which gives an image where the thinnest EH pair (grid coordinate A1) appears underexposed and the heaviest EH pair (grid coordinate D5) appears overexposed. If this condition exists at more than one exposure level, then the exposure in which the degree of underexposure (grid coordinate A1) and overexposure (grid coordinate D5) appears similar should be chosen.

Using the form slide exposure setting established in the above test, make an exposure series, with the settings recorded, of the EH patterns with the image generator. After processing the film, examine the images with a full-size blowback microfilm reader, if available. Choose the exposure level that produces acceptable images from the image generator, and compare the acceptable dynamic images to those having the same height and line width in the form slide. Record the image generator exposure setting and the location of the comparable form slide EH pair for each of the five test patterns. The comparable pairs may not be in the same location in the different test patterns. Also, record the highest resolution target that can be read.

Once the original microimage has been selected, and the settings have been recorded, a reference test sample should be produced for use in a duplication test. A duplication test is required because duplicate film is generally what the ultimate user will view.

Using the reference test sample, a series of test copies should be made with the duplicator set at various exposure settings. Depending on the duplication equipment used, the settings for exposure time should be recorded for cross-reference purposes.

Following the same procedures outlined above, check the duplicate samples, first for best optical density and contrast and next for best resolution. The duplicator setting (or settings) that yield the best test copy should be recorded for future reference, and a duplicate reference sample should be produced. The resolution loss on the duplicate compared to the master should not be greater than one resolution pattern. If the loss is greater than this, the duplicator should be checked, particularly for proper contact between the master and duplicate films.

When the proper exposure is established, the coordinate positions of the pair of Es and pair of Hs (e.g., grid coordinate C4) that appear most nearly the same should be recorded. The coordinates should be recorded for each of the five target locations, because a different match may occur at each location.

To obtain reproducible results in future tests, the density of the density square of the first-generation, or camera silver, image must be measured. If the processing used produces a positive-appearing image (1P), the density of the image of the clear area (right side) of the form slide should be measured. If the processing used produces a negative-appearing image (1N), the density of the images of the screened area (left side) of the slide should be measured. The aperture of the densitometer must be smaller than the density square (2 mm at 1:48) to ensure valid readings. When the densitometer aperture closely approximates the test area size, several readings of the same area should be taken, removing and replacing the microfilm from the stage each time. Inconsistencies among these consecutive readings indicate a need for a smaller aperture. If a densitometer is not available, a fairly good approximation may be made by visually comparing the test sample with the reference sample, comparing narrow lines of the form slide, row A. To make this comparison, place the reference and test samples side by side in a reader (it may be necessary to cut the samples), and compare the form slide images in the upper left test targets, grid coordinate A1. Generally, the lower exposure level obtained on film because of the thinner lines results in lower contrast on the film. Under these conditions, variations in density and/or character line width are easy to detect. Although it is possible to conduct this test using a microform reader, the preferred method is to examine the images using a microscope.

8.3 Routine testing

The output from the COM recorder should be monitored on a regular basis using the alphanumeric COM quality test form slide. The frequency of testing should be determined by the volume of fiche produced within a specific time frame. As a practical matter, this type of test is needed infrequently due to consistent exposure attained in COM recorders and consistent process activity in well-controlled processors. If a quality problem has been detected, the test may be used to assist with trouble-shooting and correcting the problem. The test is not intended to be included on fiche with actual report data, only as a separate fiche for normal monitoring of the quality from the COM device.

The dynamic output from the image generator should be compared to the form slide, as previously described. The exposure level of the forms illuminator should be adjusted if needed to provide the same exposure as that used for the original reference film test. Sample output is generated and checked for the proper match between routine and reference test samples. If a densitometer is available, the appropriate density square should be measured. Given proper process control, the density of the routine sample should be within ±0.05 of the reference sample. If the proper E and H character match is not achieved, the COM recorder should be adjusted to yield the proper match. In general, this adjustment should require only a change in the image generator exposure level.

9 Microfilm density

9.1 General

This clause provides guideline values of image and background optical density for first-generation imagery and distribution copies. These values may not be satisfactory in all situations, however. For instance, if there are several generations between the COM recorder-generated film and the distribution copy, or if equipment performance, such as excess flare light in the microform reader, is coupled with a positive-appearing image, then different limits on density may be necessary. Generally, density values outside the limits given in this clause reduce the probability of consistently satisfactory system performance.

A major problem associated with specifying COM generated image density is the difficulty of measurement. The very small size of the image requires using a micro-densitometer. Not only is this equipment very expensive and the measurements time consuming to perform, but there are no standards to permit conducting valid, reliable measurements.

This clause is limited to a discussion of optical transmission density (referred to subsequently in this clause simply as density) and is concerned solely with maximum and minimum densities for character images and background.

Because of the general impracticality of measuring COM character density directly, alternative methods are used. One alternative that has been used is measuring the density of the cut mark or blip mark, because these marks are generally large enough to measure using a regular densitometer. However, this method can lead to false conclusions, because these marks are typically generated by a light source other than the image generator. This same problem occurs if a forms flash is used to expose a large area of the image. In addition, even if a large area and regular images are recorded with the same light source, the smaller images will have a different density value than the larger images because of light scattering in the film emulsion and the effects of film processing.

The density of a microfilm image plays a critical role in establishing the satisfactory performance of a COM recorder. Satisfactory system performance is impossible to achieve if the background density for positive-appearing images (1P) is too high, the background density for negative-appearing images (1N) is too low, the density difference between the image and the background is inadequate, or the density variation over the image area is too large.

Microfilm image density is a measure of the modulation attenuation) of light or other spectral radiation when the microfilm is illuminated on one side and viewed on the other i.e., light is transmitted through the film. The measured value of density is the logarithm, to the base 10, of the ratio of radiant flux incident on the sample to the radiant flux transmitted. The density of a given sample generally is not unique, but depends strongly on the measurement conditions. Commonly used density measurements include diffuse, projection, and printing density. The type of density measurement used with a given sample depends on the intended use of the sample.

9.1.1 Visual diffuse density

Visual diffuse density is measured when the sample is illuminated with diffuse light from one side and viewed from the other side, such as when viewing a photographic transparency on a light table. Visual diffuse density is the type measured by common transmission densitometers. When the detector in the densitometer has the same spectral response as the so-called human standard observer, then the measurements are referred to as visual diffuse density. In this case, the energy source is at a stated color temperature, such as 2854 K for black-and-white photographic materials. (See ANSI/ISO 5/2 (ANSI PH2.19) AND ANSI/ISO 5/3 (ANSI PH2.18-1)).

9.1.2 Projection density

Projection density occurs when the sample is illuminated by collimated light, or by light confined to some prescribed input cone angle, and when the image is projected by an objective lens, such as that in a microfilm reader. The density value obtained in this case depends largely on the light-scattering characteristics of the image and on the cone angles involved. Projection density is never less than diffuse density and is often much higher (see ANSI/ISO 5/2).

9.1.3 Printing density

Printing density is a measure of the density of a sample when the response of the detector in the densitometer is the same as that of the duplicate film itself, such as might be encountered in making a duplicate onto diazo or vesicular film. For use in microfilm duplication, see ANSI/ISO 5/3 for a description of measuring density with a narrow band filter. Diffuse printing density is most commonly measured.

9.1.4 Density measurement

Silver film density is usually determined using visual diffuse conditions as described in ANSI/ISO 5/2 and ANSI/ISO 5/3. Visual diffuse density measurement of diazo films uses the same conditions as those used for silver films, except that some densitometers may require the addition of a Corning 4-94 infrared rejection filter. For vesicular films, projection density is measured using a densitometer that simulates a projector with an f/4.5 aperture.

In today's COM systems, first-generation film is either silver-gelatin or thermally processed silver film. Silver-gelatin film is either positive-appearing (1P) or negative-appearing (1N) depending on film type and method of processing. Thermally processed silver film is always positive-appearing (1P).

Positive-appearing silver-gelatin film is spectrally neutral. Also, most duplicators use reasonably well collimated light for producing duplicates. Hence using visual diffuse density to describe first-generation (1P), silver-gelatin film generally yields satisfactory results.

Thermally processed silver film is not spectrally neutral. The absorption of light in the near ultraviolet region is generally higher than in the visual region of the light spectrum. For these films printing density should be used to describe the characteristics.

Negative-appearing (1N) silver-gelatin film images can be achieved in several ways. Full-reversal or halide-reversal processing of conventional films or conventional processing of auto positive films may be used. These films may or may not be spectrally neutral. Therefore, printing density should be used to describe these products. Measuring the printing density of halide-reversal film may yield ambiguous results because tonal changes occur during the course of making a measurement, resulting in an increase in the background density.

For distribution copies, projection density is the proper measurement. However, because diazo and fine-grain silver-gelatin films scatter light only slightly, if at all, specifying visual diffuse density is satisfactory. If vesicular film is used for distribution copies, projection density must be specified if meaningful results are expected. In this case, the projection density should be measured using an optical system with the same numerical aperture, or f number (written f/n), as used in the reader. Because this is generally impractical, an f/4.5 optical system has become the standard reference aperture used for these measurements.

9.2 Density of first-generation film (COM camera film)

The line and background density requirements for first-generation film depend on how the film will be used. If, for example, the film will be used for making duplicates, then diffuse density and printing density are important. The image contrast, or density difference between the background and image, must be sufficient to yield duplicates with usable contrast. The density variation of images from the form and character image generator should be small enough to provide reasonable exposure latitude during duplication, while the minimum density must be low enough to provide satisfactory throughput speed in the duplicator. If the film is to be used for projection viewing or to make hardcopies, then the projection density characteristics become the governing factor and diffuse density is of minor importance. In duplicating COM-generated images, the duplicating film used is generally diazo or vesicular film; however, silver-gelatin print films are also employed. Table 1 summarizes density recommendations.

Film type	Process	Density measurement method	Minimum *Dmax*	Maximum *Dmin*	Minimum density difference
Silver gelatin (1P)	Conventional	Printing or visual diffuse	0.75*	0.15 or 0.10 plus base†	0.60
Silver gelatin (1N)	Full reversal	Printing	1.50 (1.80 preferred)	0.20 plus base†‡	1.30
Thermally processed silver (1P)	Heat	Printing	1.00*	0.40 plus base†	0.60 (0.80 preferred)
Diazo (2N)	Ammonia	Visual diffuse	1.30	0.15 plus base*	--
Vesicular (2N)	Heat	*f*/4.5 projection, visual	1.80	0.15 plus D*[1]	--

*Character or line density, measured with a microdensitometer or by comparing the film under a microscope with an image of a known density.

†Base equals the density of the uncoated base.

‡Character or line density, measured with a microdensitometer or by comparing the film under a microscope with an image of a known density; the cut mark is useful for processing control only.

[1]D equals the density of unprocessed film that has been cleared.

Table 1 — Summary of acceptable density limits

9.2.1 Positive-appearing (1P) COM silver-gelatin films Positive-appearing, first-generation COM film may be used for direct viewing or for making duplicates. Vesicular film is used if negative-appearing (2N) duplicates are desired. Diazo film is used if positive-appearing (2P) duplicates are desired. The density requirements depend on the intended use.

9.2.1.1 Positive-appearing (1P) COM film used for making duplicates The diffuse density of the background (fog) of the film plays a major role in determining the throughput speed achievable with a particular duplicator. The higher the background density, the lower the throughput speed achievable for a given level of output quality. For this reason, a minimum background density commensurate with the system would be the goal.

The background printing or diffuse density of silver-gelatin film should be a maximum of 0.10 plus the density of the base material. Most often, a clear base material with a density of no more than 0.05 is used. If dyes are used in the base, this density may be higher.

Printing density should be measured for thermally processed silver film. The base-plus-fog density should not be greater than 0.25.

The density difference between the character and background is usually a compromise. A large difference is desired to make duplicating simple, but with many COM films, the image spreads or blooms severely at high exposure levels. This spreading decreases the effective resolution of the system and degrades image quality. The compromise density difference is usually lower for 1:48 images than it is for 1:24.

9.2.1.2 Positive-appearing (1P) COM film used for direct projection viewing on readers only Positive-appearing silver-gelatin COM film that will be used for projection viewing should have the same density values as film to be used for making duplicates. Base-plus-fog level should be less than 0.15; otherwise, reader screen brightness can be impaired, and at high background densities, emulsion graininess can seriously degrade image quality.

Thermally processed silver film may have a background density higher than 0.15 because antihalation dyes, which are not removed during processing, remain in the emulsion or base material.

9.2.2 Negative-appearing (N) COM silver-gelatin film Negative-appearing, first-generation COM film is used for direct viewing in readers, for making prints from reader-printers, or for duplicating onto diazo film. The density requirements depend on the end use. With some film-processing combinations, a residual stain may be present on the film, resulting in a printing density considerably higher than the visual diffuse density.

9.2.2.1 Negative-appearing (1N) COM film used for making duplicates High line density can seriously affect duplicator throughput speed. Line density should not exceed 0.2. The background density should not be less than 1.5. A background density of 1.8 or greater will yield consistent high quality duplicates. The minimum background density that can be tolerated depends on the film granularity (graininess). The higher the background density, the lesser the effect of granularity on the quality of the duplicate.

9.2.2.2 Negative-appearing (1N) direct projection viewing only Original COM film intended for long term or permanent records should not be used for direct viewing except under extreme circumstances. Negative-appearing COM film that will be used for projection viewing on rare occasions should have the same density values as film used for making duplicates. However, the projection density, which depends on the film granularity, will be higher than the visual diffuse density. A background density of 1.5 measured as visual diffuse density will yield higher density when measured as projection density, with the value depending on film granularity. While a fine-grain film with a visual diffuse density of 1.5 may show a projection density of 1.7, at f/4.5, films with coarser grain may yield values of 1.8 or higher. Halide-reversal films show significantly higher values for projection density than for visual diffuse density.

10 Density of distribution copies

10.1 Negative-appearing (2N) vesicular film

The f/4.5 projection density of the background should be a minimum of 1.8. One study has shown that optimum exposure using vesicular film occurs when the background density is approximately 85 percent of the maximum density achievable with fully exposed film.

10.2 Negative-appearing (2N, 3N, etc.) diazo film

The visual diffuse density of the background should be a minimum of 1.5.

10.3 Positive-appearing (2P, 3P, etc.) film

Because positive-appearing distribution copies are rarely used with COM, recommended values are not included in this document.

11 Resolution and quality index

11.1 General

Measurement of the resolution captured from the COM quality test slide is used to determine the ability of the COM system to record fine detail. Because the resolving power measurement is made using a high-quality, high-contrast form slide and not the image generator, it is not a measure of the character resolution. Measuring resolving power will help determine whether the lens and film components of the system are capable of recording fine detail. For details on how to read resolving power the user is referred to ANSI/ISO 3334. Additional information on resolving power and application of the quality index is given in ANSI/AIIM MS23.

11.2 Requirements

The resolving power requirements for COM recording depend on the information being recorded and on the reduction used. If the data consists of lower-case or complex characters, then the resolving power requirements are higher than if all uppercase characters are used. If the lowercase e is used, then the full-size equivalent of this character may be used along with the nomograph given in figure 5 to determine the resolution pattern that should be resolved for acceptable quality. For example, frequently the full-size equivalent of the lower-case e in alphanumeric COM recording is 2.0 mm high. If the first-generation film will be used for duplicating to yield second-generation film, examining the nomograph given in figure 5 reveals that, for acceptable quality, the resolution pattern 2.8 should be resolved in the camera film. For minimum quality under the same circumstances, pattern 2.0 should be resolved. High quality formslide resolution targets are a requirement because low measured quality may be a reflection of a poor formslide rather than a system problem.

If only uppercase characters are used, the height of the uppercase E may be employed in using the nomograph. The typical full-size equivalent height of this character is 2.5 mm. However, this height may vary over a considerable range, depending on the particular recorder set-up and on user preference. Assuming the 2.5 mm height, the pattern 2.2 should be resolved for acceptable quality. The highest resolving power obtained in the camera film exposure series using the test form slide is the maximum obtainable from the system. The character size being used in a particular COM recorder can be determined through the match of the EH pattern from the form slide and image generator. The equivalent full-size height of the upper-case E in the form slide image varies from 2.0 to 2.8 mm, as stated in clause 7. Although these measurements represent the distance from the center of the top horizontal line of the character E to the center of the bottom horizontal line rather then the overall height, these values can be used for approximation in determining the resolution requirements. Because this entire measurement represents an evaluation of the photographic system rather than the image generator, and because the quality of the image from the image generator is lower than that of the form slide, erring on the side of higher resolution requirements can prove beneficial.

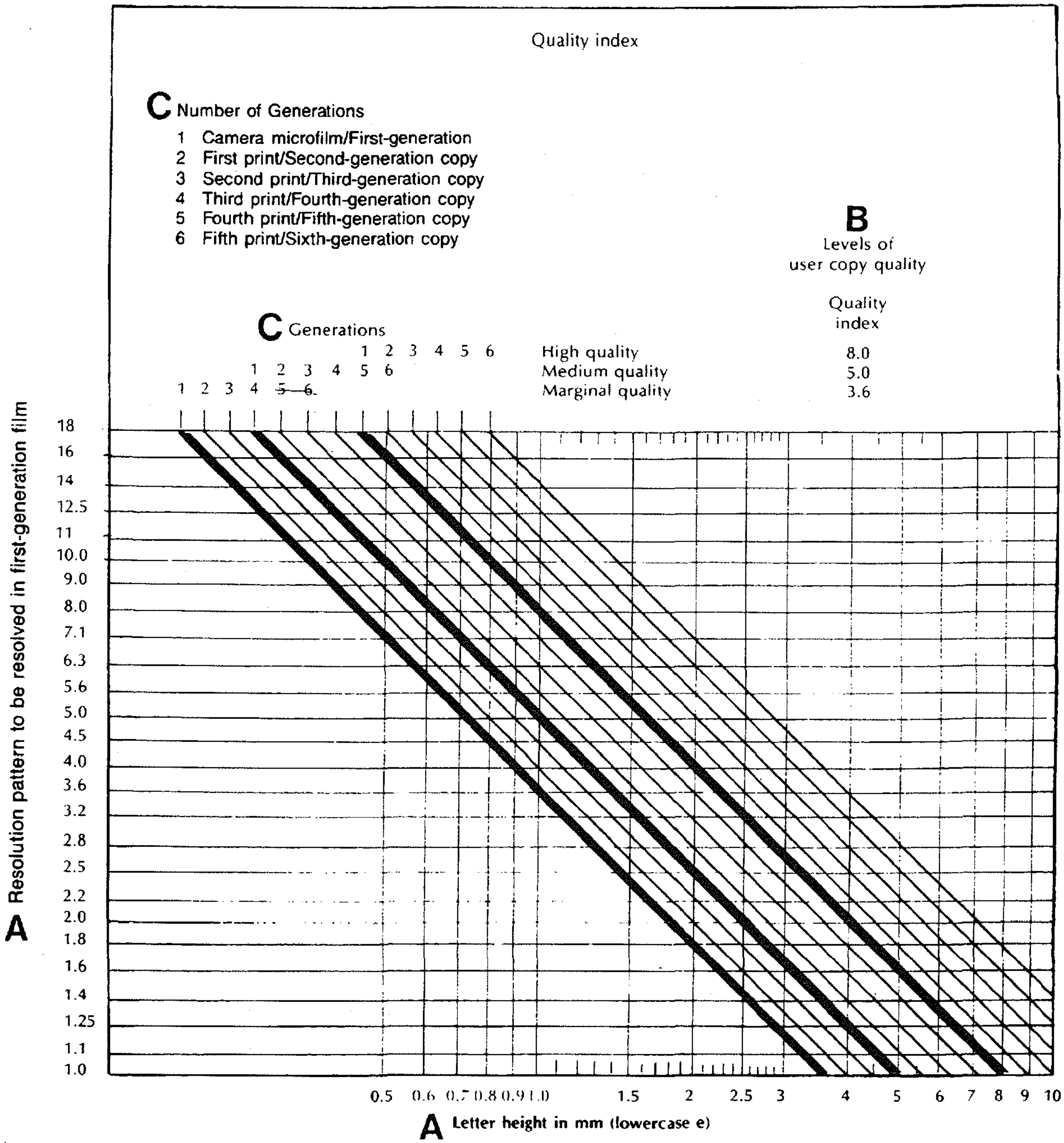

Figure 5 — Quality index graph

12 Reproducibility

All characters must be recorded so that they can be easily read by users, which means that the quality of the first generation camera film must be sufficiently high to allow for the normal image degradation that results from making subsequent generation copies. The maximum acceptable loss in resolution is about 12 percent (one pattern) for each subsequent generation. The duplication step should result in the loss of not more than one resolution pattern between camera film and duplicate.

13 Printability test

To ensure that users can obtain legible hardcopy prints, a printability test should be conducted on the same type of reader-printer available to the end users or customers. The reader-printer should be thoroughly cleaned and calibrated to the manufacturer's recommendations. Two frames should be selected at random on the distribution microform sample. Using any enlargement ratio in the range of 70 to 100 percent of the effective reduction, paper prints should be made. The prints should be examined for legibility. If the prints are not legible, the cause should be ascertained and corrected. If the film meets the density and resolution requirements described in this document, then the reader-printer will probably be the cause of the legibility problem.

14 Standards for storing microfilm

The care used in storing microfilm, especially the original, can definitely affect the capability to reproduce or use the film at a future time. COM film used for long-term retention records must be stored in a location that meets the environmental conditions of the archival storage requirements specified in ANSI IT9.11. In any case, it is recommended that microfilm be stored in proper storage containers and in environmentally controlled areas where the temperature does not exceed 21 °C (70 °F) and the relative humidity does not exceed 40 percent. However, if the humidity is too low, film degradation might occur. ANSI IT9.11 should be consulted for specifics. Do not interfile dissimilar films (i.e., silver, dry silver, vesicular, or diazo) in the same storage containers. ANSI IT9.2 contains specific recommendations regarding storage containers.

15 Guidelines for preparing form slides

15.1 General

These guidelines are intended to assist form slide users and vendors ensure optimum quality. For more details see ANSI/AIIM MS28.

NOTE: These are general guidelines and not simply a description of the form slide used in this standard for comparing image quality.

15.2 Original artwork

All dimensions refer to the full-size master unless otherwise specified by the COM manufacturer.

15.2.1 Dimensional stability

The original artwork should be dimensionally stable. A polyester-base material is preferred.

15.2.2 Line density

The form lines should have sufficient density to prevent them from filling in when reduced to fit on the form slide.

15.2.3 Character spacing

The clear (blank) space between adjacent characters should be a minimum of 0.2 mm (0.008 in).

15.2.4 Line width

The form lines should have a minimum width of 0.2 mm (0.008 in). The width of a line to be used to separate characters should not exceed 0.3 mm (0.012 in). Individual form lines should have a constant width to within ± 5 percent.

15.2.5 Type size and style

The smallest character on the form should be not less than 2.0 mm (0.08 in). A medium or bold sans serif font of at least 8 points is preferred for maximum legibility. However, this may not be possible with detailed slides. In general, the slides should conform to the artwork selected by the users of the application.

15.2.6 Halftone screens

If logos or other identifying symbols will be used on the form slide, halftone screens of not more than 65 lines per in and 35 percent transmission are recommended. Halftone screens should not be used in any area where data is to be printed.

15.2.7 Color

The artwork should be black on a white background or black on a transparent background.

15.3 Form slide

The information in this clause is intended to assist form slide manufacturers in making form slides and users in preparing specifications.

15.3.1 Polarity

The form slide should be negative-appearing, that is, it should have clear lines on a dark background.

15.3.2 Material

Silver-gelatin emulsion coated on a stable polyester base or glass plate is preferred. The material should satisfy the requirements of the COM manufacturer.

15.3.3 Resolution

The camera for generating the form slide should be capable of resolving the 9.0 target described in ANSI/ISO 3334 at the image plane of the form slide, regardless of the reduction used to reduce the full-size artwork to the form slide dimensions.

15.3.4 Line density

The line density of the clear areas of the form slide should not be greater than 0.1.

15.3.5 Background density

The background density should be 2.0 or greater.

15.3.6 Defects

There should be no defects or pinholes greater than 0.013 mm (0.0005 in) in any dimension.

15.3.7 Line-width uniformity

Each line on the form slide should be uniform to its specified width to within ±5 percent.