

# Standards and Recommended Practices

## Proposed SMPTE Standards

Published here for a trial period and public review are four Proposed SMPTE Standards: SMPTE 111, Motion-Picture Film (35-mm) — Prints Made on Continuous Contact Printers — Exposed Areas for Picture and Audio; SMPTE 266M, Television — 4:2:2 Digital Component Systems — Digital Vertical Interval Time Code; SMPTE 270, Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information; and SMPTE 271, Motion-Picture Film (16-mm) — Manufacturer-Printed Latent Image Identification Information. The proposals will be submitted to the American National Standards Institute for approval as American National Standards if no adverse comments are received from publication. Comments should

be addressed to Sherwin H. Becker, Director of Engineering, at Society Headquarters prior to March 1, 1994. The proposals may be purchased from Headquarters as follows: SMPTE 111 for \$10.00 and SMPTE 266M, 270, and 271 for \$13.00.

## Approved SMPTE Recommended Practices

The Society recently approved two SMPTE Recommended Practices: RP 174-1993, Bit-Parallel Digital Interface for 4:4:4:4 Component Video Signal (Single Link); and RP 175-1993, Digital Interface for 4:4:4:4 Component Video Signals (Dual Link). RP 174 may be obtained from Headquarters for \$20.00 and RP 175 for \$13.00.

— *Sherwin H. Becker, Director of Engineering*

## ***SMPTE Standards Subscription Service***

The Society provides a Standards Subscription Service to assist firms, libraries, and individuals in establishing and maintaining a complete and current file of approved American National Standards, SMPTE Recommended Practices, and SMPTE Engineering Guidelines in the motion-picture, television, and video magnetic recording fields. Through this service, the Society makes automatic distribution to standards subscribers of all new and revised standards, recommended practices, and guidelines that are approved during the calendar year in these fields.

For further information, write to: Standards Subscription Service, Engineering Dept., Society of Motion Picture and Television Engineers, 595 West Hartsdale Ave., White Plains, NY 10607.

# PROPOSED SMPTE STANDARD

## for Motion-Picture Film (35-mm) — Prints Made on Continuous Contact Printers — Exposed Areas for Picture and Audio

**SMPTE 111**  
Revision of  
ANSI/SMPTE 111-1988

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### 1 Scope

1.1 This standard specifies the location and width dimensions of the exposed areas for picture and photographic audio on 35-mm motion-picture prints made on continuous contact printers.

1.2 This standard is applicable to the printing of motion-picture raw stock which is cut and perforated in accordance with ANSI/SMPTE 139 or ANSI/SMPTE 237.

1.3 This standard refers to the adjustment of the printer, and is in accordance with ANSI/SMPTE 40.

### 2 Dimensions

The dimensions shall be as specified in the figures and tables.

### 3 Additional exposed areas for photographic audio

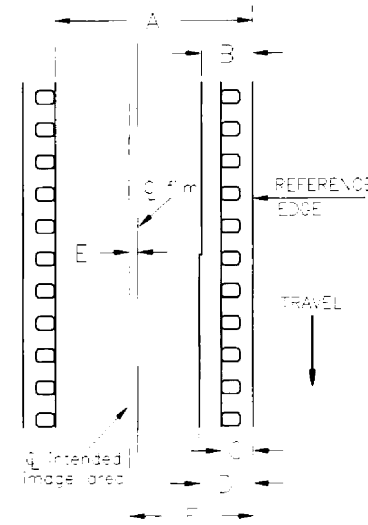
It is recognized that some formats for photographic audio may require exposed areas in locations other than or in addition to those specified by dimensions C and D in figure 1 and table 1. Exposed areas for these formats are given in figure 2 and table 2.

#### NOTES

1. In table 1, dimension A minus B defines the width of the picture area exposed in accord with this standard, and dimension D minus C that of the sound track area. Thus, an overlap area ranging from 0.000 in to 0.008 in (0.00 mm to 0.20 mm) will receive exposure from both picture and sound printing apertures. In table 2, the dimensions given for a format define the width of the sound track area exposed for that format.

2. The centerline information (dimensions E and F) given in table 1 is provided as a convenient reference. These dimensions are specified in ANSI/SMPTE 195.

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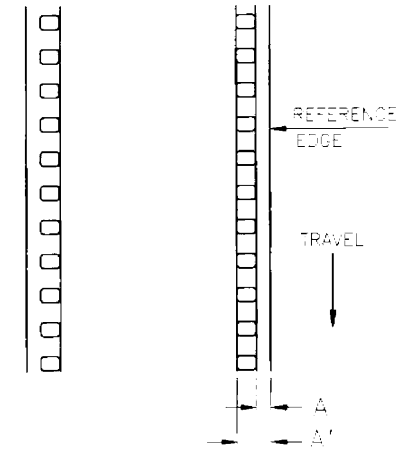


As seen from emulsion side of print

Figure 1 – Exposed areas for picture and sound

Table 1 – Dimensions of exposed areas

Dimensions	Inches	Millimeters
A	1.184 ± 0.002	30.07 ± 0.05
B	0.304 ± 0.002	7.72 ± 0.05
C	0.192 ± 0.001	4.88 ± 0.03
D	0.308 ± 0.002	7.82 ± 0.05
E	0.050 nom	1.27 nom
F	0.738 nom	18.75 nom



As seen from emulsion side of print

Figure 2 – Additional exposed areas

Table 2 – Dimensions of additional exposed areas

Format	Dimensions	Inches	Millimeters
DSRD	A	0.078 ± 0.002	1.98 ± 0.05
	A'	0.188 ± 0.001	4.78 ± 0.03

### Annex A (informative) Bibliography

ANSI/SMPTE 40-1991, Motion-Picture Film (35-mm) — Photographic Audio Records — Release Prints

ANSI/SMPTE 139-1986 (R1991), Motion-Picture Film (35-mm) — Perforated KS

ANSI/SMPTE 195-1993, Motion-Picture Film (35-mm) — Motion-Picture Prints — Projectable Image Area

ANSI/SMPTE 237-1993, Motion-Picture Film (35-mm) — Perforated DH-1870

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# PROPOSED SMPTE STANDARD

## for Television — 4:2:2 Digital Component Systems — Digital Vertical Interval Time Code

SMPTE 266M

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### 1 Scope

This standard describes the signal format of a digital vertical interval time code suitable for use with the digital coding given in SMPTE 125M (for 525-line, 59.94-Hz field rate, 4:2:2 component digital signals) or CCIR Rec. 601-2 (for 625-line, 50-Hz field rate, 4:2:2 component digital signals).

### 2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the documents indicated below.

SMPTE 12M, Television, Audio and Film — Time and Control Code

ANSI/SMPTE 125M-1992, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

CCIR Rec. 601-2, Encoding Parameters of Digital Television for Studios

### 3 D-VITC general

#### 3.1 Signal definition

D-VITC is an 8-bit digital data representation of the band-limited analog signal corresponding to the vertical interval time code (VITC) of SMPTE 12M. The 8 bits of D-VITC shall be carried in the eight most significant bits of the 10 bits of the SMPTE 125M

coding. Since some equipment built to an early version of SMPTE 125M uses only 8 of the 10 bits, both 10- and 8-bit interpretations of the values are given in this standard, with 10 bits the preferred expression.

#### 3.2 Data assignment

The 90 bits of information in the VITC defined in SMPTE 12M (see figure 1) are carried by 675 consecutive luminance samples of the data stream defined in SMPTE 125M. Each D-VITC bit is therefore represented by 7.5 luminance samples.

#### 3.3 Transitions

The shape of transitions between D-VITC bits is defined by the values assigned to luminance samples in the transition region. Because the number of luminance samples chosen is an odd integer multiple (15) of one-half the total number of bits, it is necessary to define two distinct transition data sets (see figure 2). When viewed in the analog domain, the resulting transitions are a close approximation to a raised cosine shape.

#### 3.4 Digital data

In the following paragraphs, 10-bit expressions are given and preferred. Equivalent values for 8-bit representations used in earlier documentation of SMPTE 125M are given in parentheses.

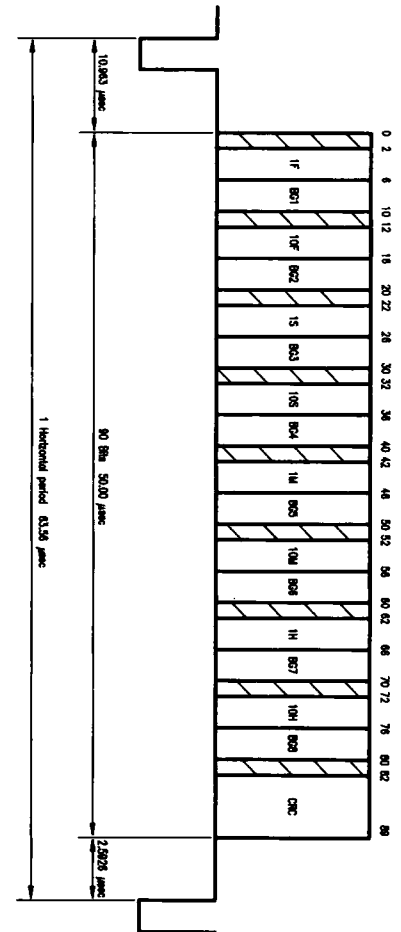
**3.4.1** The data value associated with a binary state of "1" in the D-VITC shall be 300<sub>h</sub> (C0<sub>h</sub>).

**3.4.2** The data value associated with a binary state of "0" in the D-VITC shall be 040<sub>h</sub> (10<sub>h</sub>).

SMPTE 266M

0-1	Synchronizing bits	0 Fixed one	30-31	Synchronizing bits	30 Fixed one	60-61	Synchronizing bits	60 Fixed one
2-5	Units of frames	1 Fixed zero	32-34	Tens of seconds	31 Fixed zero	62-65	Units of hours	61 Fixed zero
6-9	First binary group (BG1)		35	Field mark		66-69	Seventh binary group (BG7)	
10-11	Synchronizing bits	10 Fixed one	36-39	Fourth binary group (BG4)	40 Fixed one	70-71	Synchronizing bits	70 Fixed one
12-13	Tens of frames	11 Fixed zero	40-41	Synchronizing bits	41 Fixed zero	72-73	Tens of hours	71 Fixed zero
14	Drop frame flag		42-45	Units of minutes	40 Fixed zero	74	Unassigned bit (zero, until specified)	
15	Color frame flag		46-49	Fifth binary group (BG5)	50 Fixed one	75	Binary group flag	
16-19	Second binary group (BG2)		50-51	Synchronizing bits	51 Fixed zero	76-79	Eighth binary group (BG8)	
20-21	Synchronizing bits		52-54	Tens of minutes		80-81	Synchronizing bits	80 Fixed one
22-25	Units of seconds		55	Binary group flag		81	Fixed zero	81 Fixed zero
26-29	Third binary group (BG3)		56-59	Sixth binary group (BG6)		82-89	CRC code	(Cyclic redundancy check code)

Figure 1 — Address bit assignment



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3.4.3 The data values of samples associated with transitions between D-VITC binary states are defined in figure 2.

3.4.4 The data values of all luminance samples of the active line period which are not used in forming the D-VITC shall be set to 040h (10h).

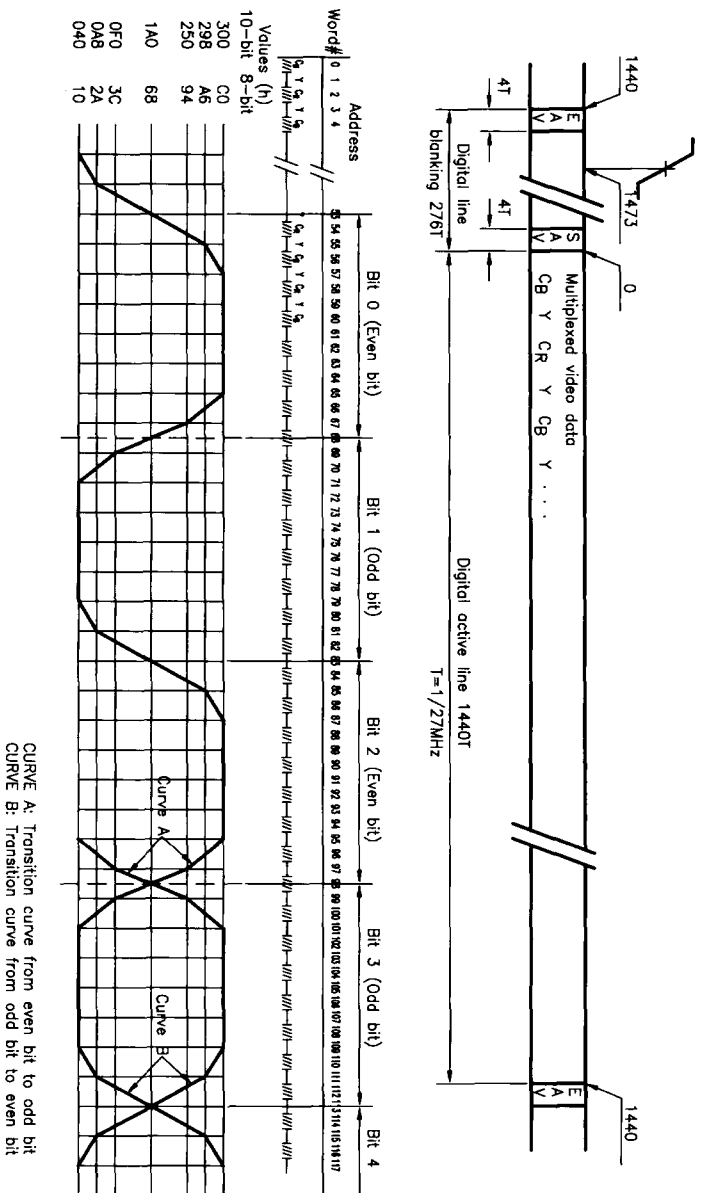
**Annex A (informative)  
525-line signals**

The timing relationship between analog VITC and D-VITC for 525-line, 59.94-Hz field rate signals is given in figure A.1.

3.4.5 The data values of all unused chrominance samples of the active line period shall be set to 200h (80h).

**3.5 Insertion lines**

The D-VITC shall be inserted on lines 14 and 277. Insertion on lines 16 and 279 is optional.



CURVE A: Transition curve from even bit to odd bit  
CURVE B: Transition curve from odd bit to even bit

Figure 2 – D-VITC waveform representation and position in ANSI/SMPTE 125M sequence

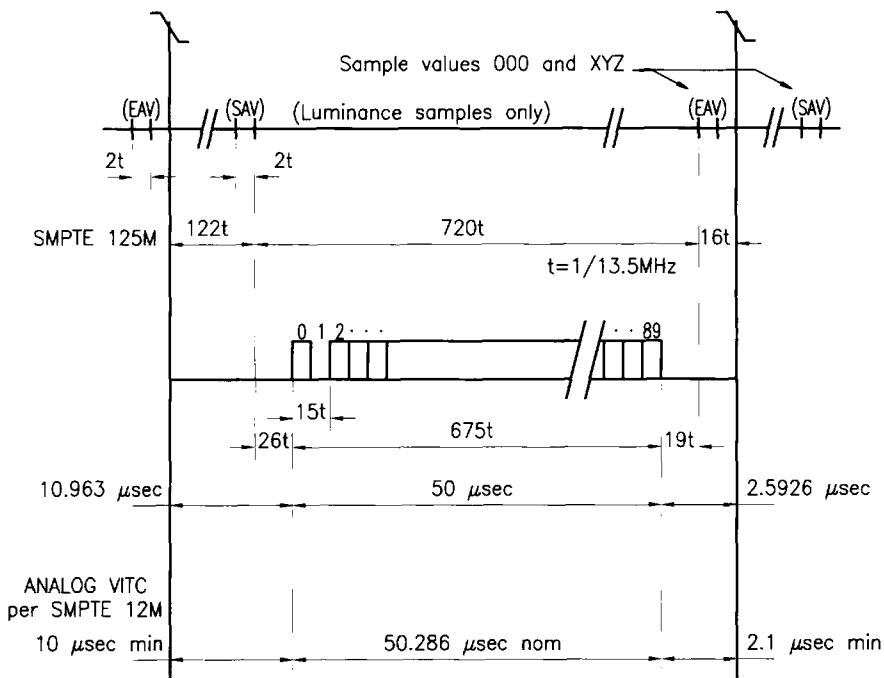


Figure A.1 – Timing relationship between analog VITC and D-VITC for 525/60 standard

**Annex B (informative)**  
**625-line signals**

The timing relationship between analog VITC and D-VITC for 625-line, 50-Hz field rate signals is given in figure B.1.

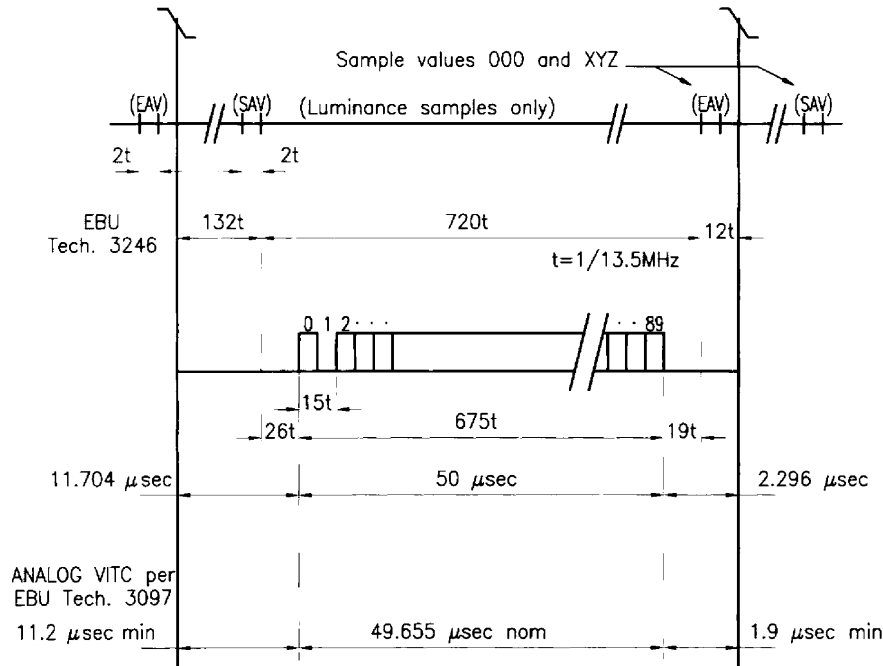


Figure B.1 – Timing relationship between analog VITC and D-VITC for 625/50 standard

**Annex C (informative)**  
**Tolerance deviations**

When D-VITC is decoded and D to A converted, the resulting analog signal could deviate from the tolerances given in SMPTE 12M. Table C.1 gives possible deviations. The deviations are a consequence of the use of the 13.5-MHz

sampling frequency defined by the 4:2:2 digital data specification of SMPTE 125M (similar deviations exist for the 625/50 operations).

Table C.1 – Tolerance deviations

	SMPTE 12M	D-VITC	Deviation
Bit rate (Hz)	1,789,772 ± 200	1,800,000.0	+ 10227.5
Duration (μs)	50.286 + 0.005 - 0.006	50.0	- 0.286

**Annex D (informative)**  
**A to D conversion**

Design engineers should be aware of a potential difference in defined digital values when an analog signal (VITC) is A to D converted.

# PROPOSED SMPTE STANDARD

SMPTE 270

## for Motion-Picture Film (65-mm)— Manufacturer-Printed Latent Image Identification Information

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### 1 Scope

1.1 This standard specifies the position and dimensions of machine-readable identification numbers. These numbers are intended to be a machine-readable version of the latent image key number. This standard also specifies the encoding format to be used for these machine-readable numbers, as well as the area scanned and the spectral characteristics of the scanner.

1.2 This standard also specifies the position, dimensions, and content of human-readable identification (key) numbers for use on 65-mm motion-picture films intended for original photography or intermediate printing which also include the machine-readable key number described in 1.1. These numbers normally will be exposed onto the film at the time of manufacture.

1.3 This standard further specifies an area that may be used for optional manufacturer-specific film-type identification information.

1.4 This standard also specifies an area on the film which is not to be exposed by the film manufacturer, thus leaving it available for customer data recording.

1.5 Finally, this standard specifies an optional frame line index mark.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility

of applying the most recent edition of the standards indicated below.

ANSI/SMPTE 145-1988, Motion-Picture Film (65-mm) — Perforated KS

USS 128, Uniform Symbology Specification, 1986 version (available from Automatic Identification Manufacturers, Inc., 1326 Freeport Road, Pittsburgh, PA 15283, U.S.A.)

### 3 Definition

**key number:** A number, sometimes referred to as an edge number or footage number, that is printed with ink or exposed onto the film at the time of manufacture. The numbers are placed at regular intervals, typically one foot. For the purposes of this standard, the key numbers are latent-image exposed.

### 4 General format

#### 4.1 Format

The general format of the latent-image identification information shall be as shown in figure 1.

#### 4.2 Use of the other edge

No latent information shall be placed along the upper edge of the film, as shown in figure 1. This area is reserved for data recording at the time of photography.

#### 4.3 Film

This identification information is intended to be printed onto film cut and perforated in accordance with ANSI/SMPTE 145.

SMPTE 270

EMULSION TOWARDS VIEWER

TRAVEL

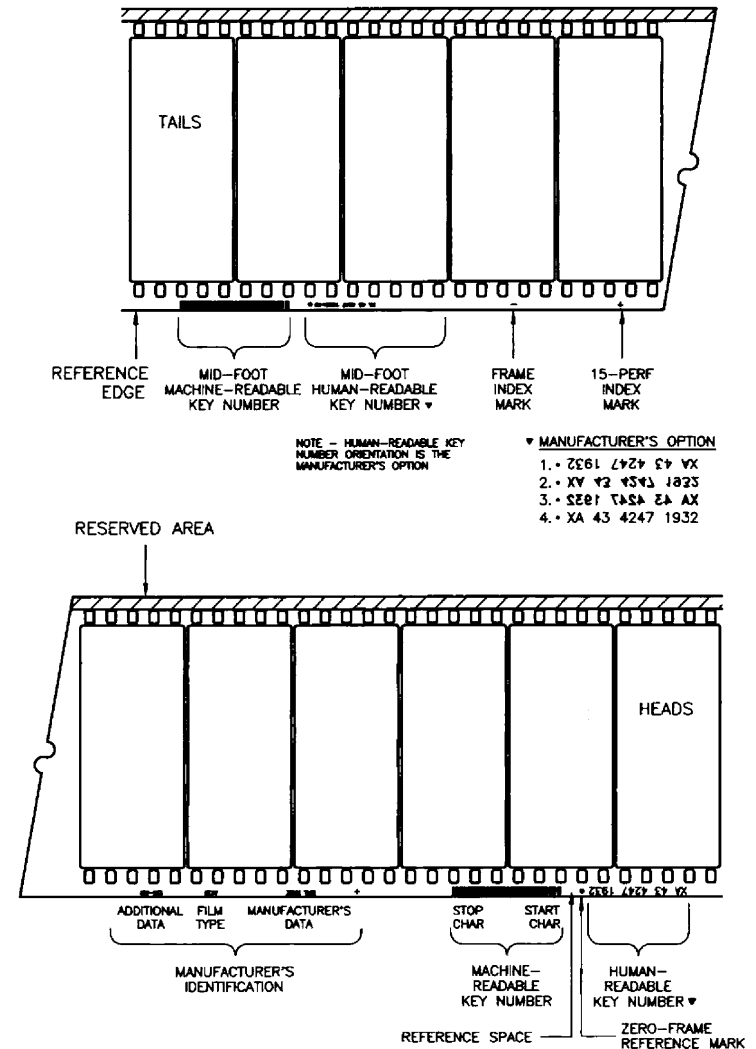


Figure 1 - General format

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5 Human-readable key numbers

5.1 Key number

An incrementing, human-readable key number shall be printed onto the film at the time of manufacture. The film shall be supplied to the user with the lowest number at the outside of the roll.

5.2 Dimensions

The height and width of the human-readable key numbers shall be as specified in figure 2 and table 1.

5.3 Reference mark

A zero-frame reference mark shall be printed adjacent to the character of the human-readable key number that is closest to the tail of the film as shown in figure 1.

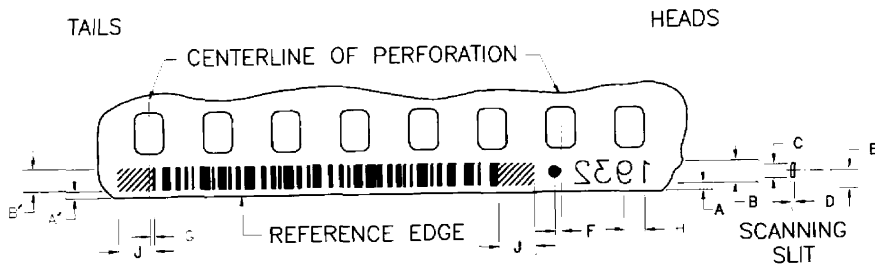


Figure 2 – Position and dimensions

Table 1 – Specifications

	Dimensions	Inches	Millimeters
A	Edge of film to bottom of characters	0.009 ± 0.005	0.23 ± 0.13
A'	Edge of film to bottom of bars	0.009 + 0.005 - 0.009	0.23 + 0.13 - 0.23
B	Height of characters	0.060 ± 0.004	1.52 ± 0.10
B'	Height of bars	0.060 + 0.010 - 0.004	1.52 + 0.25 - 0.10
C	Scanning slit length	0.038 max	0.97 max
D	Scanning slit width	0.005 max	0.13 max
E	Edge of film to centerline of scanning slit	0.035 ± 0.002	0.89 ± 0.05
F	Zero-frame reference mark displacement	0.00 ± 0.04	0.0 ± 1.0
G	Bar code displacement	0.00 ± 0.04	0.0 ± 1.0
H	Character-to-character spacing	0.060 nom	1.52 nom
J	Quiet zone (no print area)	0.100 min	2.54 min

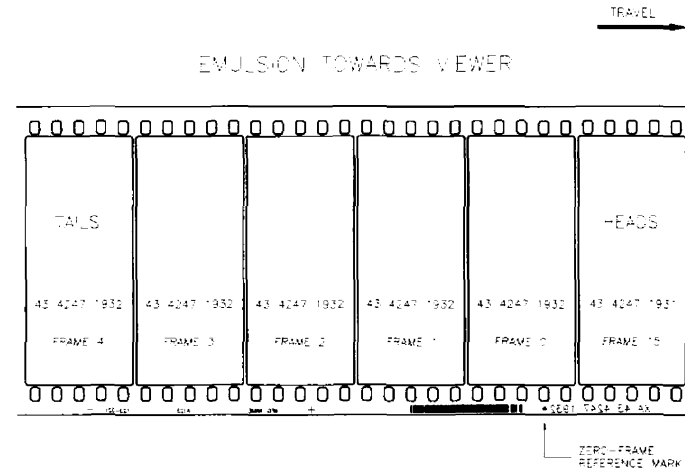


Figure 3 – Alignment of zero-frame reference mark

The zero-frame reference mark shall be a filled circle with a diameter of approximately 0.025 to 0.030 in (0.64 to 0.76 mm).

5.4 Alignment with respect to perforations

The numbers shall be printed so that the centerline of the zero-frame reference mark is aligned with the centerline of a perforation, within the tolerance shown in figure 2.

5.4.1 This alignment is intended to facilitate frame identification with a minimum of confusion, even though the picture frame may have one of several positions relative to the key number. The following rule shall be applied to frame identification:

The frame immediately above the zero-frame reference mark is the one referenced by that key number. Other frames are specified by an offset which is written as an additional digit(s) separated from the key number by a plus sign. Figure 3 shows an example of this rule.

5.5 Repeat frequency

The spacing from one key number to the next shall be 80 perforations.

5.6 Format and orientation

5.6.1 Number and grouping of digits

The human-readable key number shall consist of 2 alphabetic characters and 10 digits. This alphanumeric code shall be separated into groups of 2 characters and 2, 4, and 4 digits, which in turn shall be separated by spaces (see figure 1). For the 10 digits, only the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 shall be used, and they shall be in normal counting sequence. It is recommended, although not required, that the ten thousands place not be allowed to increment within a single roll of film.

5.6.2 Orientation

The number may be placed in one of several orientations at the discretion of the film manufacturer. When the original negative film is held with the emulsion toward the viewer and the head toward the right, the numbers may be in any one of the following orientations:

- Right side up, reading from head to tail
- Upside down, reading from head to tail
- Right side up, reading from tail to head
- Upside down, reading from tail to head

In all cases, regardless of the orientation, the dot is to the left (closer to the tail) and adjacent to the trailing (closest to the tail) character, as shown in figure 1. The key number shall precede the machine-readable key number; i.e., the human-readable key number shall be closer to the head of the roll.

**5.6.3 Contents of the alphabetic characters**

The first two characters of the key number identify the manufacturer and film type. The character set used shall be the normal upper-case letters A through Z. The first character shall identify the film manufacturer according to table 2. Other letters are reserved for future assignment by the SMPTE.

The second character shall be a film-type identifier. The character is chosen at the discretion of the film manufacturer.

**Table 2 – Manufacturer alphabetic code**

Manufacturer	Code
Agfa-Gevaert, N.V.	A
Eastman Kodak Co.	K
Fuji Photo Film U.S.A., Inc.	F
Other or nondesignated	(nothing)

**6 Machine-readable key numbers**

**6.1** The machine-readable key numbers are intended to be a machine readable version of the immediately adjacent human-readable key numbers.

**6.2 Dimensions**

**6.2.1** The dimensions and lateral location of the machine-readable identification numbers shall be as specified in figure 2 and table 1.

**6.2.2** The nominal width of the narrowest bar or space shall be 0.0075 in (0.190 mm). All other bars and spaces are to be integer multiples of the narrowest bar as specified in USS 128. The total bar code message, which consists of 123 elements (not counting the quiet zones), shall have a width of 0.9225 in  $\pm$  0.0400 in (23.432 mm  $\pm$  1.016 mm).

For measurement purposes, the width of the bar is the distance between two bar edges. A bar edge is defined as the point where the transmittance is halfway between the maximum adjacent space transmittance and the minimum adjacent bar transmittance.

**6.2.3** The message shall be printed so that the trailing edge of the last character (the stop character) shall be longitudinally aligned with the centerline of a perforation, that perforation being six perforations displaced from the perforation specified in 5.3, within the tolerance shown in figure 2.

**6.2.4** The recording shall be made so that the azimuth of the record is at an angle of  $90^\circ \pm 1^\circ$  to the reference edge of the film.

**6.2.5** The lateral location, length, and width of the scanned area shall be as specified in figure 2 and table 1.

**6.2.6** The reproducing (scanning) slit image shall be positioned at an angle of  $90^\circ \pm 1^\circ$  to the reference edge of the film.

**6.3 Repeat frequency**

The machine-readable message shall be immediately adjacent to the human-readable key number and shall repeat at the same frequency.

**6.4 Format**

**6.4.1** The machine-readable numbers shall consist of a series of bars and spaces of varying width that meet the bar code specification of USS 128. Code subset C of this specification, which allows double density numeric digits, shall be used.

**6.4.2** The data portion of the message shall be of fixed length and shall consist of 16 digits. Since code subset C encodes two digits per bar code character, this corresponds to 8 bar code characters. In addition, quiet zones, a start character (for code C), a check sum character, and a stop character shall be recorded. Including the start and stop characters, the entire message shall be 11 bar code characters.

**6.4.3** The start character shall be nearest the head end of the film and the stop character shall

be nearest the tail end of the film, regardless of the orientation of the human-readable characters; i.e., when the film is transported in the normal direction of travel past a fixed scanning position, the start character shall be read first.

**6.4.4** The 8 bar code characters (16 data digits) are defined as follows:

**6.4.4.1** The first character shall be encoded with a two-digit manufacturer code. These codes shall be assigned as per table 3. Other codes are reserved for future assignment by the SMPTE.

**Table 3 – Manufacturer codes**

Manufacturer	Code
Agfa-Gevaert, N.V.	01
Eastman Kodak Co.	02
Fuji Photo Film U.S.A., Inc.	03
Other or nondesignated	00

**6.4.4.2** The second character shall be a two-digit product specification code assigned at the discretion of the manufacturer. If the manufacturer does not wish to identify the product, the digits 00 shall be encoded.

**6.4.4.3** The third through seventh characters shall be encoded with the 10 characters of key-number information. These shall be the same information as in the immediately adjacent human-readable key number. The third character shall contain the most significant digits and the seventh character shall contain the least significant digits.

**6.4.4.4** The eighth character shall be encoded with a two-digit offset in perforations from the preceding key number. This offset shall be 00 for the key numbers described above and 40 for the mid-foot key number described in 6.5.

**6.4.5** The check sum is equal to the modulo 103 sum of the value of the start character and the weighted values of the eight data characters as specified in USS 128.

**6.5 Mid-foot key number**

A mid-foot key number, as shown in figure 1, shall be placed halfway between each key number. The mid-

foot key number shall have two parts: a mid-foot human-readable key number and a mid-foot machine-readable key number.

**6.5.1 Mid-foot human-readable key number**

The mid-foot human-readable key number shall consist of a zero-frame reference mark, an adjacent key number that is to be nearer the head end of the roll, and an offset in perforations which is to be 40 always. The mid-foot key number shall thus have the format "XA 12 3456 7890 + 40." The mid-foot key number shall have the same orientation as the standard human-readable key number (see 5.6.2). All characters are to be small in size (approximately half size).

**6.5.2 Mid-foot machine-readable key number**

The mid-foot machine-readable key number shall consist of a bar coded message in exactly the same format as specified in 6.4. The offset-in-perforations digits will be set to 40.

**7 Optional frame index mark**

**7.1** An optional frame index mark in the form of a hyphen may be placed on the film every five perforations except where it would overlay some other edge information, as shown in figure 1. The index marks shall be aligned midway between the perforations coincident with a possible position of the frameline.

**7.1.1** A "reference space" is defined as being the space between the perforation above the zero-frame reference mark and the perforation immediately to its left (toward the tail of the film).

**7.1.2** The frame index mark shall be aligned longitudinally such that, were it to be printed, a mark would fall on the reference space.

**7.1.3** Every third frame index mark, when printed, shall be a plus sign (+) rather than a hyphen. The purpose is to provide a 15-perforation frame index mark.

**8 Optional manufacturer-identification information**

**8.1** Additional manufacturer information may be printed along the edge of the film as shown in figure 1. This information is to be printed in small size characters (approximately half size).

## 8.2 Recommended minimum information

### 8.2.1 Manufacturer's name

The first piece of information shall be the name of the manufacturer. This, in general, shall be an abbreviated name, rather than the full company name.

### 8.2.2 Film type

The second piece of information, separated from the manufacturer's name by a space, shall be the film type. Its form, whether numeric, alphabetic, or mixed, shall be at the discretion of the manufacturer.

### 8.2.3 Optional information

The manufacturer may place additional information following the film type, if so desired. This may include batch numbers, for example. It is recommended that the length of this information be limited so the entire string of manufacturer-identification information is no more than 12 perforations long.

### 8.3 Repeat distance

The repeat distance of this information is at the discretion of the manufacturer, but the repeat distance shall be a multiple of 80 perforations, and a distance of no more than 240 perforations is recommended.

## 9 Bar code scanner and density specifications

### 9.1 Scanner spectral sensitivity

The peak or maximum response of the combination of the light source, filters, and photo receptor shall be at  $680 \text{ nm} \pm 60 \text{ nm}$ . In addition, the lower wavelength at which the response is down to 10% of peak response shall be equal to or greater than 600 nm and the upper wavelength at which the response is down to 10% of peak response shall be equal to or less than 760 nm. Notwithstanding these specifications, the spectral response of the scanning system must be designed for good differentiation between bars and spaces with existing conventional color and black-and-white films.

### 9.2 Quality of machine-readable messages

The following clauses specify measurement techniques for the signal level of the machine-readable

message and a minimum value for these measurements to ensure readability.

#### 9.2.1 Definitions

**9.2.1.1 scan transmittance profile:** A record of the transmittance measured as a function of distance along the entire bar code symbol.

**9.2.1.2 symbol contrast (SC):** The difference between the largest and smallest transmittances in a scan transmittance profile

$$SC = T_{\max} - T_{\min}$$

**9.2.1.3 minimum edge contrast (EC<sub>min</sub>):** The minimum difference between a space transmittance ( $T_s$ ) and the adjoining bar transmittance ( $T_b$ )

$$EC_{\min} = T_s - T_b$$

**9.2.1.4 modulation (MOD):** The ratio of minimum edge contrast (EC<sub>min</sub>) to symbol contrast (SC)

$$MOD = EC_{\min} / SC$$

#### 9.2.2 Measurement methodology

The measurement of bar code modulation is based on the analysis of the scan transmittance profile. A scan is made with a particular aperture and wavelength. For the purposes of this standard, the wavelength shall be as specified in 9.1 and the scanning slit shall have the dimensions specified in table 1. Figure 4 is a graphical representation of a scan transmittance profile. In figure 4, the vertical axis is percent transmittance and the horizontal axis represents linear position. The high transmittance areas on the left and right are the quiet zones. The high transmittance areas are spaces and the low transmittance areas are bars. The necessary measurements can be determined by manual graphical analysis or automatically by numeric analysis.

Figure 4 illustrates the measurement of  $T_{\max}$  and  $T_{\min}$ , the largest and smallest transmittances in the scan reflectance profile, respectively. It also illustrates the measurement of  $EC_{\min}$ , which for this particular example, is at edge 4. In general, it is necessary to determine edge contrast for each edge (each pair of bar and space) and then find the minimum of this set of edge contrasts.

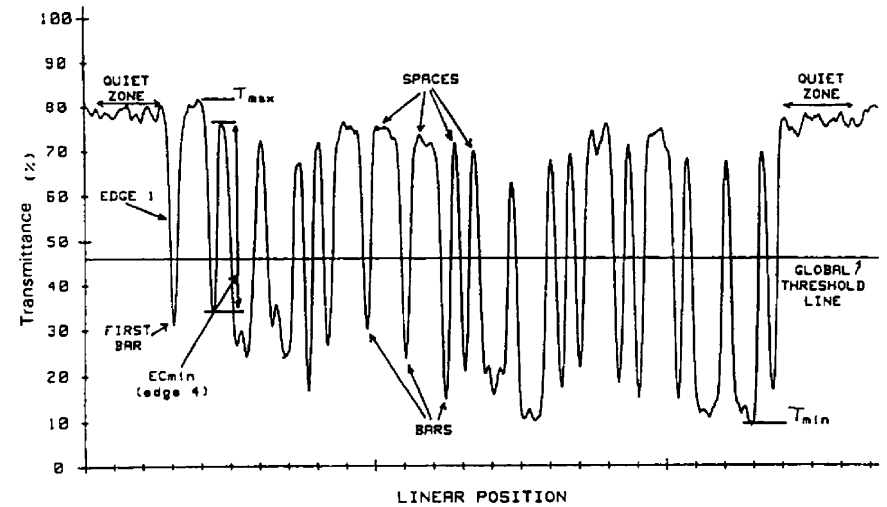


Figure 4 – Example of scan transmittance profile

Minimum edge contrast, symbol contrast, and modulation are calculated using the formulas given in the definitions of 9.2.1.

#### 9.2.3 Modulation specification

The edge print applied by the manufacturer shall be exposed so that, when the film is processed through the manufacturer's recommended process, the symbol contrast shall be equal to or greater than 0.40 and the modulation shall be equal to or greater than 0.40.

#### Annex A (informative) Orientation

The orientation of the human-readable key numbers has been left to the manufacturer's discretion in this standard. However, it is suggested that in the next review of this

#### 9.3 Density of printed machine-readable messages

When the machine-readable message is printed onto a conventional color print film, it is recommended that the edge lights on the printer be controlled to produce a status A red density of the bars of  $2.00 \pm 0.30$ .

When the machine-readable message is printed onto a conventional color intermediate film, it is recommended that the edge lights on the printer be controlled to produce a status M red density of the bars of  $D_{\min} + 0.75 \pm 0.10$ .

standard, an effort be made to seek agreement on a single orientation.

# PROPOSED SMPTE STANDARD

SMPTE 271

## for Motion-Picture Film (16-mm)— Manufacturer-Printed Latent Image Identification Information

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### 1 Scope

1.1 This standard specifies the position and dimensions of machine-readable identification numbers. These numbers are intended to be a machine-readable version of the latent image key number. This standard also specifies the encoding format to be used for these machine-readable numbers, as well as the area scanned and the spectral characteristics of the scanner.

1.2 This standard also specifies the position, dimensions, and content of human-readable identification (key) numbers for use on 16-mm motion-picture films intended for original photography or intermediate printing which also include the machine-readable key number described in 1.1. These numbers normally will be exposed onto the film at the time of manufacture.

1.3 This standard further specifies an area that may be used for optional manufacturer-specific film-type identification information.

1.4 This standard also specifies an area on the film which is not to be exposed by the film manufacturer, thus leaving it available for customer data recording.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI/SMPTE 109-1992, Motion-Picture Film (16-mm) — Perforated 1R and 2R

USS 128, Uniform Symbology Specification, 1986 version (available from Automatic Identification Manufacturers, Inc., 1326 Freeport Road, Pittsburgh, PA 15283)

### 3 Definition

**key number:** A number, sometimes referred to as an edge number or footage number, that is printed with ink or exposed onto the film at the time of manufacture. The numbers are placed at regular intervals, typically six inches for 16-mm film. For the purposes of this standard, the key numbers are latent-image exposed.

### 4 General format

#### 4.1 Format

The general format of the latent-image identification information shall be as shown in figure 1.

#### 4.2 Use of the other edge

No latent information shall be placed along the upper edge of the film, as shown in figure 1. This area is reserved for data recording at the time of photography.

#### 4.3 Film

This identification information is intended to be printed onto film cut and perforated in accordance with ANSI/SMPTE 109.

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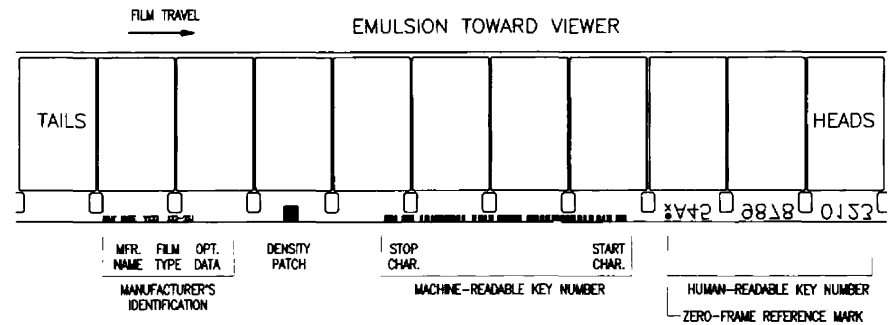


Figure 1 — General format

### 5 Human-readable key numbers

#### 5.1 Key number

An incrementing, human-readable key number shall be printed onto the film at the time of manufacture. The film shall be supplied to the user with the lowest number at the outside of the roll unless the sales format of the unit shown states differently.

#### 5.2 Dimensions

The height and width of the human-readable key numbers shall be as specified in figure 2 and table 1. Note that the height of the first character is less than that of the others to allow for the reference mark specified in 5.3. The width of each human readable character is left to the manufacturer's discretion, but it should be wide enough for good legibility, while still maintaining dimension F. A character height-to-width ratio of 14:10 and a space between characters of  $\frac{2}{14}$  of a character height is recommended.

#### 5.3 Reference mark

A zero-frame reference mark shall be printed between the first human-readable key number and the edge of the film as shown in figure 1. This may be above or below the character, depending upon which of the possible orientations allowed in 5.6.2 is used. The zero-frame reference mark shall be a filled circle with a diameter as given by dimension B<sub>3</sub> of table 1.

#### 5.4 Alignment with respect to perforations

The numbers shall be printed so that each of the three groups of four characters is centered between two perforations. To ensure visibility, the human-readable key numbers shall not be printed closer to the perforation than the distance specified as dimension F in figure 2 and table 1.

5.4.1 Since the key number is longer than one frame, the following rule shall be applied to frame identification:

The frame immediately above the zero-frame reference mark is the one referenced by that key number. Other frames are specified by an offset which is written as an additional digit(s) separated from the key number by a plus sign. Figure 3 shows an example of this rule.

#### 5.5 Repeat frequency

The spacing from one key number to the next shall be 20 perforations.

#### 5.6 Format and orientation

##### 5.6.1 Number and grouping of digits

The human-readable key number shall consist of 2 alphabetic characters and 10 digits. This alphanumeric code shall be separated into three groups of 4 characters, as shown in figure 1. For the 10 digits, only the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 shall be used.

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and they shall be in normal counting sequence. It is recommended, although not required, that the ten thousands place not be allowed to increment within a single roll of film.

**5.6.2 Orientation**

The number may be placed in one of two orientations at the discretion of the film manufacturer. When the original negative film is held with the emulsion toward the viewer and the head toward the right, the numbers may be in either of the following orientations:

- Right side up, reading from tail to head;
- Upside down, reading from tail to head.

In all cases, regardless of the orientation, the dot is above the trailing character (closest to the tail), as shown in figure 1. The human-readable key number shall precede the machine-readable key number; i.e., the human-readable key number shall be closer to the head of the roll.

**5.6.3 Contents of the alphabetic characters**

The first two characters of the key number identify the manufacturer and film type. The character set used shall be the normal upper-case letters A through Z. The first character shall identify the film manufacturer according to table 2. Other letters are reserved for future assignment by the SMPTE.

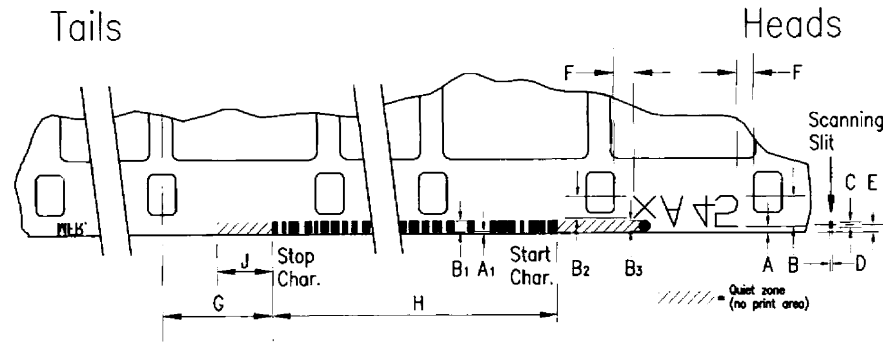


Figure 2 - Position and dimensions

Table 1 - Specifications

Dimensions	Inches	Millimeters
A Edge of film to bottom of characters	0.0115 ± 0.0030	0.292 ± 0.076
A <sub>1</sub> Edge of film to bottom of bars	0.004 ± 0.003	0.10 ± 0.08
B Height of characters	0.0525 ± 0.0030	1.334 ± 0.076
B <sub>1</sub> Height of bars and manufacturer's information	0.0188 ± 0.0030	0.478 ± 0.076
B <sub>2</sub> Height of first character	0.033 min 0.039 max	0.84 min 0.99 max
B <sub>3</sub> Height of zero-frame reference	0.018 min 0.024 max	0.46 min 0.61 max
C Scanning slit length	0.006 max	0.15 max
D Scanning slit width	0.005 max	0.13 max
E Edge of film to centerline of scanning slit	0.013 ± 0.002	0.33 ± 0.05
F Key number to edge of perforation	0.030 min	0.76 min
G Bar code displacement	0.188 ± 0.020	4.78 ± 0.51
H Length of bar code	0.9225 ± 0.0200	23.432 ± 0.508
J Quiet zone (no print area)	0.100 min	2.54 min

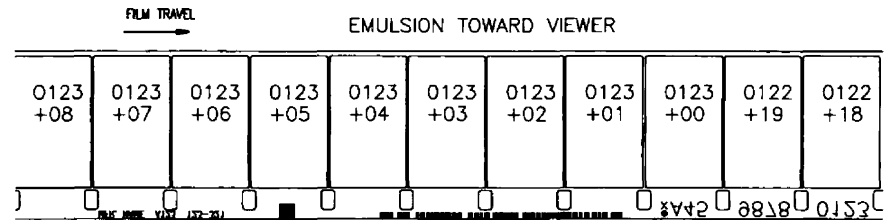


Figure 3 - Alignment of zero-frame reference mark

The second character shall be a film-type identifier. The character is chosen at the discretion of the film manufacturer.

Table 2 - Manufacturer alphabetic code

Manufacturer	Code
Agfa-Gevaert, N.V.	A
Eastman Kodak Co.	K
Fuji Photo Film U.S.A., Inc.	F
Other or nondesignated	(nothing)

For measurement purposes, the width of the bar is the distance between two bar edges. A bar edge is defined as the point where the transmittance is halfway between the maximum adjacent space transmittance and the minimum adjacent bar transmittance.

6.2.3 The recording shall be made so that the azimuth of the record is at an angle of 90° ± 1° to the reference edge of the film.

6.2.4 The lateral location, length, and width of the scanned area shall be as specified in figure 2 and table 1.

6.2.5 The reproducing (scanning) slit image shall be positioned at an angle of 90° ± 1° to the reference edge of the film.

**6 Machine-readable key numbers**

6.1 The machine-readable key numbers are intended to be a machine-readable version of the immediately adjacent human-readable key numbers.

**6.2 Dimensions**

6.2.1 The dimensions and lateral location of the machine-readable identification numbers shall be as specified in figure 2 and table 1.

6.2.2 The nominal width of the narrowest bar or space shall be 0.0075 in (0.190 mm). All other bars and spaces are to be integer multiples of the narrowest bar as specified in USS 128. The total bar code message, which consists of 123 elements (not counting the quiet zones), shall have a width as given by dimension H of table 1.

**6.3 Repeat frequency**

The machine-readable message shall be immediately adjacent to the human-readable key number and shall repeat at the same frequency.

**6.4 Format**

6.4.1 The machine-readable numbers shall consist of a series of bars and spaces of varying width that meet the bar code specification of USS 128. Code subset C of this specification, which allows double-density numeric digits, shall be used.

6.4.2 The data portion of the message shall be of fixed length and shall consist of 16 digits. Since code subset C encodes two digits per bar

code character, this corresponds to 8 bar code characters. In addition, quiet zones, a start character (for code C), a check sum character, and a stop character shall be recorded. Including the start and stop characters, the entire message shall be 11 bar code characters.

**6.4.3** The start character shall be nearest the head end of the film and the stop character shall be nearest the tail end of the film, regardless of the orientation of the human-readable characters; i.e., when the film is transported in the normal direction of travel past a fixed scanning position, the start character shall be read first.

**6.4.4** The 8 bar code characters (16 data digits) are defined as follows:

**6.4.4.1** The first character shall be encoded with a two-digit manufacturer code. These codes shall be assigned as per table 3. Other codes are reserved for future assignment by the SMPTE.

**Table 3 – Manufacturer codes**

Manufacturer	Code
Agfa-Gevaert, N.V.	11
Eastman Kodak Co.	12
Fuji Photo Film U.S.A., Inc.	13
Other or nondesignated	10

**6.4.4.2** The second character shall be a two-digit product specification code assigned at the discretion of the manufacturer. If the manufacturer does not wish to identify the product, the digits 00 shall be encoded.

**6.4.4.3** The third through seventh characters shall be encoded with the 10 characters of key number information. These shall be the same information as in the immediately adjacent human-readable key number. The third character shall contain the most significant digits and the seventh character shall contain the least significant digits.

**6.4.4.4** The eighth character shall be encoded with a two-digit offset in perforations from the zero-frame reference mark. This offset shall be 00.

**6.4.5** The check sum is equal to the modulo 103 sum of the value of the start character and the weighted values of the eight data characters as specified in USS 128.

## 7 Optional manufacturer-identification information

**7.1** Additional manufacturer information may be printed along the edge of the film as shown in figure 1 and specified in table 1.

### 7.2 Recommended minimum information

#### 7.2.1 Manufacturer's name

The first piece of information shall be the name of the manufacturer. This, in general, shall be an abbreviated name, rather than the full company name.

#### 7.2.2 Film type

The second piece of information, separated from the manufacturer's name by a space, shall be the film type. Its form, whether numeric, alphabetic, or mixed, shall be at the discretion of the manufacturer.

#### 7.2.3 Optional information

The manufacturer may place additional information following the film type, if so desired. This may include batch numbers, for example. It is recommended that the length of this information be limited so the entire string of manufacturer-identification information is no more than 3 perforations long.

#### 7.2.4 Repeat distance

The repeat distance of this information is at the discretion of the manufacturer, but the repeat distance shall be one of the following: 40, 80, or 120 perforations.

## 8 Optional density measurement patch

### 8.1 Density patch

A patch suitable for measurement of edgeprint density may be printed along the edge of the film as shown in figure 1.

### 8.2 Shape and size

The density patch may be either circular or square. Its height and width shall be no greater than the height specified for human-readable characters (dimension B in table 1).

## 8.3 Color and density

The density patch shall be exposed with the same color and intensity of light as is used for the human-readable key numbers. If the intensity of red light used for the human-readable key numbers is not the same as is used for the machine-readable key numbers (barcode), then a second density patch, exposed with the same color and intensity of light as the machine-readable key numbers may be placed immediately adjacent to the first density patch. Optionally, separate patches may be exposed with red and green light.

## 8.4 Repeat frequency

The spacing from one density patch to another shall be equal to or greater than 400 perforations and shall be an integral multiple of 20 perforations. This specification is intended to allow a density patch as infrequent as once per roll or not at all.

## 9 Bar code scanner and density specifications

### 9.1 Scanner spectral sensitivity

The peak or maximum response of the combination of the light source, filters, and photo receptor shall be at 680 nm  $\pm$  60 nm. In addition, the lower wavelength at which the response is down to 10% of peak response shall be equal to or greater than 600 nm and the upper wavelength at which the response is down to 10% of peak response shall be equal to or less than 760 nm. Notwithstanding these specifications, the spectral response of the scanning system must be designed for good differentiation between bars and spaces with existing conventional color and black-and-white films.

### 9.2 Quality of machine-readable messages

The following clauses specify measurement techniques for the signal level of the machine-readable message and a minimum value for these measurements to ensure readability.

#### 9.2.1 Definitions

**9.2.1.1 scan transmittance profile:** A record of the transmittance measured as a function of distance along the entire bar code symbol.

**9.2.1.2 symbol contrast (SC):** The difference between the largest and smallest transmittances in a scan transmittance profile

$$SC = T_{\max} - T_{\min}$$

**9.2.1.3 minimum edge contrast (EC<sub>min</sub>):** The minimum difference between a space transmittance (T<sub>s</sub>) and the adjoining bar transmittance (T<sub>b</sub>)

$$EC_{\min} = T_s - T_b$$

**9.2.1.4 modulation (MOD):** The ratio of minimum edge contrast (EC<sub>min</sub>) to symbol contrast (SC)

$$MOD = EC_{\min} / SC$$

### 9.2.2 Measurement methodology

The measurement of bar code modulation is based on the analysis of the scan transmittance profile. A scan is made with a particular aperture and wavelength. For the purposes of this standard, the wavelength shall be as specified in 9.1 and the scanning slit shall have the dimensions specified in table 1. Figure 4 is a graphical representation of a scan transmittance profile. In figure 4, the vertical axis is percent transmittance and the horizontal axis represents linear position. The high transmittance areas on the left and right are the quiet zones. The high transmittance areas are spaces and the low transmittance areas are bars. The necessary measurements can be determined by manual graphical analysis or automatically by numeric analysis.

Figure 4 illustrates the measurement of T<sub>max</sub> and T<sub>min</sub>, the largest and smallest transmittances in the scan reflectance profile, respectively. It also illustrates the measurement of EC<sub>min</sub>, which for this particular example, is at edge 4. In general, it is necessary to determine edge contrast for each edge (each pair of bar and space) and then find the minimum of this set of edge contrasts.

Minimum edge contrast, symbol contrast, and modulation are calculated using the formulas given in the definitions of 9.2.1.

### 9.2.3 Modulation specification

The edge print applied by the manufacturer shall be exposed so that, when the film is processed through the manufacturer's recommended process, the symbol

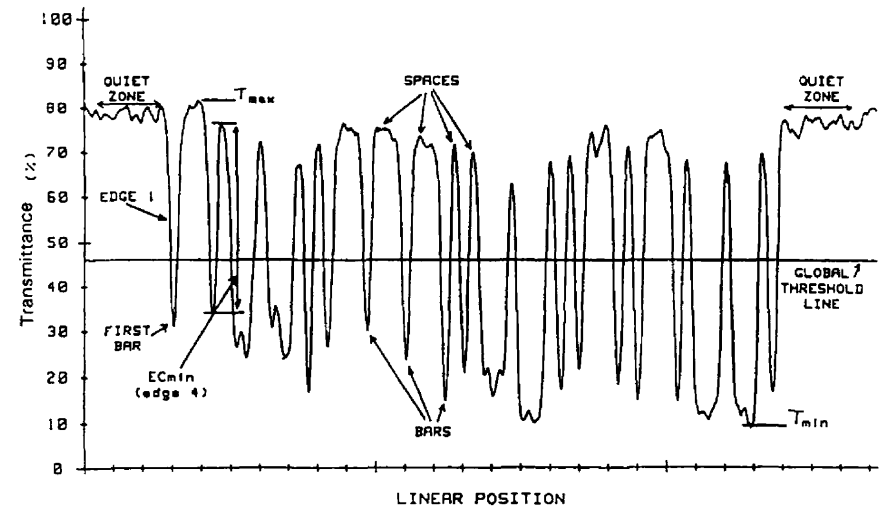


Figure 4 – Example of scan transmittance profile

contrast shall be equal to or greater than 0.40 and the modulation shall be equal to or greater than 0.40.

### 9.3 Density of printed machine-readable messages

When the machine-readable message is printed onto a conventional color print film, it is recommended that the edge lights on the printer be controlled to produce status A red densities of  $2.00 \pm 0.30$  for the bars and 0.25 maximum for the spaces.

When the machine-readable message is printed onto a conventional color intermediate film, it is recommended that the edge lights on the printer be controlled to produce a status M red density of  $D_{min} + 0.75 \pm 0.10$  for the bars.

### 10 Color of edgeprint information

In order to increase the visual discrimination between the human-readable key number and the other edge print information, it is recommended, but not required, that, on color negative films, the following colors of exposing light be used for the various types of information:

- Human-readable key numbers — red + green or red + blue;
- Machine-readable key number (bar code) — red;
- Manufacturer's information — green.