MIL-STD-1347A
1 SEPTEMBER 1971
SUPERSEDING
MIL-STD-1347
1 JULY 1969

MILITARY STANDARD

FOR

NAVIGATION DISPLAY

MULTICOLOR MICROCHART/MAP TRANSPARENCIES

FSC-6605

DEPARTMENT OF DEFENSE
Washington, D. C. 20301

Multicolor Microchart/Map Transparencies, For Navigation Display

MIL-STD-1347A

1. This Military Standard is mandatory for use by all Departments and Agencies of the Department of Defense.

2. Recommended corrections, additions, or deletions should be addressed to Naval Air Systems Command, Code AIR 53371, Washington, D. C. 20360.

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MILITARY STANDARD FOR NAVIGATION DISPLAY MULTICOLOR MICROCHART/MAP TRANSPARENCIES

1. GENERAL

1.1 Scope. - This standard covers the general requirement for the preparation and production of multicolor microchart/map transparencies for use with optical projection viewing devices. It defines the physical and photographic characteristics of the output transparencies. These transparencies shall exhibit sufficient fidelity so that when projected back to the original size, the projected image shall be an acceptable facsimile of the original chart.

1.2 Application. - The transparency described in this standard is intended for use with optical projection display systems. The projected microchart/map image may be used in conjunction with automatic data processing systems, cathode ray tube (CRT) display or other auxiliary data sources to present a complete static and dynamic display of the operational situation. These transparencies may be used with airborne navigation, land based, or shipboard projection systems.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

Military Handbook

MIL-HDBK-25-Glossary of Photographic Terms

American National of American Standards Institute, (ANSI) Standards

PH 1.13-1953 Dimensions for Molded Type Cores for Photographic Film and Paper Rolls

PH 1.20-1963 Unperforated and Perforated Film for Cameras other than Motion Picture Cameras, Dimensions for

PH 1.25-1965 Safety Photographic Film Specifications for

PH 1.29-1958 Curl of Photographic Film, Methods for determining the

PH 1.31-1965 Brittleness of Photographic Film, Method of determining the

PH 1.32-1959 Determining the Dimensional Change Characteristic of Photographic Film and Papers, Methods for

PH 1.35-1961 35 mm. 100-Foot Spools for Recording Instruments, Microfilm and Still Picture Cameras, Dimensions for

PH 1.37-1963 Scratch Resistance of Processed Photographic Film, Methods for determining the

PH 2.17-1958 Diffuse Reflection Density

PH 2.19-1959 Diffuse Transmission Density

American Society for Testing and Materials (ASTM) Standards

D-882-67-Methods of Test for Properties of Thin Plastic Sheets and Film

Military Standards

MS26565 - Spool-Photographic Film

3. DEFINITIONS

3.1 Terms. - The definitions given herein are those most applicable to this document and to the specifications prepared in accordance with this standard. For the purpose of this standard, all photographic terms not defined herein shall be in accordance with MIL-HDBK-25.

3.1.1 Sensitometric Terms.

3.1.1.1 Density. - The light-absorbing quality of a photographic image. It is the logarithm of the optical opacity, where the opacity is the ratio of the incident light to the transmitted or reflected light. It varies with the use of scattered or specular light.

3.1.1.1.1 Total Density. - The sum of the dye deposit density and the base plus fog density as defined herein.

3.1.1.1.2 Fog Density. - That which is produced on a piece of processed film by causes other than exposure to light such as chemical processes during development.

3.1.1.1.3 Base plus Fog Density. - For a Negative Film - the total density of processed film that has not been exposed to light prior to development; For a Reversal Film - the total density of processed film that has received sufficient exposure to light, prior to development, such that any additional exposure will not produce a lower density.

3.1.1.1.4 Net Density. - The difference between total density and base plus fog density (applicable to negative color films).

3.1.1.2 Gamma - A numerical designation for the contrast of a photographic material as represented by the slope of the straight-line portion of the characteristic curve. The Gamma is numerically equal to the tangent of the angle which the straight-line portion makes with the base line. A Gamma of 1 in a negative signifies that the range of density in the negative is the same as the range of light values in the subject photographed; a Gamma of .5 signifies that the range of density in the negative is one-half of the range of the subject. Emulsion characteristics and development procedures directly affect the Gamma value.

3.1.1.3 Average Gradient - The slope of the straight line drawn between two specified points on the H and D curve (Refer MIL-HDBK-25).

3.1.1.4 Emulsion Number. - A number assigned by the manufacturer to identify a specific film production run.

3.1.2 Physical Terms

3.1.2.1 Physical Defects. - Scratches, pinholes, or other physical imperfections including streaks, spots, areas of uneven coating, bubbles, lap marks, lumps, foreign materials, etc.

3.1.2.2 Film Direction. - The direction parallel to its forward movement in the base casting/extrusion machine. This is also termed "grain" or "machine direction." The width direction also termed "cross direction," shall be at right angles to the film direction in the plane of the sheet.

3.1.2.3 Humidity Coefficient of Expansion. - The average change in dimension per unit distance per one percent change in relative humidity.

3.1.2.4 Thermal Coefficient of Expansion. - The average change in dimension per unit distance per one degree Centigrade or Fahrenheit change in temperature.

3.1.2.5 Dimensional Change Due to Processing. - The permanent dimensional change caused by the wetting and drying of the sensitized material during photographic processing. The amount of change is obtained by measuring the processed and dried film after it has reached equilibrium in an atmosphere having the same relative humidity and temperature values as those which existed during the measuring of unprocessed film. The amount of change in film dimensions is expressed as a percentage.

3.1.2.6 Dimensional Change Due to Processing Plus Aging. - Permanent dimensional changes occur as a result of processing plus aging of the processed film. It is measured after the processed, aged film has reached equilibrium in an atmosphere of the same relative humidity and temperature, as that used in the pre-measurement conditioning of the unprocessed film. This change is expressed as a percentage.

3.1.2.7 Differential Dimensional Change. - The difference between the dimensional changes of the material in the two principal directions (machine and cross).

3.1.2.8 Brittleness. - That property of the film which causes it to crack, break, or fail when deformed by bending.

3.1.2.9 Tensile Strength. - The force, applied parallel to the plane of the film in tension, required to rupture a sample of film of specified width, length, and thickness under specified conditions of loading.

3.1.2.10 Total Thickness. - The thickness of the end product shall include the emulsion and the emulsion support, plus any backings.

3.1.2.11 Curl. - The deviation from flatness of the film plane. A deformation caused by dimensional difference between the emulsion layer and the support. It results from changes in moisture content of the emulsion layer and support because of variations in relative humidity of the atmosphere.

3.1.2.12 Resolution. - The number of lines in a standard test pattern that can be counted by the human eye using a suitable optical aid. If the number of lines that can be counted in the image is not the same as the number in the original pattern, the resolution is spurious and the image is considered to be not resolved. In some patterns, when the lines cannot be counted in the body of the pattern, it is possible to count the lines in the pattern at the end of the image.

In such cases, the image is considered to not resolved. The image of the test pattern shall also be considered not resolved if the image of the test pattern of the next lower spatial frequency is not resolved.

4. MATERIALS and THEIR CHARACTERISTICS

4.1 General. - The film used to make the transparency shall consist of a film base with color emulsion layers. The film shall be free of any physical defects and possess the characteristics described hereinafter.

4.2 Film Base. - The film base shall be a polyester or equivalent film and shall include optical transparency and freedom from imperfections; chemical stability to resist moisture and processing chemicals; photographic inertness to emulsions; non-color selectivity, mechanical toughness, flexibility, dimensional stability, freedom from physical distortions, and supplied perforated or non perforated as specified. The uncoated base support density shall not exceed 0.005.

4.3 Safety Base. - The base material shall meet the safety limits as defined in ANSI Standard PH 1.25 "Safety Photographic Film."

4.4 Antihalation Protection. - Antihalation protection shall be provided. The protective layer shall be bleached or completely removed during processing without interfering with the normal functioning of the processing solutions and without requiring any special manipulation of the film.

4.5 Tensile Strength. - The force applied parallel to the plane of the film, required to cause permanent deformation (YIELD) and rupture (BREAK) of the film sample. The tensile properties of the film shall be determined by ASTM procedure D882-67 and must exhibit a minimum yield strength of 13,500 psi and a minimum break strength of 25,000 psi.

4.6 Film Widths. - Film widths shall be slit in accordance with Table I shown below. Dimensions shown apply to the material immediately after slitting.

TABLE I

Nominal Film Width	Film Width Tolerance (inches)
16 mm	0.628 ± 0.001
35 mm	1.377 ± 0.002
70 mm	2.754 ± 0.002
105 mm	4.134 ± 0.005
3 1/4 inches	3.245 ± 0.005
5 inches	4.960 ± 0.010
7 inches	6.991 ± 0.010
9 1/2 inches	9.460 ± 0.010

4.7 Film Thickness. - The thickness of the sensitized base film shall conform to Table II.

TABLE II

Thickness (inches)
0.0025 ± 0.0005
0.0033 ± 0.0007
0.0044 ± 0.0008
0.0054 ± 0.0010
0.0075 ± 0.0015

4.8 Thermal Coefficient of Expansion. - The coefficient of thermal expansion of the sensitized film shall not exceed 0.0015 percent per degree of Fahrenheit or 0.0027 percent per degree Centigrade change in temperature in the range of 70° to 175°F (21° to 80°C).

4.9 Hygroscopic Coefficient of Expansion. - The coefficient of hygroscopic expansion of the sensitized film shall not exceed 0.0035 percent for each percent of change in the relative humidity in the range of 15 percent to 50 percent at 70°F (21°C).

4.10 Permanent Change in Linear Dimension. - Dimensional changes which occur as a result of processing are permanent and shall not exceed 0.10 percent.

4.11 Photographic Characteristics

4.11.1 Reduction. - The maximum reduction ratio is primarily determined by the quality combination of optics and films. Currently the reduction ration with color film is in the order of fifteen to one.

4.11.2 Reduction Displacement. - Image displacement due to reduction shall not exceed 0.3 percent at any point within the frame aperture.

4.11.3 Base Plus Fog Density. - The base plus fog density in the clear areas of the complete processed photographic films (color) shall not exceed 0.20 density units for negative color films and 0.20 density units for reversal color films. The clear areas shall be free of discoloration.

4.11.4 Color Density/Saturation. - Color transparencies shall have the specified minimum/maximum densities when read with color filters recommended by the film manufacturer for that particular color film.

Figure 1 illustrates a typical tone reproduction curve of a final color transparency using the standard densitometric measuring technique.

4.11.5 Plotting the Characteristic Curve. - The average diffuse visual transmission density of each step on the film strip shall be plotted against the corresponding logarithm of the exposure on a test sheet similar to that shown on figure 1.

4.11.6 Determination of Average Gradient of a Tone Reproduction Curve. - The average gradient is the slope of the straight line drawn between points E_1 and E_2 on the tonal reproduction curve typically shown in figure 1. Point E_1 shall be a point on the curve where the density is at lease 0.10 above the base plus fog density. Point E_2 shall be a point on the curve which is at least 1.20 above the base plus fog density.

4.11.7 Screen Reproduction. - Transparencies made from screened masters shall present a tonal effect equivalent to the original screened area, although the screen pattern need not be maintained.

4.11.8 Color/Gray Scales Guides. - The test chip transparency shall contain an acceptable gray scale (minimum 10 steps) and a nine color control guide as specified.

4.12 Protective Coating. - The processed transparency shall be coated with a clear protective substance to afford mechanical protection to the base and emulsion. The coating shall

contain fungus inhibitors and shall resist deterioration by salt water moisture. The protective coating shall be uniform in thickness.

4.13 Physical Defects. - The materials and their characteristics shall be such that the finished transparency shall be free from physical defects upon visual inspection.

5. TEST EQUIPMENT AND TECHNIQUES

5.1 General. - All film transparencies shall be tested in accordance with the equipment, methods, and other provisions of this standard and the applicable detail specifications for determining acceptable quality.

5.1.1 Densitometer. - The densitometer, used in these tests, shall have a repeatable accuracy of plus or minus 0.02 in the density range from 0 to 1.00 and plus or minus 0.05 in the density range from 1.00 to 3.00. The densitometer shall provide type P2-b density as specified in ANSI Standard PH 2.19-1959. The color separation filters used in the densitometer shall be the filters recommended by the film manufacturer for reading color densities of the film used in preparing the output transparency.

5.1.2 Dimensional Change Gauge. - The dimensional change gauge shall be the "pom gauge" or optical guage described in ANSI Standard PH 1.32-1959 or equivalent.

5.1.3 Constant Humidity Chamber. - A room or cabinet, which meets the requirements of section 4, ANSI Standard PH 1.32-1959, shall be used for those tests requiring controlled conditions of temperature and relative humidity.

5.1.4 Color Resolution. - Resolution in the color transparencies shall be a minimum of 70 lines per millimeter in the center, and minimum of 50 lines per millimeter at the corners. Using a minimum of five National Bureau of Standards (NBS) microcopy resolution tests charts (1000:1 Brightness range) for formats up to 35 mm, nine resolution test charts for 70 mm formats, and thirteen resolution test charts for the larger size formats and positioned as indicated in figure 2. Measurements will be made with a microscope having a 50-100X magnification, as defined in "Instructions for the Use of the National Bureau of Standards Microcopy Resolution Test Chart." (See paragraph 3.1.2.12) The exposure and processing of the test samples shall use the same procedures and equipment used to produce the final transparencies.

6. QUALITY TESTS

6.1 General Description. - The following is a general description of the methods which shall be used to determine the physical properties of the film transparencies to be tested. Only those tests which are necessary to determine the characteristics for which specific values of ranges are given in the applicable detailed specification, shall be performed.

6.1.1 Dimensional Change Characteristics of Color Film

6.1.1.1 Humidity Coefficient Test. - The procedures, calculations, and reporting of this test shall be in accordance with ANSI Standard PH 1.32-1959.

6.1.1.2 Dimensional Change Due to Processing Test. - Tests for dimensional change characteristics due to processing shall be conducted in accordance with procedure I of ANSI Standard PH 1.32-1959.

6.1.1.3 Dimensional Change Due to Processing Plus Aging Tests. - These tests shall be conducted and reported in accordance with ANSI Standard PH 1.32-1959. The aging conditions shall be 120° ± 5°F (49° ± 2°C) and 20 plus or minus 2 percent relative humidity. The aging time shall be at least one week.

6.1.2 Brittleness Test. - The brittleness test shall be conducted with raw stock (unexposed, unprocessed) photographic film and shall be in accordance with method "B" (Wedge Test) of ANSI Standard PH 1.31-1958. The testing temperature shall be 70° ± 2°F (21° ± 1°C), and the testing relative humidity shall be 14 plus or minus 2 percent. The raw brittleness shall be 0.5 inches ± 0.03.

6.1.3 Curl Test. - The film transparency shall be tested in accordance with ANSI Standard PH 1.29-1958.

6.1.4 Thermal Coefficient of Expansion Test. - The film transparency shall be subjected to the thermal coefficient of expansion test as described in section 7 of the ANSI Standard PH 1.32-1959.

6.1.5 Film Chip Edges. - The film chip edges and perforations must be clean, smooth and free of burrs or tears.

TONE REPRODUCTION CURVE

MULTICOLOR MICROCHART / MAP TRANSPARENCY

DATE _____
NUMBER _____
PREPARED BY _____
PRODUCT _____
CLASSIFICATION _____
MANUFACTURER _____
EXPIRATION DATE _____
EMULSION NUMBER _____
SENSITOMETER _____
LAMP _____
EXPOSURE TIME _____
WEDGE NUMBER _____
DEVELOPER _____
TIME _____
TEMPERATURE _____ °F

TOTAL DENSITIES

F		11	
1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8		19	
9		20	
10		21	

BASE DENSITY _____

FOG _____
INC. FOG _____
SENSITOMETRIC PROPERTIES
SPEED ( ) _____
GAMMA _____

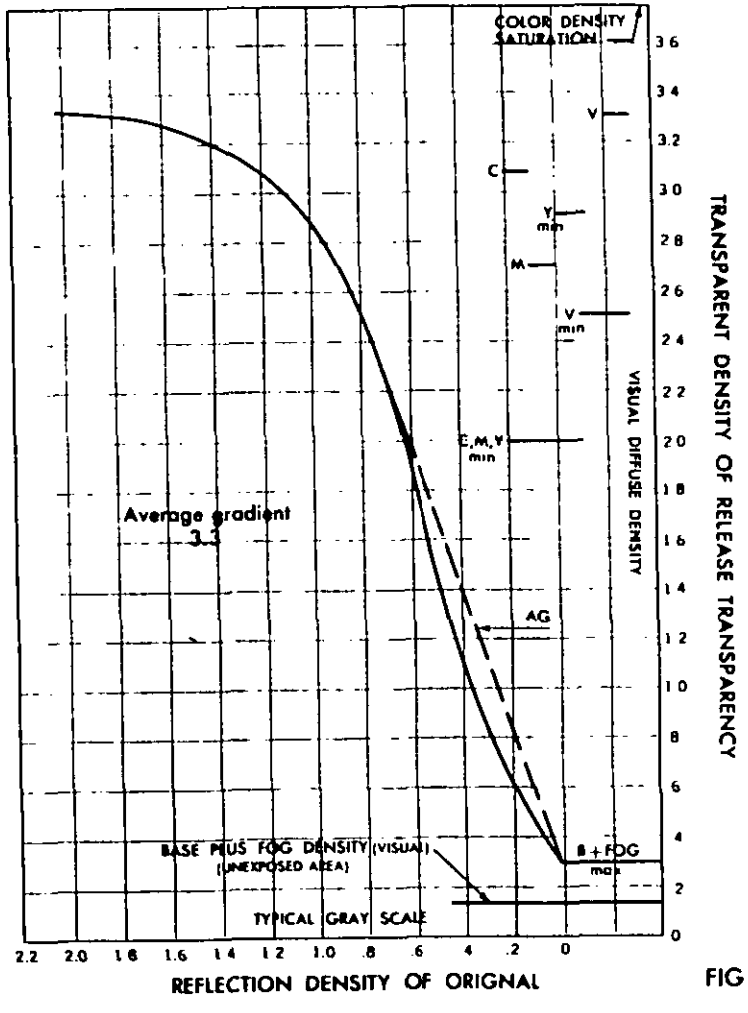
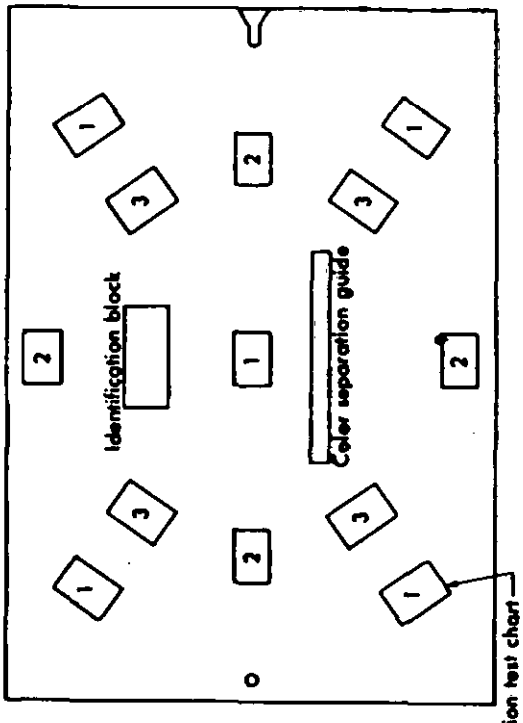


FIG 1

FIG 2

TEST TRANSPARENCY STANDARD



For formats up to 35 mm use 5 NBS test charts 1
For formats at 70 mm use 9 NBS test charts 1 & 2
For formats at 103 mm use 13 NBS test charts 1, 2 & 3

7. FILM CHIP TRANSPARENCY FORMAT

7.1 General. - It is desirable to standardize on a minimum number of differing formats, and a single one would be preferable. On the other hand, film chip formats must be designed so as not to unduly restrict satisfaction of functional variations in operational requirements. Consequently, it is the intent that this Standard provide for a "family" of format sizes with each size being standard in overall dimensions and registration design. Variation in image area within a standard size is permissable. Initially the family of sizes includes 105, 70 and 35 mm formats. Additional standard sizes may be added if required.

7.2 Format. - Shall be as shown in Figures 3, 4 and 5 for 105, 70 and 35 mm standard sizes, respectively. Registration is accomplished by a pin hole (diameter 0.0625" $\pm$ 0.0001) on one side and slot (0.0625" $\pm$ 0.0001 in width and 0.1256" in length) on the other side. The slot is used in lieu of a second circular hole to permit varsatility in the registration design for imaging, storage and retrieval, and display hardware. The reference point for all linear dimensions is the geometric center of the circular hole of the film chip. It is intended that the hole and the slot registration points shall be perforations made by protrusions designed into the camera back of the micro-charting camera.

Custodian:
Navy - AS
Army - EL
Air Force - 11

User Activity:
Army
Navy
Air Force (11)

Reviewer Activities:

DIAMC

Preparing Activity:
Navy - AS
(Project No. 6605-0221)

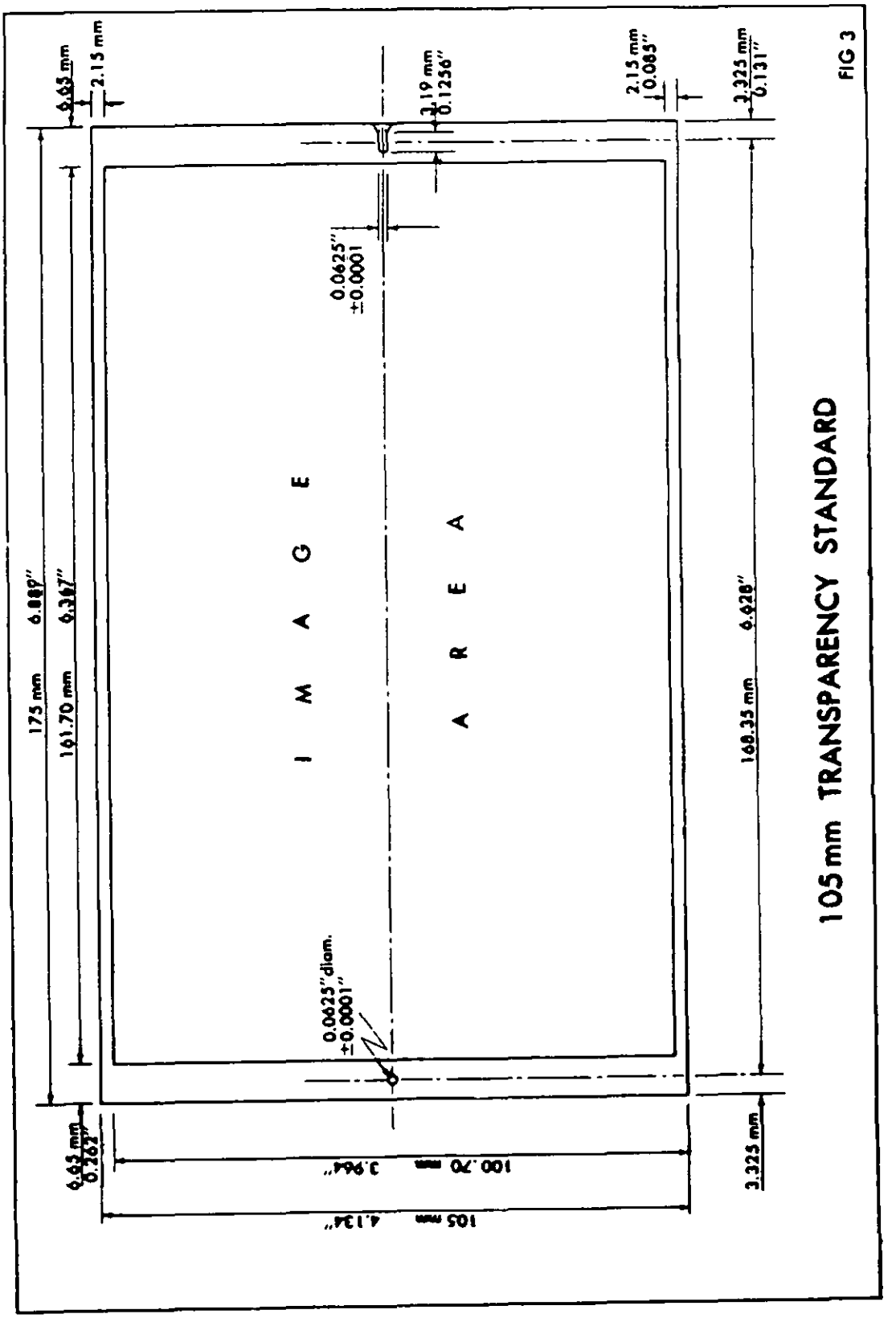


FIG 4

70 mm TRANSPARENCY STANDARD

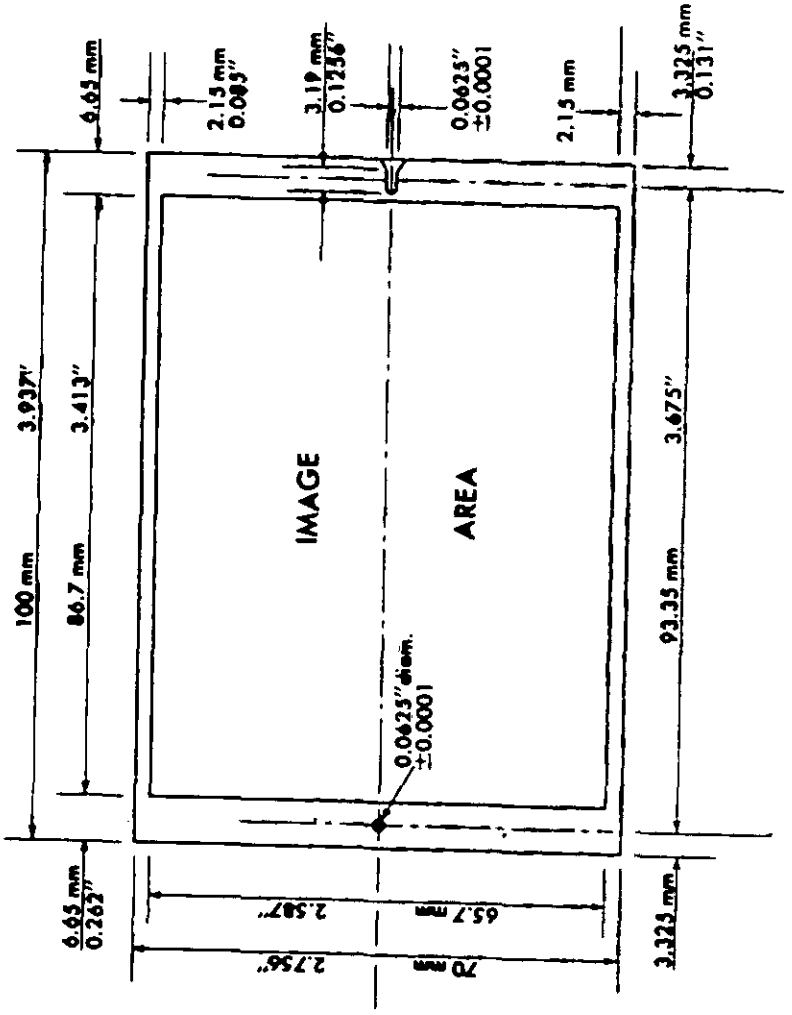
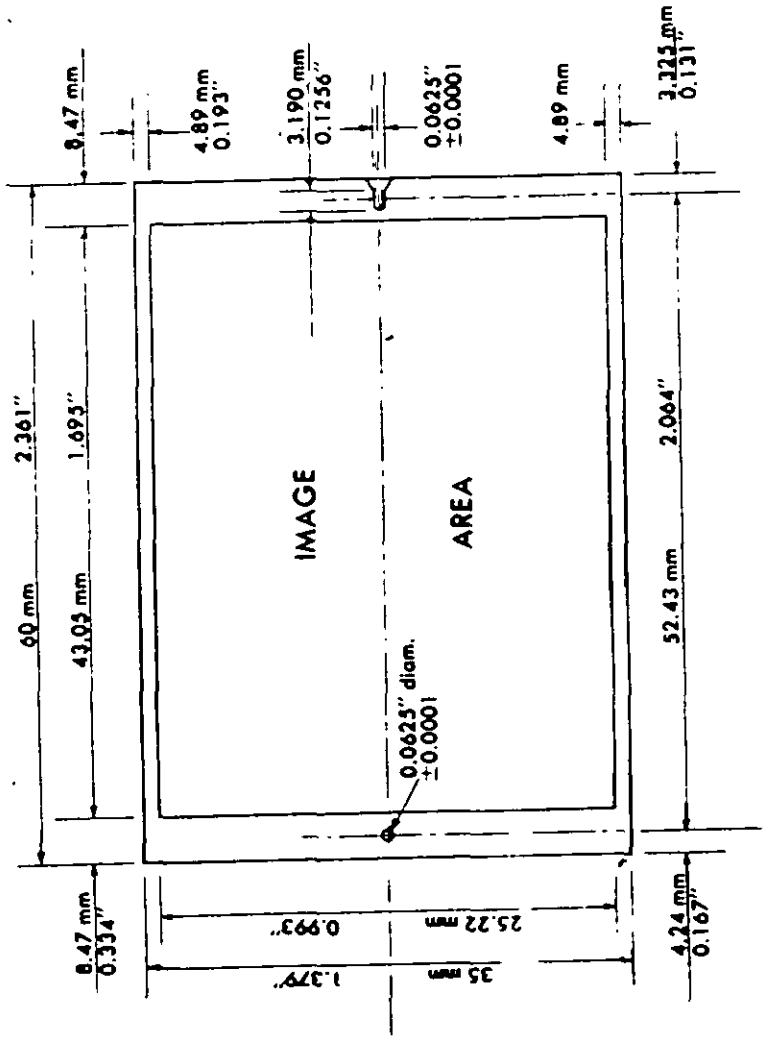


FIG 5



35mm TRANSPARENCY STANDARD