SMPTE 271-2008
Revision of
SMPTE 271-2002

SMPTE STANDARD

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

Table of Contents

Approved
October 10, 2008

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices. This SMPTE Engineering Document was prepared by Technology Committee F2.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

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 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.
A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

3 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.

SMPTE 109-2003, 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)

4 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.

5 General Format

5.1 Format

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

5.2 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.

5.3 Film

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

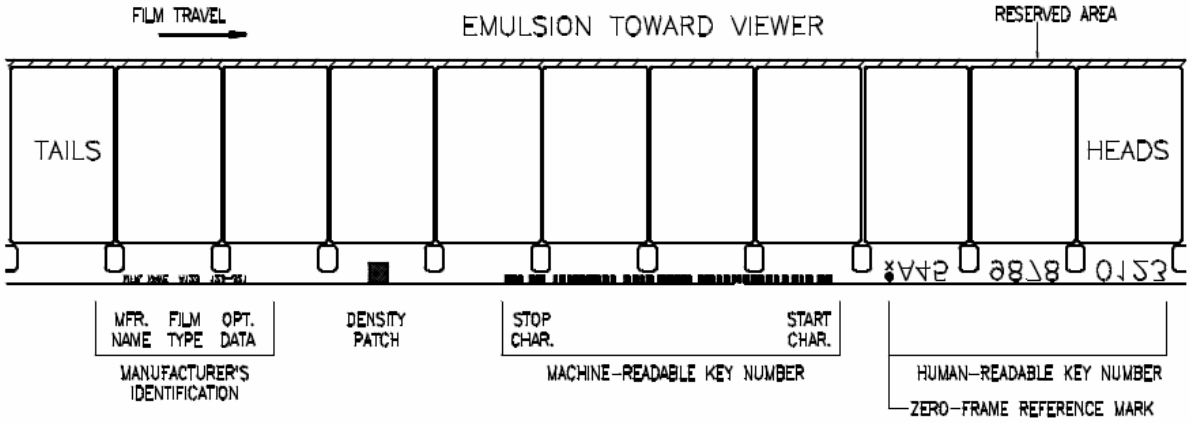

Figure 1 – General format

6 Human-Readable Key Numbers

6.1 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.

6.2 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 6.3. 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 2⁄14 of a character height is recommended.

6.3 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 6.6.2 is used. The zero-frame reference mark shall be a filled circle with a diameter as given by dimension B_3 of Table 1.

6.4 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.

6.4.1 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.

6.5 Repeat Frequency

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

6.6 Format and Orientation

6.6.1 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, 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.

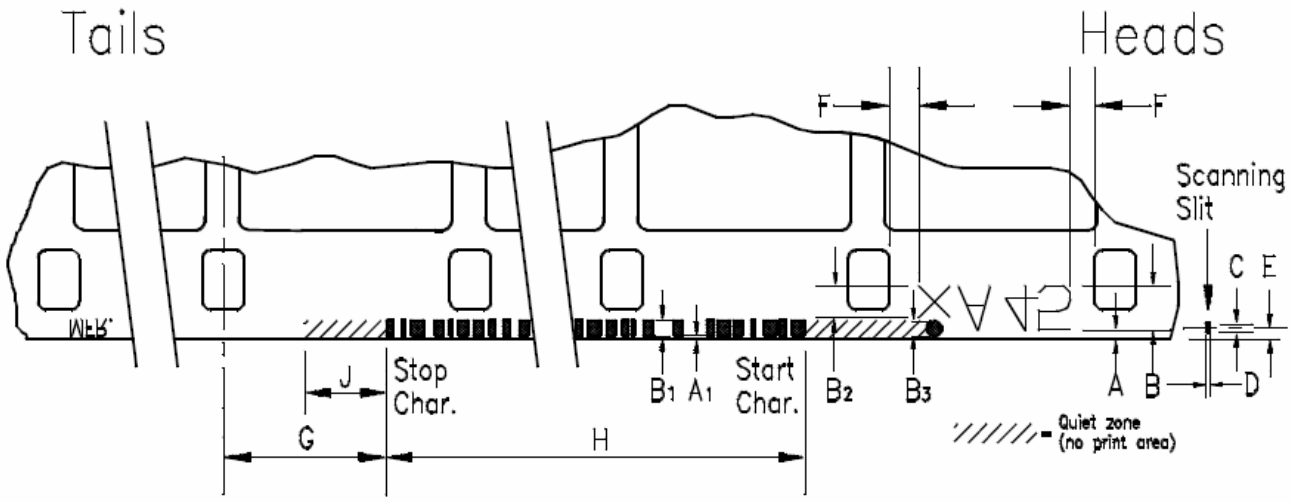

Figure 2 – Position and dimensions

Table 1 – Specifications

Dimensions		Inches			Millimeters		
A	Edge of film to bottom of characters	0.0115	±	0.0030	0.292	±	0.076
A’	Edge of film t o bottom of bars	0.004	±	0.003	0.10	±	0.08
B	Height of characters	0.525	±	0.0030	1.334	±	0.076
B_1	Height of bars and manufacturer's information	0.0188	±	0.0030	0.478	±	0.076
B_2	Height of first character	0.033 min		0.039 max	0.84 min		0.99 max
B_3	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	±	0.058
J	Quiet zone (no print area)	0.100		min	2.54		min

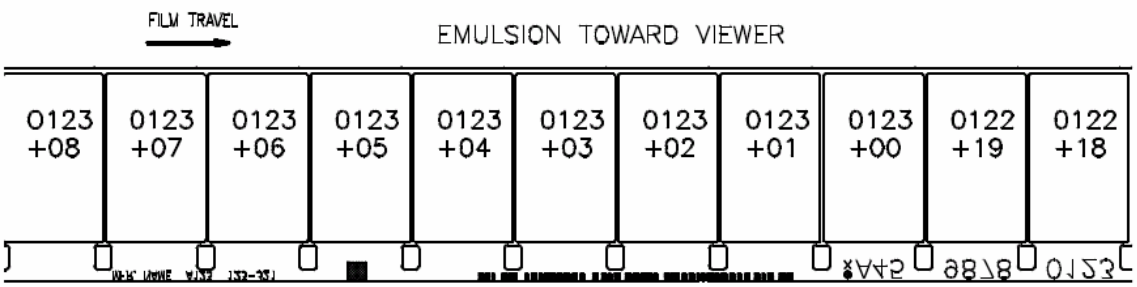

Figure 3 – Alignment of zero-frame reference mark

6.6.2 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.

6.6.3 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 and other symbols at the discretion of the manufacturer.

- The first character shall identify the film manufacturer alphabetic code according to Table 2. Other letters are reserved for future assignment by the SMPTE.
- The second character shall be a film-type identifier. The film type identifier will be used in one of two ways per the manufacturer's preference.
  - The second character is used alone to identify film type.
  - The second character is used in conjunction with the first character as a two-character film type identifier.
- The second 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.	E, K, V
FUJIFILM CO.	F
ILFORD LTD.	I
Other or nondesignated	(nothing)

7 Machine-Readable Key Numbers

7.1 Key Numbers

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

7.2 Dimensions

7.2.1 The dimensions and lateral location of the machine-readable identification numbers shall be as specified in Figure 2 and Table 1.

7.2.2 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.

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.

7.2.3 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.

7.2.4 The lateral location, length, and width of the scanned area shall be as specified in Figure 2 and Table 1.

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

7.3 Repeat Frequency

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

7.4 Format

7.4.1 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.

7.4.2 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 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.

7.4.3 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.

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

7.4.4.1 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
FUJIFILM CO.	13
ILFORD LTD.	14
Other or nondesignated	10

7.4.4.2 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.

7.4.4.3 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.

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

7.4.5 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.

8 Optional Manufacturer-Identification Information

8.1 Additional Information

Additional manufacturer information may be printed along the edge of the film as shown in Figure 1 and specified in Table 1.

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 3 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 one of the following: 40, 80, or 120 perforations.

9 Optional Density Measurement Patch

9.1 Density Patch

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

9.2 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).

9.3 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.

9.4 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.

10 Bar Code Scanner and Density Specifications

10.1 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.

10.2 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.

10.2.1 Definitions

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

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

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

10.2.1.3 minimum edge contrast (EC_{min}): The minimum difference between a space transmittance (T_s) and the adjoining bar transmittance (T_b)

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

10.2.1.4 modulation (MOD): The ratio of minimum edge contrast (EC_{min}) to symbol contrast (SC)

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

10.2.2 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 10.1 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.

Minimum edge contrast, symbol contrast, and modulation are calculated using the formulas given in the definitions of 10.2.1.

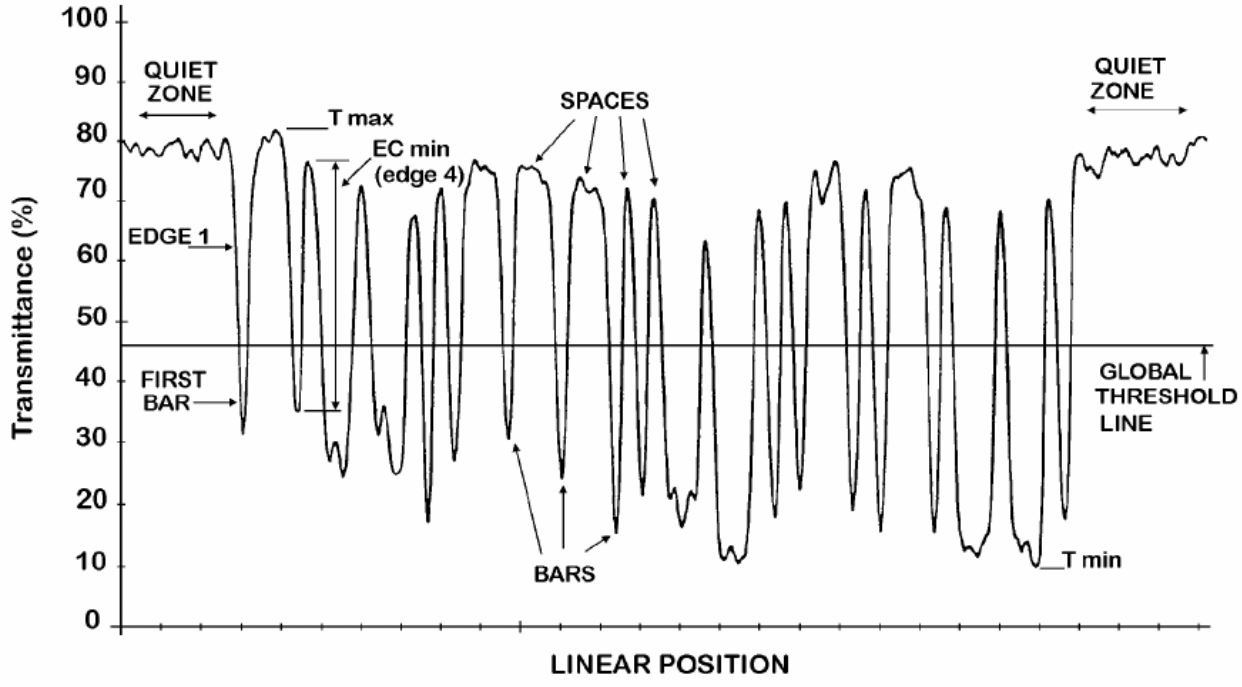

Figure 4 – Example of scan transmittance profile

10.2.3 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.

10.3 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.

11 Color of Edge Print 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.