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SMPTE STANDARD

SMPTE 270-2008
Revision of
SMPTE 270-2005

for Motion-Picture Film (65-mm) — Manufacturer-Printed Latent Image Identification Information — 80 Perforation Repeat

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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 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 optional frame line index marks.

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 145-2004, 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.)

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 one foot. 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 145.

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.

6.2 Dimensions

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

6.3 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.

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

6.4 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.

6.4.1 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.

6.5 Repeat Frequency

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

6.6.2 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 (closer 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.

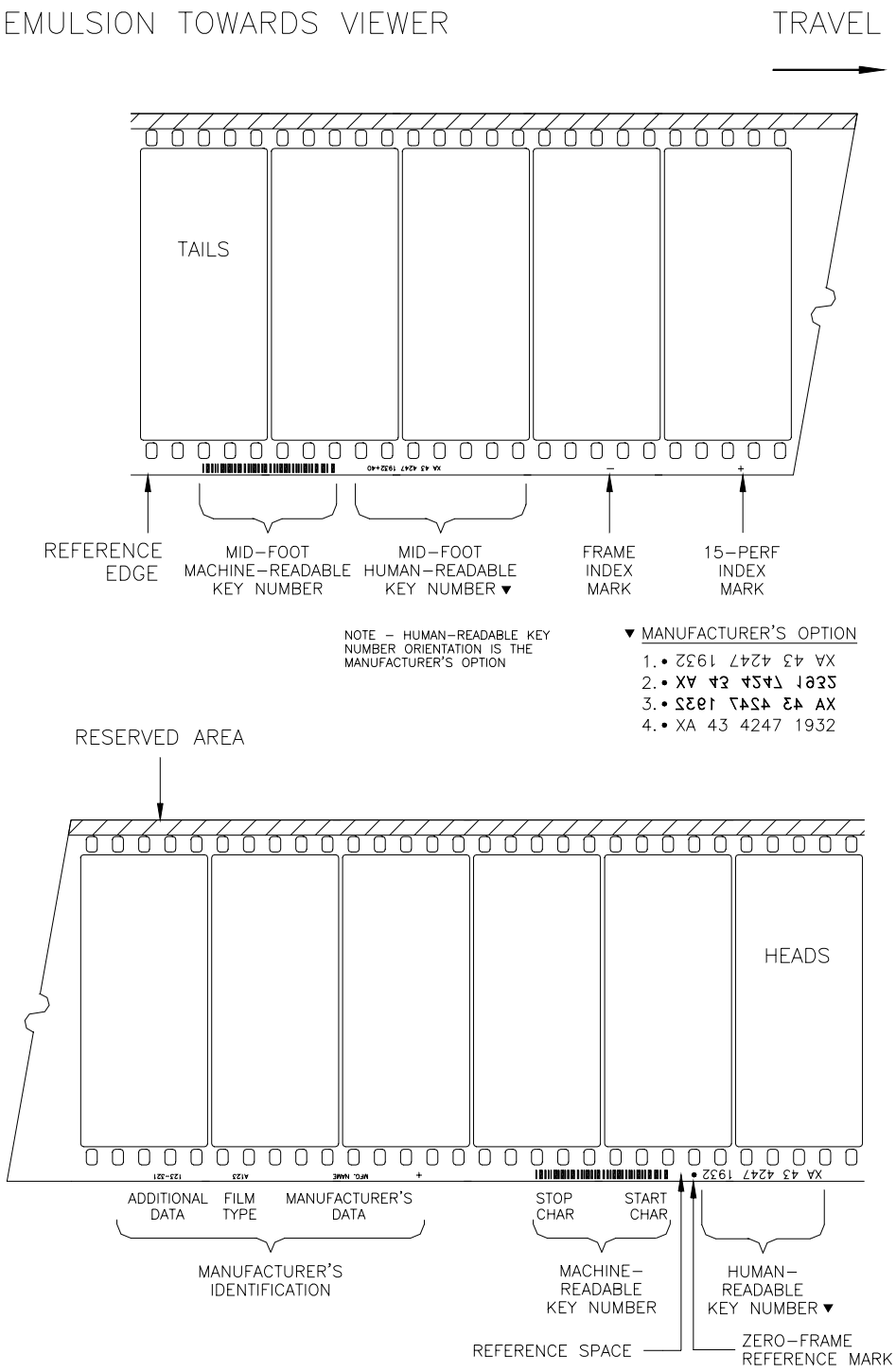

Figure 1 – General format

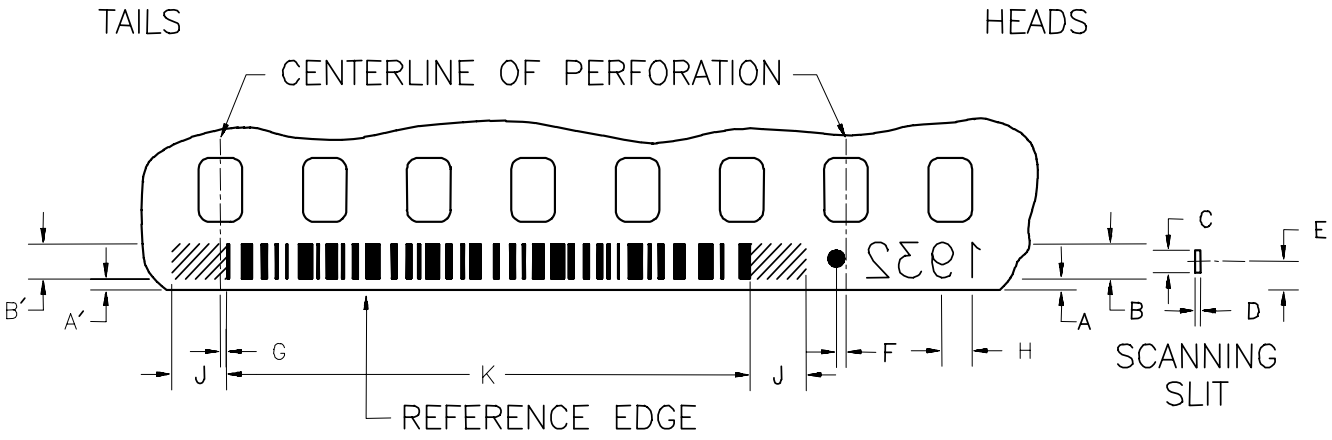

Figure 2 – Position and dimensions

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 t o 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	0.38 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

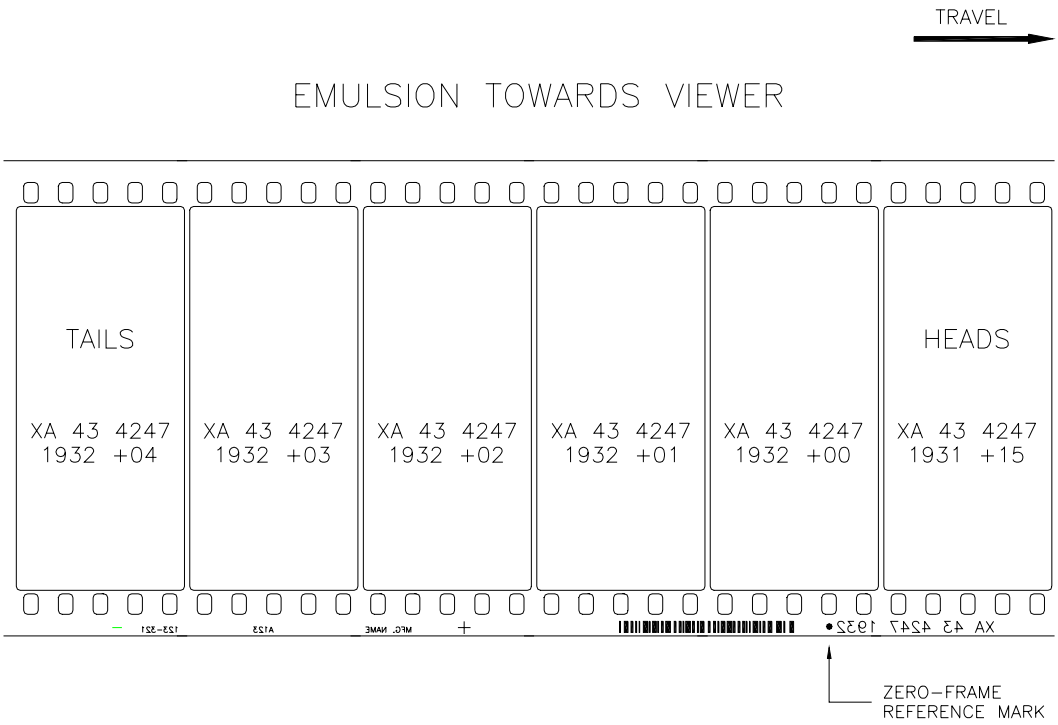

Figure 3 – Alignment of zero-frame reference mark

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 of 0.9225 in ± 0.0400 in (23.432 mm ± 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.

7.2.3 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 6.3, within the tolerance shown in Figure 2.

7.2.4 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.

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

7.2.6 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 code character, this corresponds to 8 bar code characters. In addition, quiet zones, a start character (for code C), a checksum 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.	21
EASTMAN KODAK CO.	22
FUJIFILM CO.	23
ILFORD LTD.	24
Other or nondesignated	20

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 ten 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 preceding key number. This offset shall be 00 for the key numbers described above and 40 for the mid-foot key number described in 7.5.

7.4.5 The checksum 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.

7.5 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.

7.5.1 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).

7.5.2 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 that specified in 7.4. The offset-in-perforations digits will be set to 40.

8 Optional Frame Index Mark

8.1 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.

8.1.1 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).

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

8.1.3 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.

9 Optional Manufacturer-Identification Information

9.1 Additional Information

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).

9.2 Recommended Minimum Information

9.2.1 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.

9.2.2 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.

9.2.3 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.

9.3 Repeat Distance

The repeat distance of this information is at the discretion of the manufacturer, but the repeat distance shall be a multiple of 120 perforations, and a distance of no more than 240 perforations is recommended.

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 ± 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 signal.

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

10.2.3 Modulation specification

The edge print applied by the manufacturer shall be applied 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 a status A red density of the bars of 2.00 ± 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 ± 0.10.

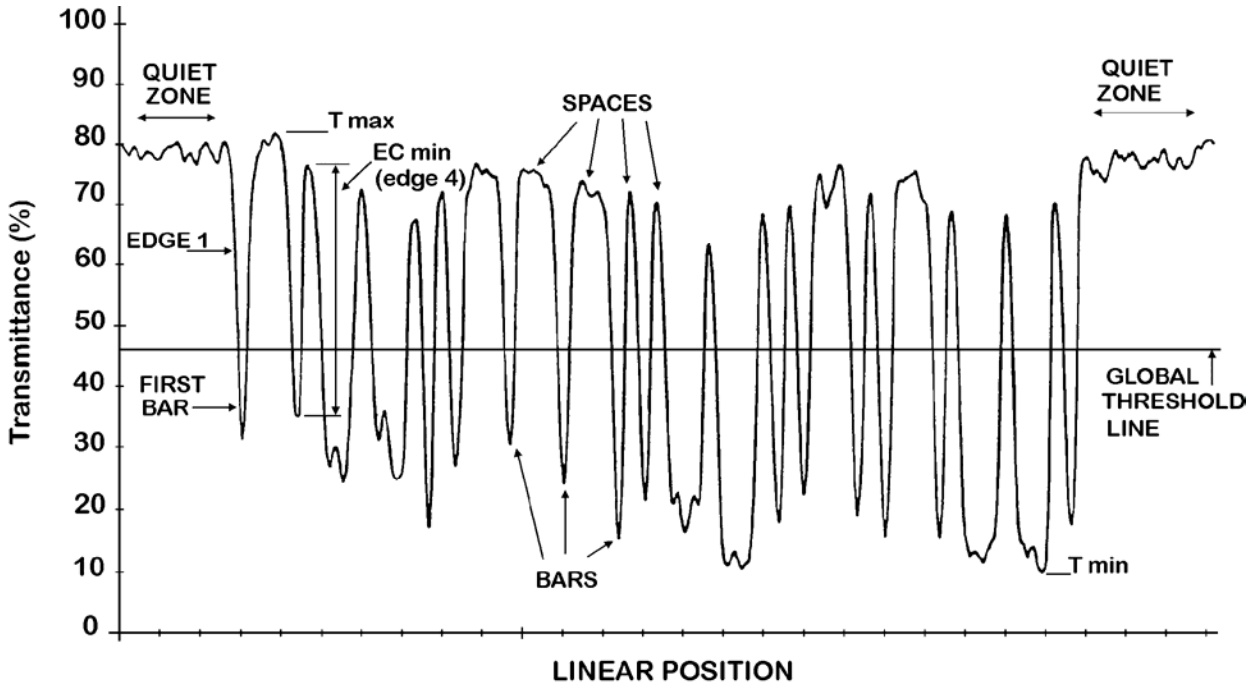

Figure 4 – Example of scan transmittance profile