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MILITARY STANDARD

RECONNAISSANCE/MAPPING

DATA MARKING

NO DELIVERABLE DATA REQUIRED BY THIS DOCUMENT

FSC MISC

DEPARTMENT OF DEFENSE

Washington, D.C. 20301

RECONNAISSANCE/MAPPING DATA MARKING

MIL-STD-782D

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ AFLC CASO/LODS, Federal Center, Battle Creek MI 49016 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

This standard establishes a common reconnaissance/mapping data marking system to be used by the Army, Navy, Air Force and Marine Corps as directed by the Department of Defense. All existing data marking systems are to be converted to the binary-coded-decimal system described herein. No film types, developers or gammas are specified in this standard.

CONTENTS

FIGURES

1. SCOPE

1.1 General. This standard establishes the dimensions, coding methods, quality of dot image, and number character positions for the code matrix block utilized in the Department of Defense Reconnaissance/Mapping Data Marking System.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. 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.

REGULATION

DEFENSE INTELLIGENCE AGENCY

No. 55-2 - Data Recorded on Reconnaissance/Mapping Imagery

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

3. DEFINITIONS

3.1 Code Matrix Block. A code matrix block (CMB) is a pattern of dots recorded on film simultaneously with sensor operation. The CMB provides digital information pertaining to the location and orientation of the sensor and/or vehicle which exposed the imagery, the sensing group, and time of exposure.

3.2 Isolated Dot. Any dot is an isolated dot if its center is at least 0.0574 centimeters (cm) [0.0226 inches (in)] away from all other dot centers.

3.3 Film Analyzer. The film analyzer is an instrument used to measure and record change in dot density as a function of displacement across the dot. The film analyzer shall resolve a 25.4 micrometers (μm)[1 mil (0.001 inch)] spot diameter at the sample film plane. The film analyzer shall utilize a photomultiplier sensor of S-4 spectral response, collimated to measure light received within a conical angle of acceptance of 0.008725 radian (rad)(0.5 degree). This 0.008725 rad (0.5 degree) acceptance angle shall subtend, through an objective of suitable magnification, the 25.4 μm (1 mil) spot-diameter resolved at the film plane.

Density is herein defined as Log 10 1/T where T equals the percent light transmission through the 25.4 µm (1 mil) spot-T diameter resolved at the film plane. Calibration of density shall be accomplished by interposing neutral density filters at the film sample plane. Density increments of 0.50 throughout a range of 0.00 to 3.00 are suggested for use in calibration.

4. GENERAL REQUIREMENTS

4.1 Intended requirements of this standard. It is intended that the requirements of this standard be met for whatever film types, developers or gamma are required by a particular reconnaissance sensor.

5. DETAILED REQUIREMENTS

5.1 Code Matrix Block Format. The information and specific format of characters within the CMB shall be as shown in latest revision DIAR 55-2.

5.2 Coding Method. The information in the CMB shall be coded digitally in excess three binary coded decimal (BCD) as shown in Figure 1.

5.3 Data Matrix. The data shall be arranged in three columns of 32 BCD characters per column as shown in Figure 2.

5.4 Interpretation of Code Matrix Data. The method of interpretation of the code matrix data shall be as follows: Each character consists of an index bit, four excess three BCD bits, and an odd parity bit. Odd parity is correctly indicated when the count of dots across one column is an even number. The bit order is Index, D4, D3, D2, D1, and parity where D4 is the teen possibilities shown in Figure 1. Identification of a particular character shall be by column-letter and row number as shown in Figure 2.

5.5 Code Matrix Block Dimensions. The dimensions for a static recording of the CMB shall be in accordance with those shown in Figure 2 and the information contained in a, b, c, d, e, f, g, and h below:

a. Reference line A is a best fit straight line as shown in Figure 2. No dot on the reference line shall have its center depart from the reference line by more than 0.00508 cm (0.002 inch).

b. Within any given digit, no bit dot center shall depart more than 0.00508 cm (0.002 inch) from a line drawn through the center of its index dot parallel to reference line A.

c. Reference line B is a best fit straight line as shown in Figure 2. No index dot center in column Y shall depart from the reference line by more than 0.03048 cm (0.012 inch).

d. Also as in (c.) above, no index dot center shall depart more than 0.03048 cm (0.012 inch) from a line drawn parallel to reference line B through the index dot files of column X or column Z. In addition, no index dot center shall depart from the adjacent index dot center by more than 0.00762 cm (0.003 inch).

e. The data matrix shall be aligned so that reference line A is parallel to within 0.05235 rad (3 degrees) of the edge of the film. Reference lines A on all data matrices recorded on a continuous roll of film shall not depart more than 0.00349 rad (0.2 degrees) from the first data matrix.

f. Skew of the CMB, as a result of Forward Motion Compensation (FMC), shall not exceed 0.150 cm (0.059 inch) for the displacement of the dots in row 1 with respect to the dots in row 32 within the same column. This 0.150 cm (0.059 inch) is in addition to the tolerances already specified. Skew of the CMB shall be such that row 1 is in a clockwise rotation about row 32. The maximum FMC condition is illustrated in Figure 3.

g. The 1.356 $\pm$ .152 cm (0.534 $\pm$ 0.060 in) and 0.841 $\pm$ 0.094 cm (0.331 $\pm$ 0.037 in) dimensions as shown in Figures 2 and 3 have precedence over all other dimensions in determining the acceptable maximum or minimum size of CMB.

h. No index dot center shall be closer to an adjacent index dot center than 0.0381 cm (0.015 inch).

5.6 Position of Code Matrix Block. The position of the CMB in early insensor recording systems was positioned from the edge of the film as shown in Figures 4A, 4B, 4C, 4D, and 5. Unless future designs prohibit this placement, the location of the CMB shall be as shown in the above figures. In any event the CMB to edge of film tolerance specified in the above figures must be maintained. The minimum distance shown between successive data blocks in the various figures denotes dwell periods in which the search circuits of an automatic reader may be inactive. This separation when established shall be consistent throughout the entire length of the film. It shall be a requirement that all dots of the CMB maintain a minimum separation of 0.0457 cm (0.018 inch) from the boundary of the uniform background density area. In Figure 4B,

4C and 4D the dashed line from the CMB indicates the photography for which the CMB refers.

5.7 Shape and Density of an Isolated Dot. The shape of an isolated dot is based upon scanning through the center of an isolated dot with a film analyzer (see 3.3) with a 1 mil spot size. The dot is assumed circular, so that the direction of the scan is unimportant. Figure 7 shows a portion of such a recording. That recording must then be shown to fall within the envelope of Figure 8 (the non-shaded area). There may be one spike extending downward into Area "A" which might result from a fiber optic or phosphor blemish. The spike shall not exceed 0.0381 millimeters (mm) (0.0015 inch) in diameter at the point of entry into area "A". Any other excursion outside the envelope is cause for rejection of the isolated dot. In this case, Figure 8 was scaled onto Figure 7 and the isolated dot is seen to be not acceptable. The prescribed shape is on an absolute distance scale. But a relative density scale, with 100% being the change in density between the peak density of the dot and the background density (see Figure 6). The exact center of an isolated dot is defined when Figure 8 is scaled onto the film analyzer tracing (see Figure 7). The relationship between the peak dot density and the background density is extremely important. Certain minimum standards are shown in Figure 9. This figure shows the dot density as a function of the background density for both negative and positive film. Figure 9 depicts an area for dots on negative film bounded by a 0.4 minimum density difference. The area for dots on positive film is similarly bounded by a 0.5 minimum density difference. Therefore, to be acceptable, an isolated dot must fall within the proper area (negative and positive) otherwise it will be rejected even though it meets the shape criteria of Figure 8. Figure 8 is the envelope for negative dots. Variation between the maximum peak density recorded in the CMB to the minimum peak density recorded in the CMB shall not exceed 30% of the maximum peak density. This is to insure reasonable uniformity over the entire CMB.

5.8 Minimum Density. The minimum density difference between center dot density and interdot density shall be 0.3.

DATA MATRIX CODING

The data matrix is coded in excess three binary coded decimal. This system uses decimal numbering but it is recorded in a coded binary form as listed below. It is read as a normal binary system, that is right to left, making a summation of the significant bits, then subtracting three to obtain the decimal values tabulated below:

DECIMAL VALUE	INDEX BIT	D4 8*	D3 4*	D2 2*	D1 1*	PARITY BIT	NUMERIC VALUE OR MEANING
-3	o					o	Not Used
-2	o				o		Minus Sign
-1	o			o			Error
0	o			o	o	o	Zero
1	o		o				One
2	o		o		o	o	Two
3	o		o	o		o	Three
4	o		o	o	o		Four
5	o	o					Five
6	o	o			o	o	Six
7	o	o		o		o	Seven
8	o	o		o	o		Eight
9	o	o	o			o	Nine
10	o	o	o		o		Plus Sign
11	o	o	o	o			Special
12	o	o	o	o	o	o	Divider

NOTES:

1. The numerical figure by the asterisk (*) indicates the binary value of the recorded bit in that column.
2. The index mark is always present.
3. The parity bit is present to cause the total count of dots across one column (six dot positions) to be an even number. This provides the "parity check" to insure that the bit recording is correct.
4. The divider is used as a visual indicator to separate major groups of characters within the Code Matrix Block.
5. Significant bits progress from D4 (most significant) through D1 (least significant).
6. "Not Used" (decimal value -3) indicates that data is not available for recording.
7. "Error" (decimal value -1) indicates the information generated for recording is outside the range of the particular sensing device in use.

FIGURE 1

8. "Special" (decimal value 11) indicates that the information normally presented in this location will be recorded by some other recording device.
9. A plus or minus code may occur in the code matrix block. This is an acceptable coded digit. The plus and minus convention is as follows:

Latitude: +North -South Longitude: + East -West

Drift/Yaw: +A/C Nose Left of Ground Track; -A/C Nose Right of Ground Track

Roll: +Right Wing Down; -Right Wing Up Pitch: +Nose Up; -Nose Down

FIGURE 1 Data Matrix Coding - Continued

CODE MATRIX BLOCK DIMENSIONS

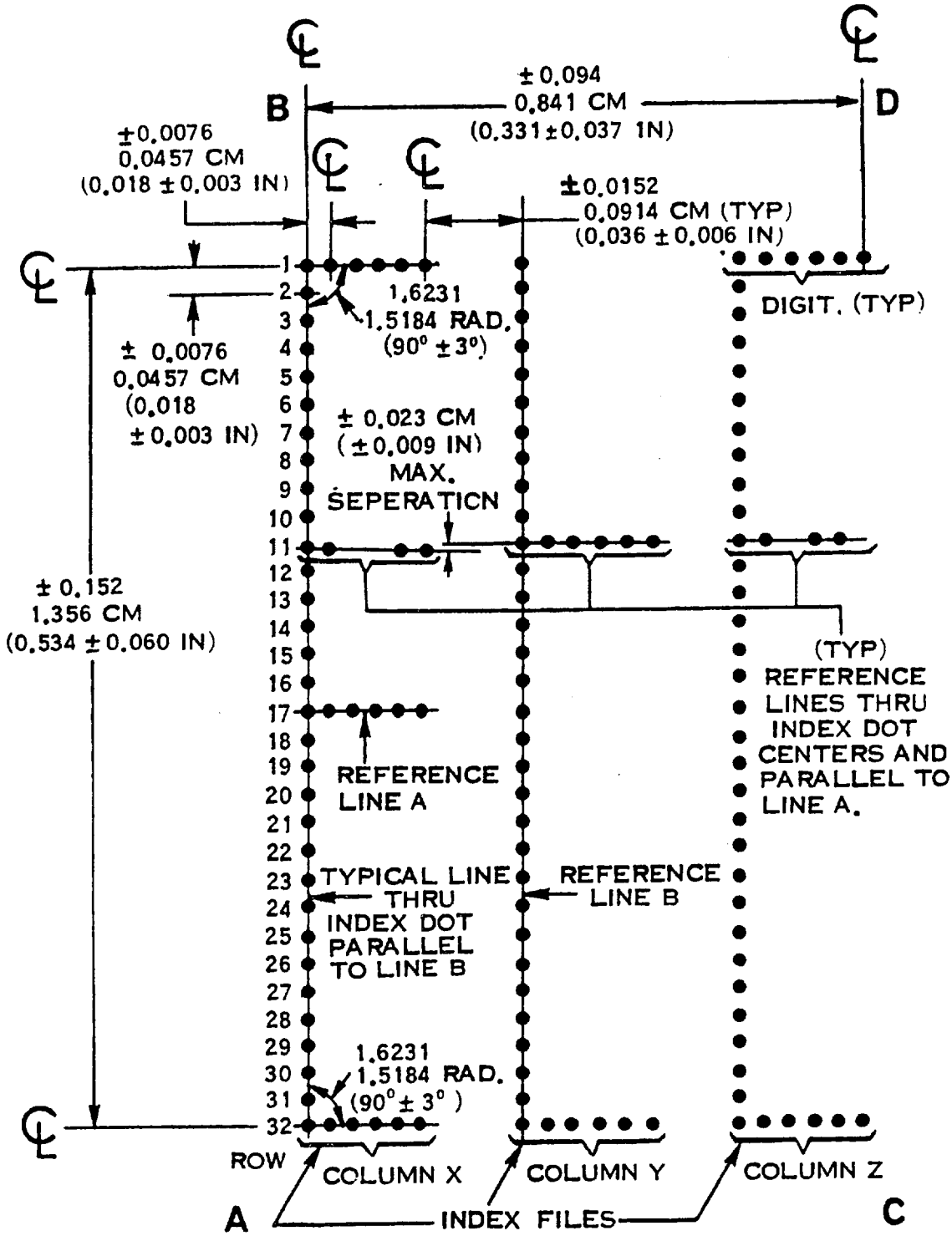
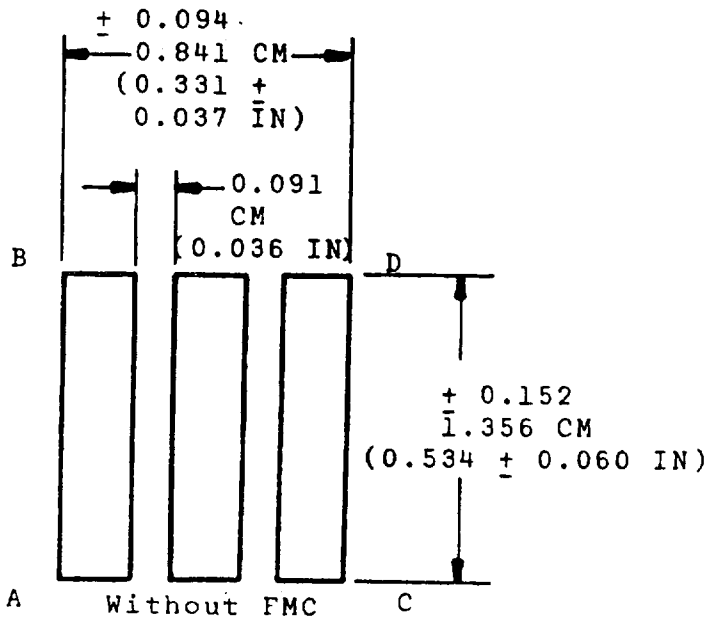
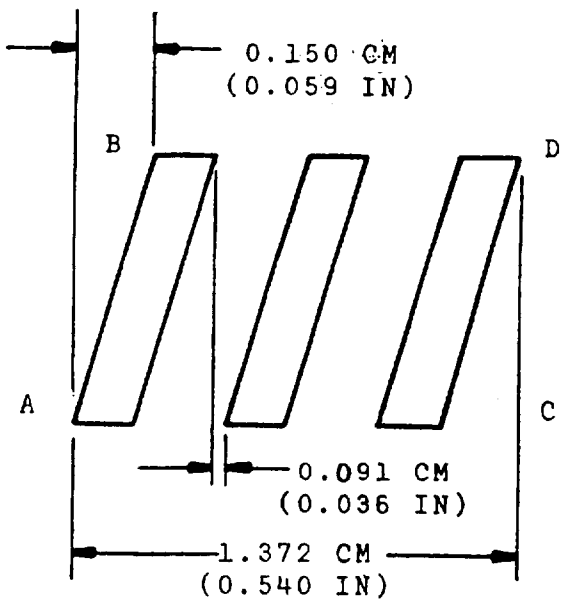


FIGURE 2

CODE MATRIX BLOCK WITH

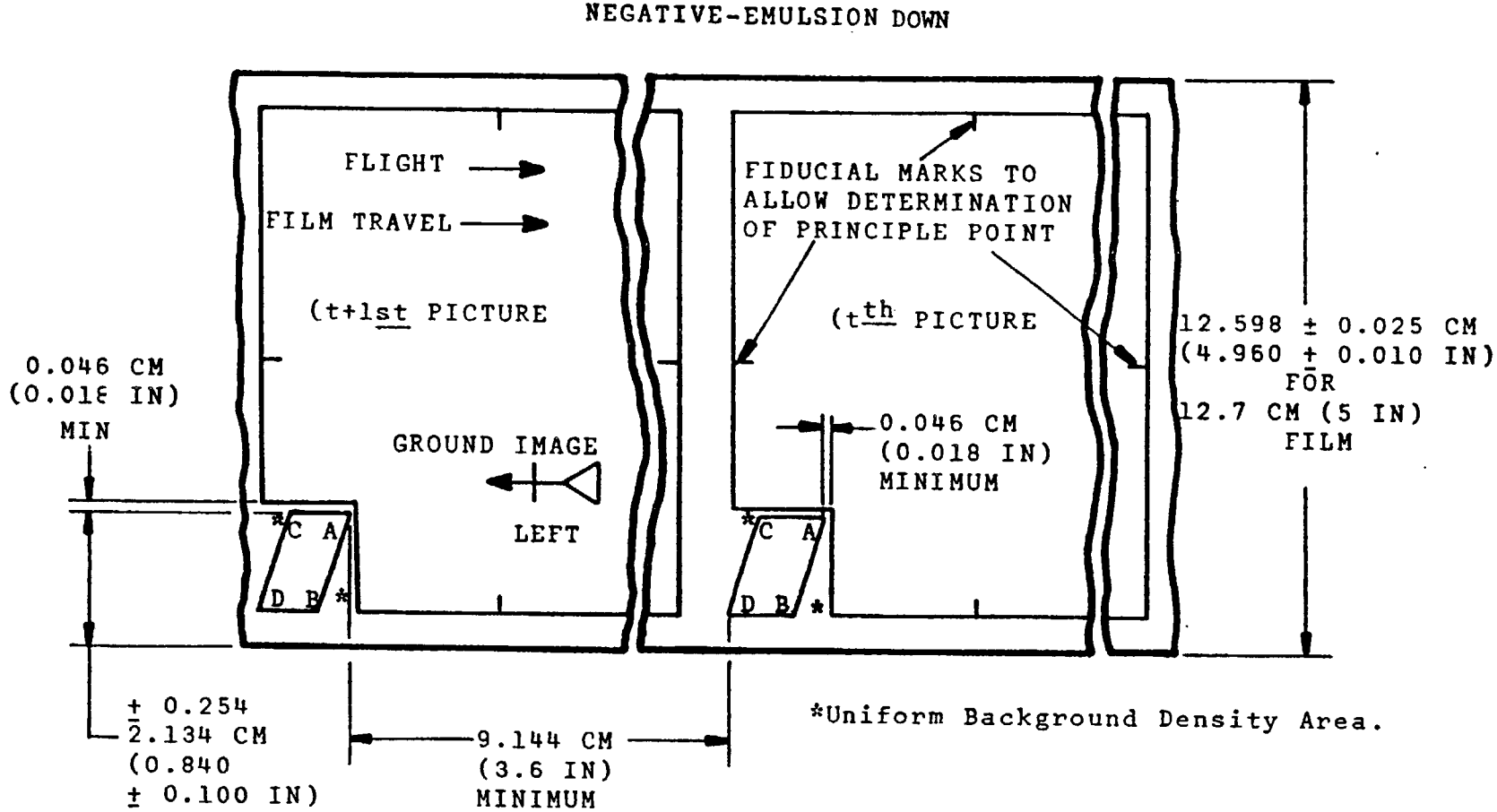
FORWARD MOTION COMPENSATION





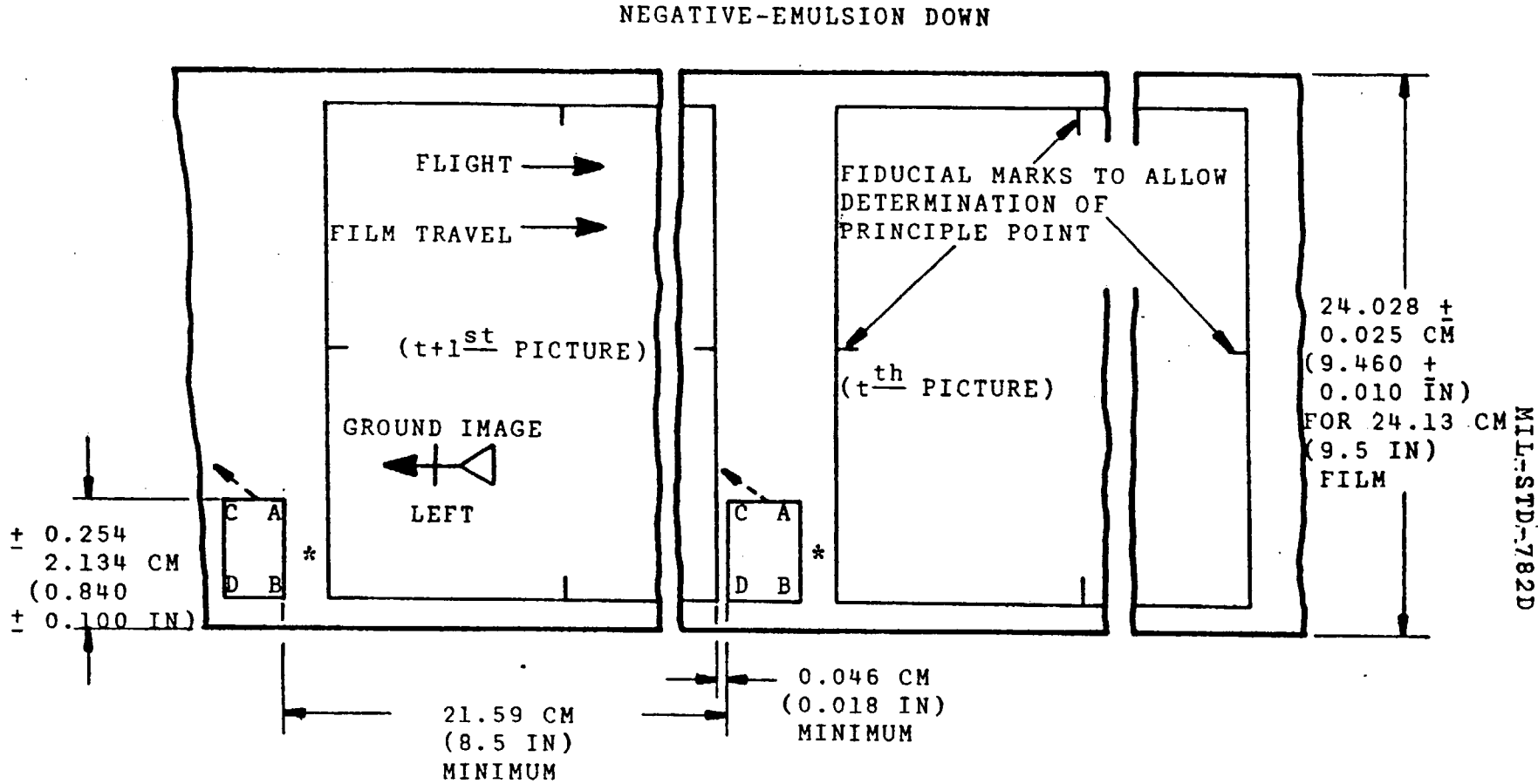
With Max, FMC

FIGURE 3



DIMENSIONS REFERRING TO THE CODE BLOCK ARE BASED UPON DOT CENTERS & OR ROW LINES.

FIGURE 4A. Frame Photography - Reconnaissance

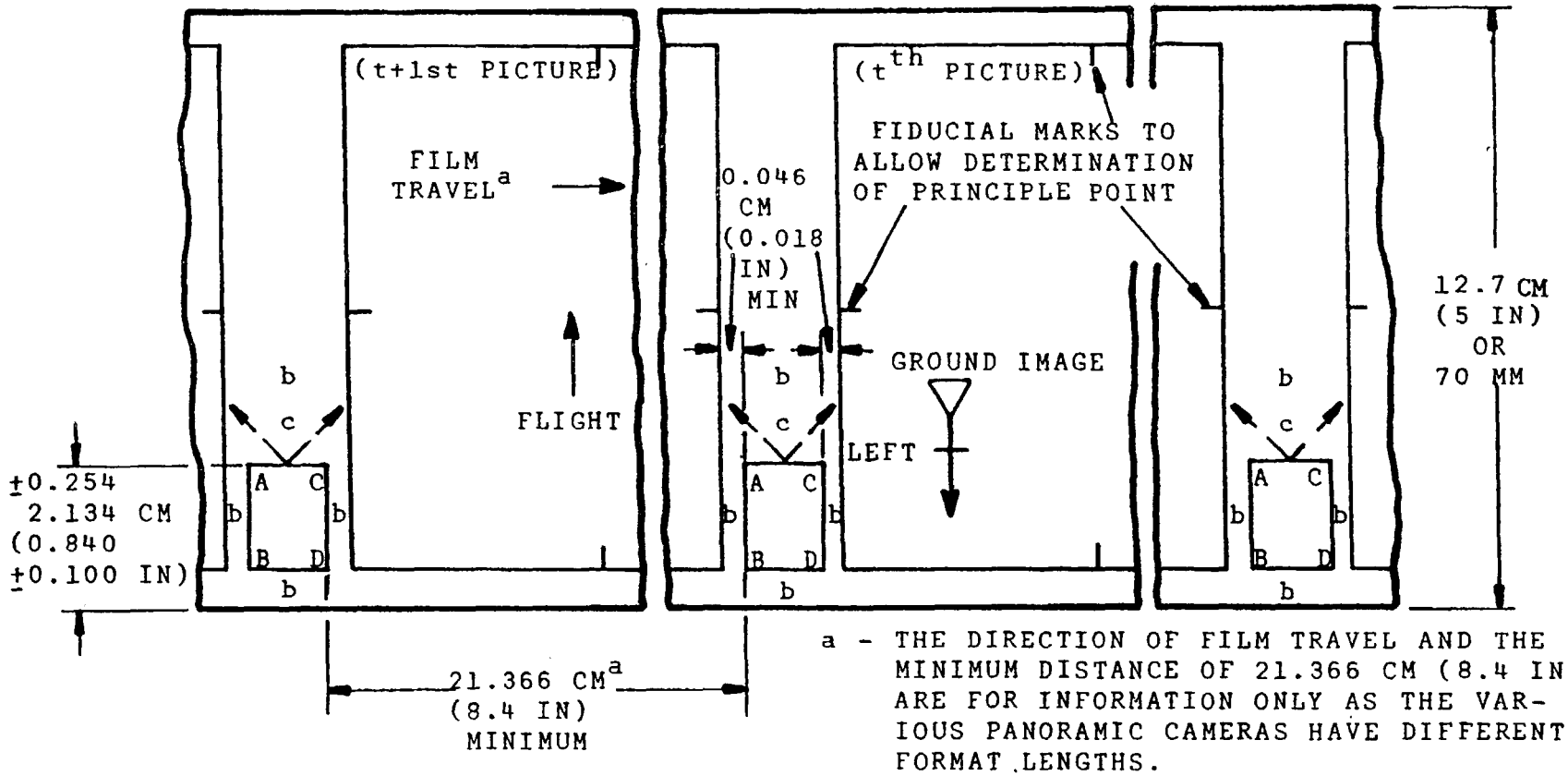


DIMENSIONS REFERRING TO THE CODE BLOCK ARE BASED UPON DOT CENTERS & OR ROW LINES.

*UNIFORM BACKGROUND DENSITY AREA

FIGURE 4B. Frame Photography - Mapping

NEGATIVE - EMULSION DOWN



a - THE DIRECTION OF FILM TRAVEL AND THE MINIMUM DISTANCE OF 21.366 CM (8.4 IN) ARE FOR INFORMATION ONLY AS THE VARIOUS PANORAMIC CAMERAS HAVE DIFFERENT FORMAT LENGTHS.

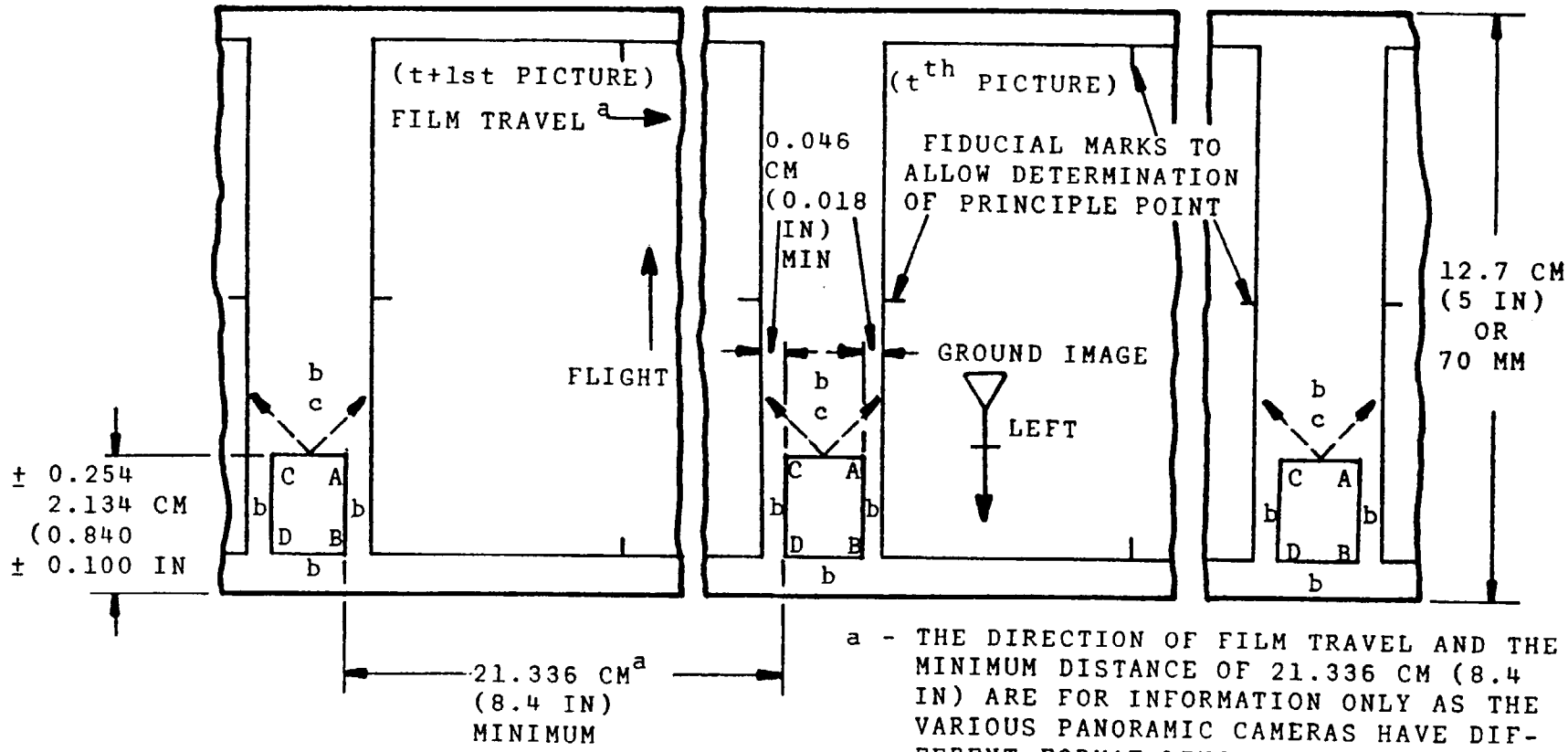
b - MINIMUM BACKGROUND DENSITY AREA

c - DATA BLOCK REFERS TO FRAME EITHER ON LEFT OR RIGHT

DIMENSIONS REFERRING TO THE CODE BLOCK ARE BASED UPON DOT CENTERS AND/OR ROW LINES.

FIGURE 4C. PANORAMIC CAMERA (MIRROR IMAGE)

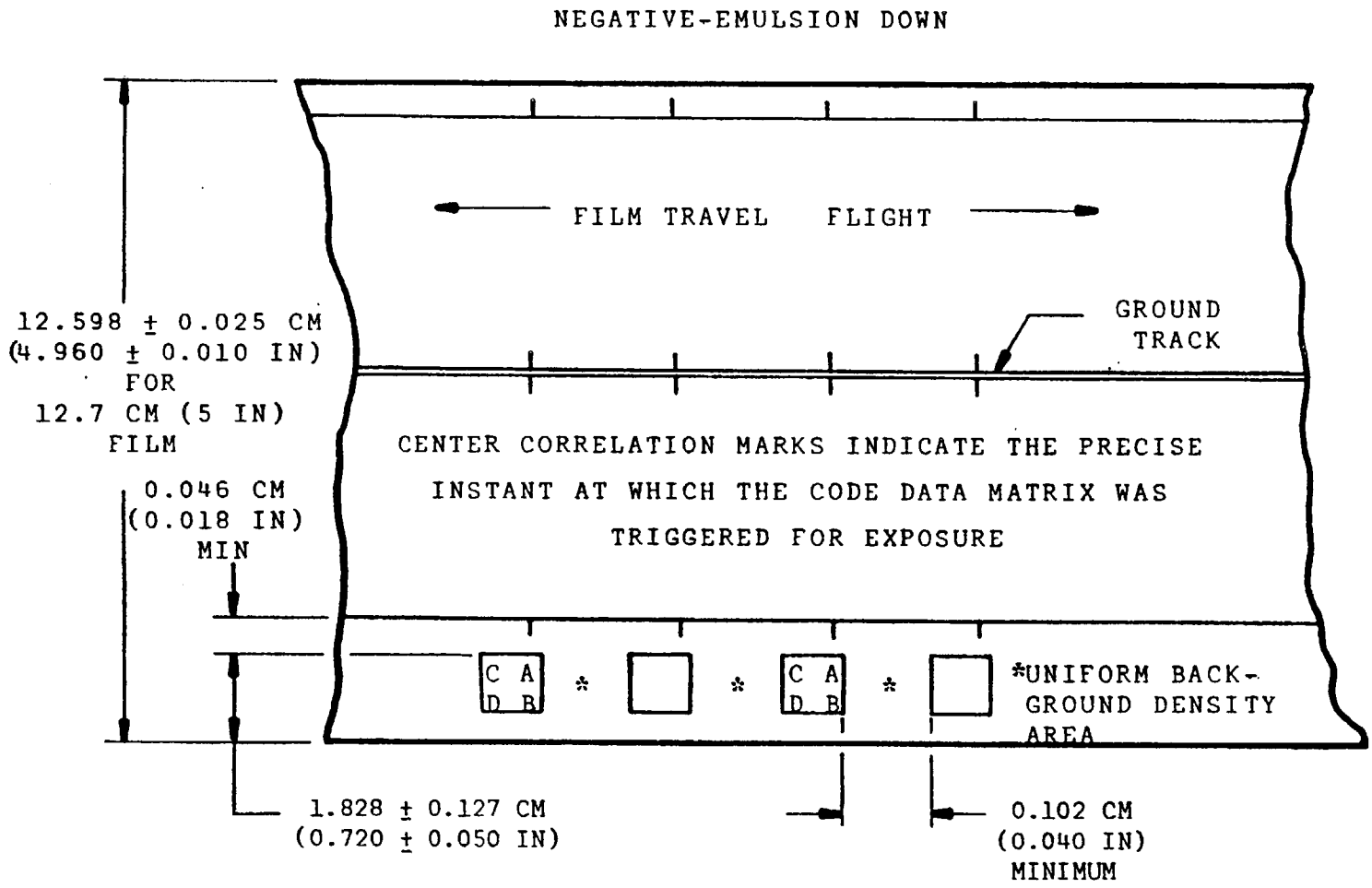
NEGATIVE - EMULSION DOWN



DIMENSIONS REFERRING TO THE CODE BLOCK ARE BASED UPON DOT CENTERS AND/OR ROW LINES.

a - THE DIRECTION OF FILM TRAVEL AND THE MINIMUM DISTANCE OF 21.336 CM (8.4 IN) ARE FOR INFORMATION ONLY AS THE VARIOUS PANORAMIC CAMERAS HAVE DIFFERENT FORMAT LENGTHS.
b - MINIMUM BACKGROUND DENSITY AREA
c - DATA BLOCK REFERS TO FRAME EITHER ON LEFT OR RIGHT

FIGURE 4D. PANORAMIC CAMERA



NOTE: On this example correlation marks are placed at 3.175 CM (1.25 IN) intervals whereas on other systems they occur more often. The two image areas on some systems are separated so that the CMB must be placed along center line of film.

DIMENSIONS REFERRING TO THE CODE BLOCK ARE BASED UPON DOT CENTERS & OR ROW LINES

FIGURE 5. Continuous Strip Recording

ISOLATED DOT

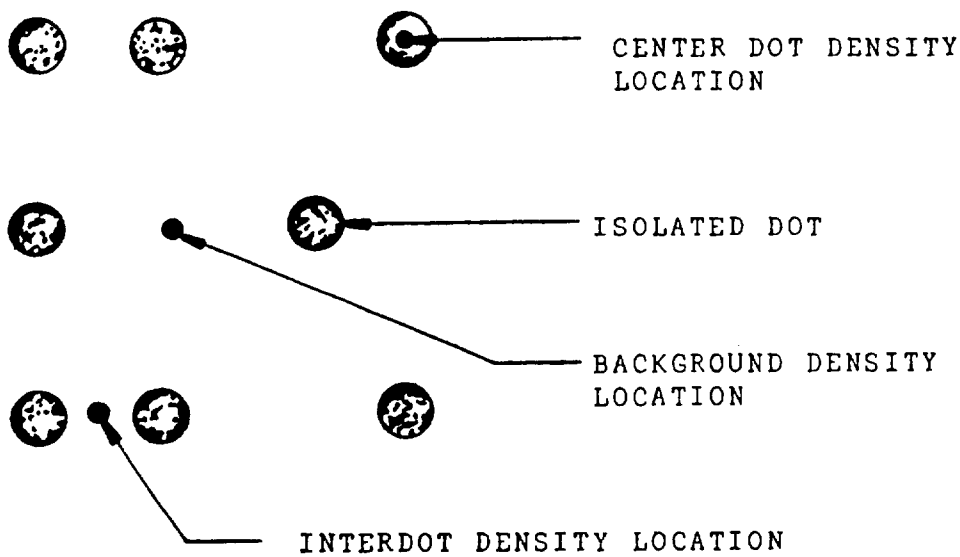


FIGURE 6

MICRODENSITOMETER RECORDING

[1 MIL (25.4 MICROMETER-μm) SPOT]

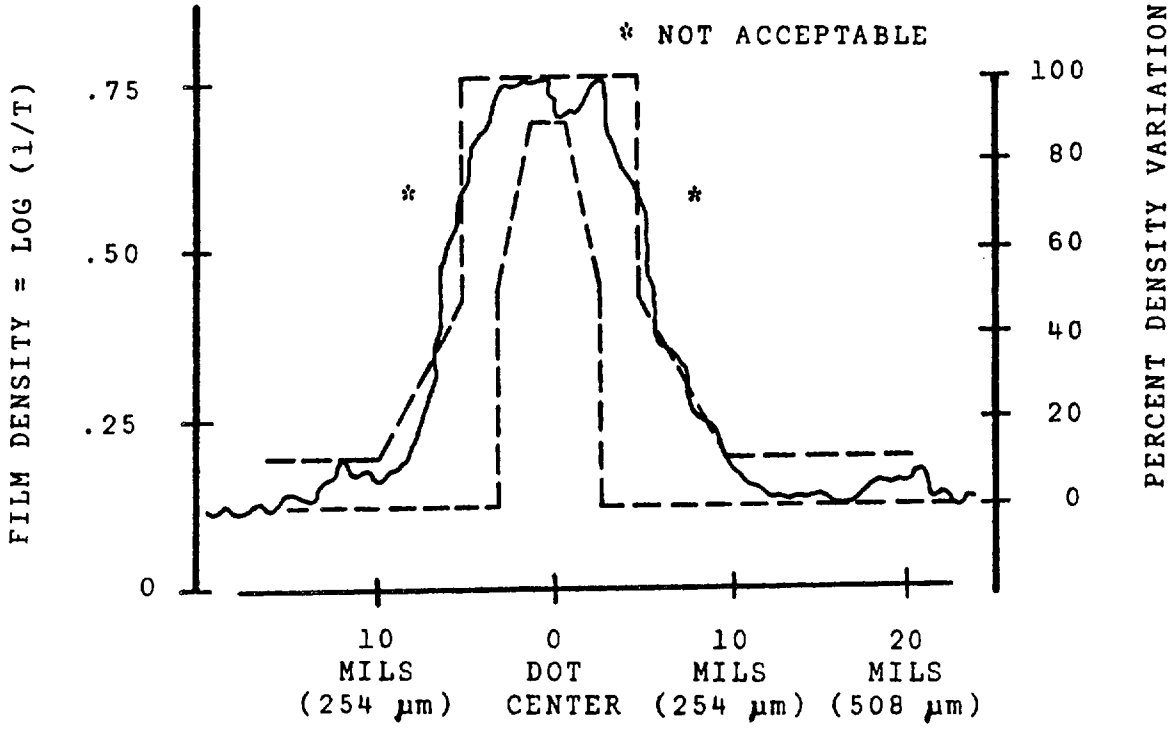


FIGURE 7

DENSITY AND DIMENSIONAL REQUIREMENTS
FOR AN ISOLATED DOT

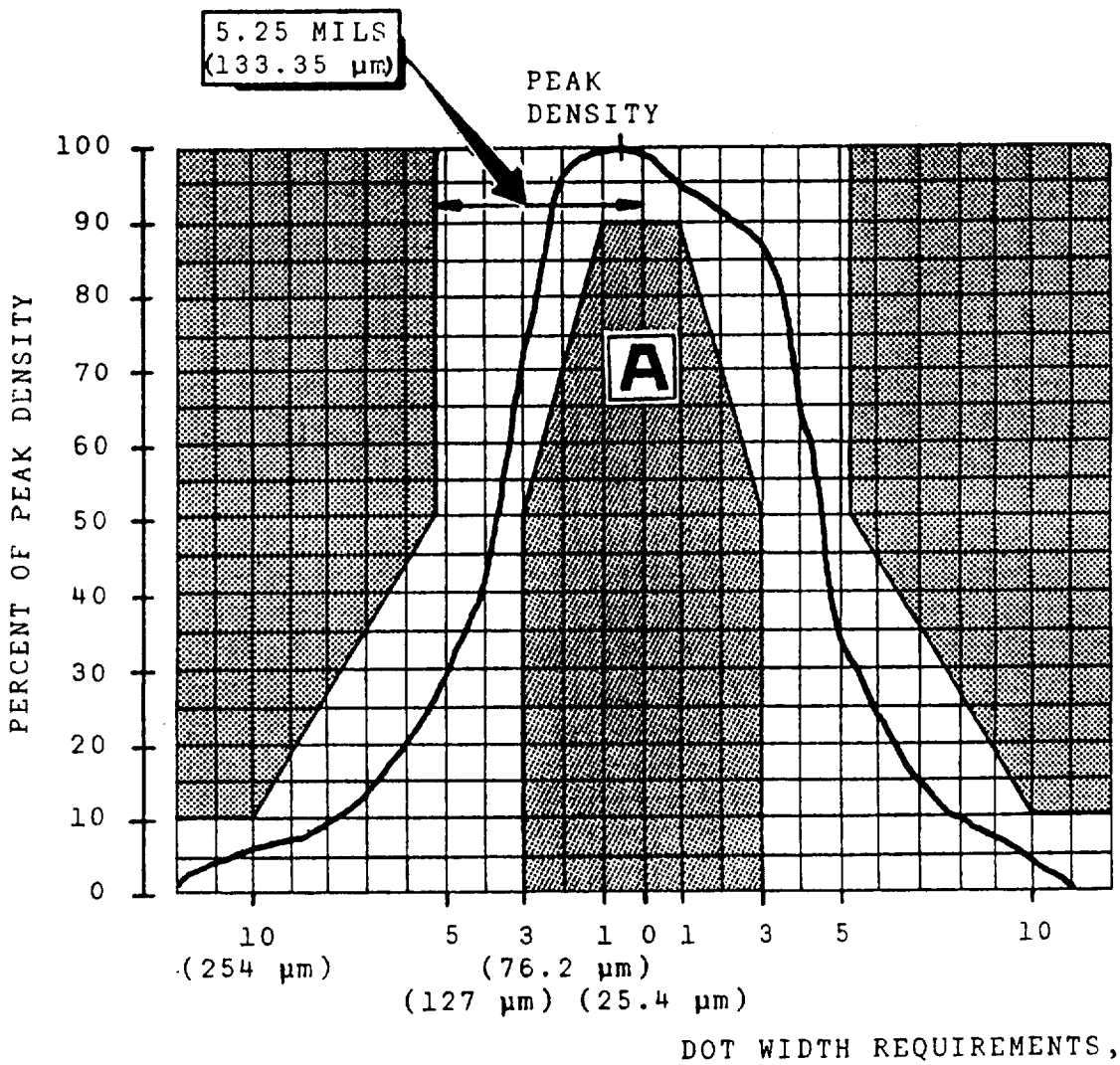


FIGURE 8

READABILITY REGIONS

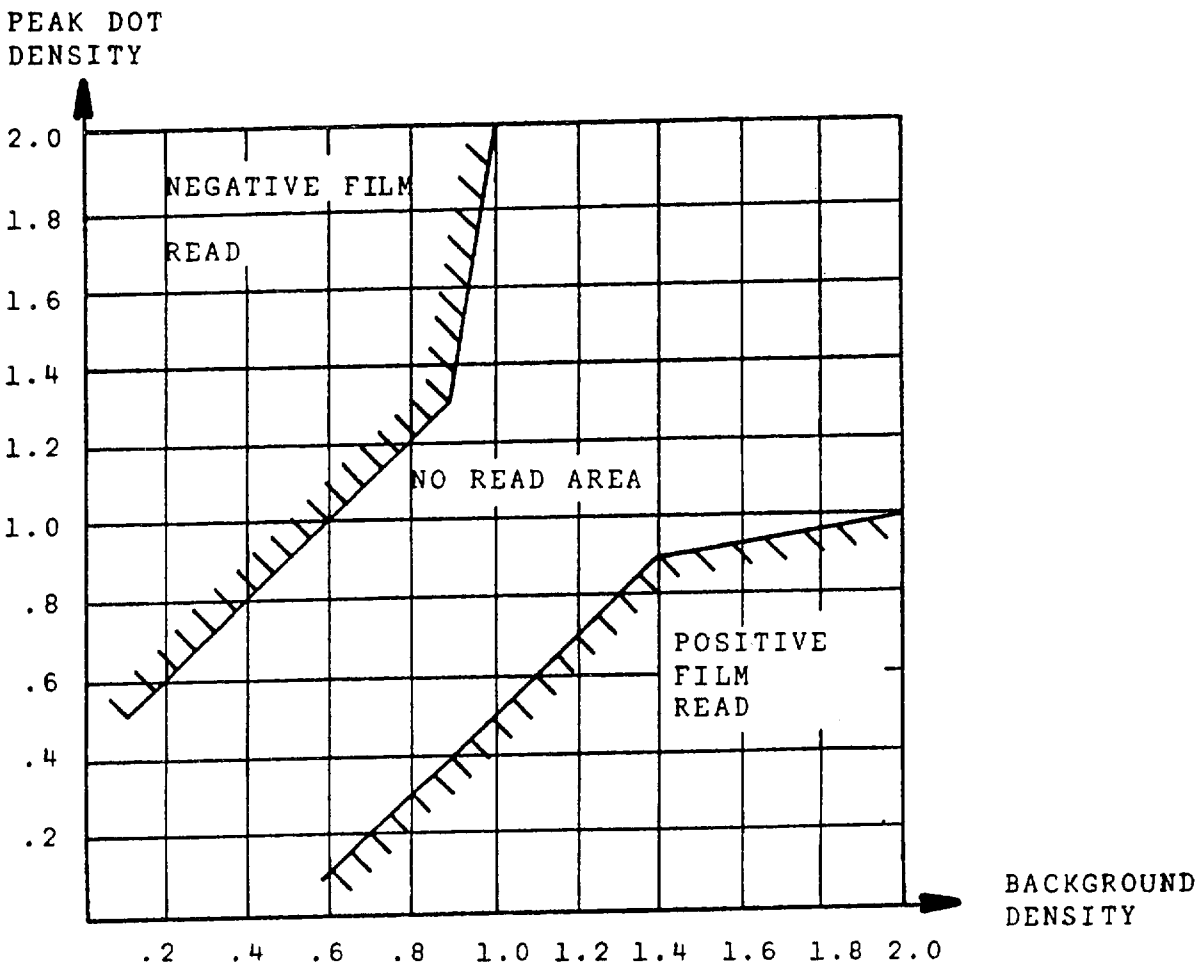


FIGURE 9

Custodians:
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Navy - AS
Air Force - 99

Preparing Activity:
Air Force- 99

(Project MISC-0D05)

Review activity:
Defense Intelligence Agency

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