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# Cinematography — Time and control code for 24, 25 and 30 frames per second motion-picture film systems — Specifications

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# National foreword

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The UK participation in its preparation was entrusted to Technical Committee CPW/36, Cinematography.

A list of organizations represented on this committee can be obtained on request to its secretary.

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BS ISO 9642:2020

# INTERNATIONAL STANDARD

# ISO 9642

Second edition
2020-01-31

# Cinematography — Time and control code for 24, 25 and 30 frames per second motion-picture film systems — Specifications

*Cinématographie — Code de chronométrage et de commande pour les systèmes de films cinématographiques à 24, 25 et 30 images par seconde — Spécifications*

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# Foreword

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This document was prepared by Technical Committee ISO/TC 36, *Cinematography*.

This second edition cancels and replaces the first edition (ISO 9642:1993), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— The title has been modified to include the word "film".

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INTERNATIONAL STANDARD ISO 9642:2020

# Cinematography — Time and control code for 24, 25 and 30 frames per second motion-picture film systems — Specifications

## 1 Scope

This document specifies digital code for mats and modulation methods for motion-picture film to be used for timing, control, editing and synchronization purposes. This document also specifies the relationship of the codes to the motion picture frame.

Two types of code are described in this document. The first type, Type C, is a continuous code which is very similar to the continuous code specified in IEC 60461. This type of code can be used in situations where the film is moving continuously at the time of both recording and reproduction.

The second type of code, Type 8, is a non-continuous, block-type code, composed of blocks of data, each complete in itself, with gaps between the blocks. It is designed so that the code can be recorded and played back on equipment with intermittent film motion but still be decoded with the same type of electronic equipment used to read the Type C or continuous time code.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 2022, *Information technology — Character code structure and extension techniques*

ISO 4241, *Cinematography — Projection film leader (time-based), trailer and cue marks — Specifications*

ISO 8758, *Cinematography — Photographic control and data records on 16 mm and 35 mm motion-picture film and prints — Dimensions and location*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**real time**
<NTSC colour recording> time elapsed during the scanning of 60 fields (or any multiple thereof) in an ideal television system at a vertical field rate of exactly 60 fields per second

**3.2**
**colour time**
<NTSC colour recording> time elapsed during the scanning of 60 fields (or any multiple thereof) in a colour television system at a vertical field rate of approximately 59,94 fields per second

| Bit number | | Bit description |
|---|---|---|
| **Type C code** | **Type 8 code** | |
| 24-26 | 48-50 | Tens of seconds |
| 27 | 51 | Bi-phase mark phase correction bit (see 5.4) |
| 28-31 | 52-55 | Fourth binary group |
| 32-35 | 56-59 | Units of minutes |
| 36-39 | 60-63 | Fifth binary group |
| 40-42 | 64-66 | Tens of minutes |
| 43 | 67 | Binary group flag bit {see 5.4) |
| 44-47 | 68-71 | Sixth binary group |
| 48-51 | 72-75 | Units of hours |
| 52-55 | 76-79 | Seventh binary group |
| 56-57 | 80-81 | Tens of hours |
| 58 | 82 | Unassigned address bit (zero until further assignment) |
| 59 | 83 | Binary group flag bit (see 5.4) |
| 60-63 | 84-87 | Eighth binary group |
| 64-79 | 88-103 | Synchronizing word |
| 64-65 | 88-89 | Fixed zero |
| 66-77 | 90-101 | Fixed one |
| 78 | 102 | Fixed zero |
| 79 | 103 | Fixed one |
| <?> | 104-111 | Alternating one, zero pattern |

| BIT NUMBER | | BIT | | |
|---|---|---|---|---|
| TYPE C | TYPE 8 | VALUE | DESCRIPTION | Notes |
| 0 | 0 | TIMING | BITS | START FOR TYPE 8 |
| 1 | 1 | | | IS CLOCK EDGE |
| 2 | 0 | | | BETWEEN BIT 111 |
| 3 | 1 | | | AND BIT 0 |
| 4 | 0 | | | |
| 5 | 1 | | | |
| 6 | 0 | | | |
| 7 | 1 | | | |
| 8 | 0 | SYNC | WORD | |
| 9 | 0 | | | |
| 10 | 1 | | | |
| 11 | 1 | | | |
| 12 | 1 | | | |

| | | | |
|---|---|---|---|
| | 13 | 1 | |
| | 14 | 1 | |
| | 15 | 1 | |
| | 16 | 1 | |
| | 17 | 1 | |
| | 18 | 1 | |
| | 19 | 1 | |
| | 20 | 1 | START FOR TYPE C |
| | 21 | 1 | IS CLOCK EDGE |
| | 22 | 0 | BETWEEN BIT 79 |
| | 23 | 1 | AND BIT 0 |
| 0 | 24 | 1 | FRAMES UNITS |
| 1 | 25 | 2 | |
| 2 | 26 | 4 | |
| 3 | 27 | 8 | |
| 4 | 28 | | 1ST BINARY GROUP |
| 5 | 29 | | |
| 6 | 30 | | |
| 7 | 31 | | |
| 8 | 32 | | 10 FRAMES TENS |
| 9 | 33 | | 20 |
| 10 | 34 | | DROP FRAME FLAG |
| 11 | 35 | | COLOUR FRAME FLAG |
| 12 | 36 | | 2ND BINARY GROUP |
| 13 | 37 | | |
| 14 | 38 | | |
| 15 | 39 | | |

| BIT NUMBER TYPE C | BIT NUMBER TYPE 8 | BIT VALUE | DESCRIPTION | Notes |
|---|---|---|---|---|
| 16 | 40 | | 1 SECONDS UNITS | |

| | | |
|---|---|---|
| 17 | 41 | 2 |
| 18 | 42 | 4 |
| 19 | 43 | 8 |
| 20 | 44 | 3RD BINARY GROUP |
| 21 | 45 | |
| 22 | 46 | |
| 23 | 47 | |
| 24 | 48 | 10 SECONDS TENS |
| 25 | 49 | 20 |
| 26 | 50 | 40 |
| 27 | 51 | BI-PHASE MARK PHASE CORRECTION BIT |
| 28 | 52 | 4TH BINARY GROUP |
| 29 | 53 | |
| 30 | 54 | |
| 31 | 55 | |
| 32 | 56 | 1 MINUTES UNITS |
| 33 | 57 | 2 |
| 34 | 58 | 4 |
| 35 | 59 | 8 |
| 36 | 60 | 5TH BINARY GROUP |
| 37 | 61 | |
| 38 | 62 | |
| 39 | 63 | |
| 40 | 64 | 10 MINUTES TENS |
| 41 | 65 | 20 |
| 42 | 66 | 40 |
| 43 | 67 | BINARY GROUP FLAG BIT |
| 44 | 68 | 6TH BINARY GROUP |
| 45 | 69 | |
| 46 | 70 | |
| 47 | 71 | |
| 48 | 72 | 1 HOURS UNITS |
| 49 | 73 | 2 |
| 50 | 74 | 4 |

| | | |
|---|---|---|
| 51 | 75 | 8 |
| 52 | 76 | 7TH BINARY GROUP |
| 53 | 77 | |
| 54 | 78 | |
| 55 | 79 | |

| BIT NUMBER | | BIT | | |
|---|---|---|---|---|
| TYPE C | TYPE 8 | VALUE | DESCRIPTION | Notes |
| 56 | 80 | | 10 HOURS TENS | |
| 57 | 81 | | 20 | |
| 58 | 82 | | UNASSIGNED ADDRESS BIT | |
| 59 | 83 | | BINARY GROUP FLAG BIT | |
| 60 | 84 | | 8TH BINARY GROUP | |
| 61 | 85 | | | |
| 62 | 86 | | | |
| 63 | 87 | | | |
| 64 | 88 | 0 | SYNC WORD | |
| 65 | 89 | 0 | | |
| 66 | 90 | 1 | | |
| 67 | 91 | 1 | | |
| 68 | 92 | 1 | | |
| 69 | 93 | 1 | | |
| 70 | 94 | 1 | | |
| 71 | 95 | 1 | | |
| 72 | 96 | 1 | | |
| 73 | 97 | 1 | | |
| 74 | 98 | 1 | | |
| 75 | 99 | 1 | | |
| 76 | 100 | 1 | | |
| 77 | 101 | 1 | | |
| 78 | 102 | 0 | | |
| 79 | 103 | 1 | | |
| | 104 | 1 | TIMING BITS | |
| | 105 | 0 | | |

| | |
|---|---|
| 106 | 1 |
| 107 | 0 |
| 108 | 1 |
| 109 | 0 |
| 110 | 1 |
| 111 | 0 |

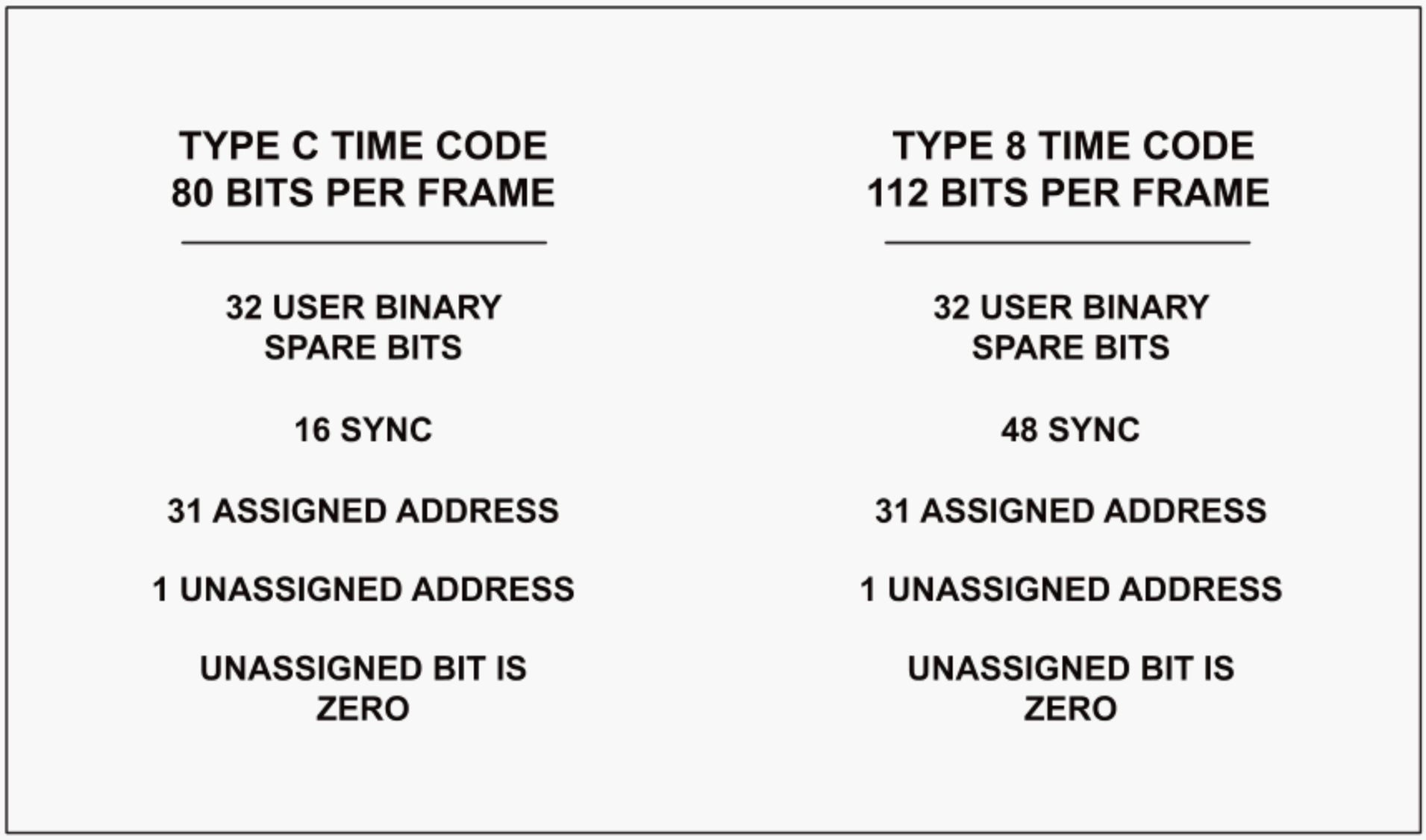
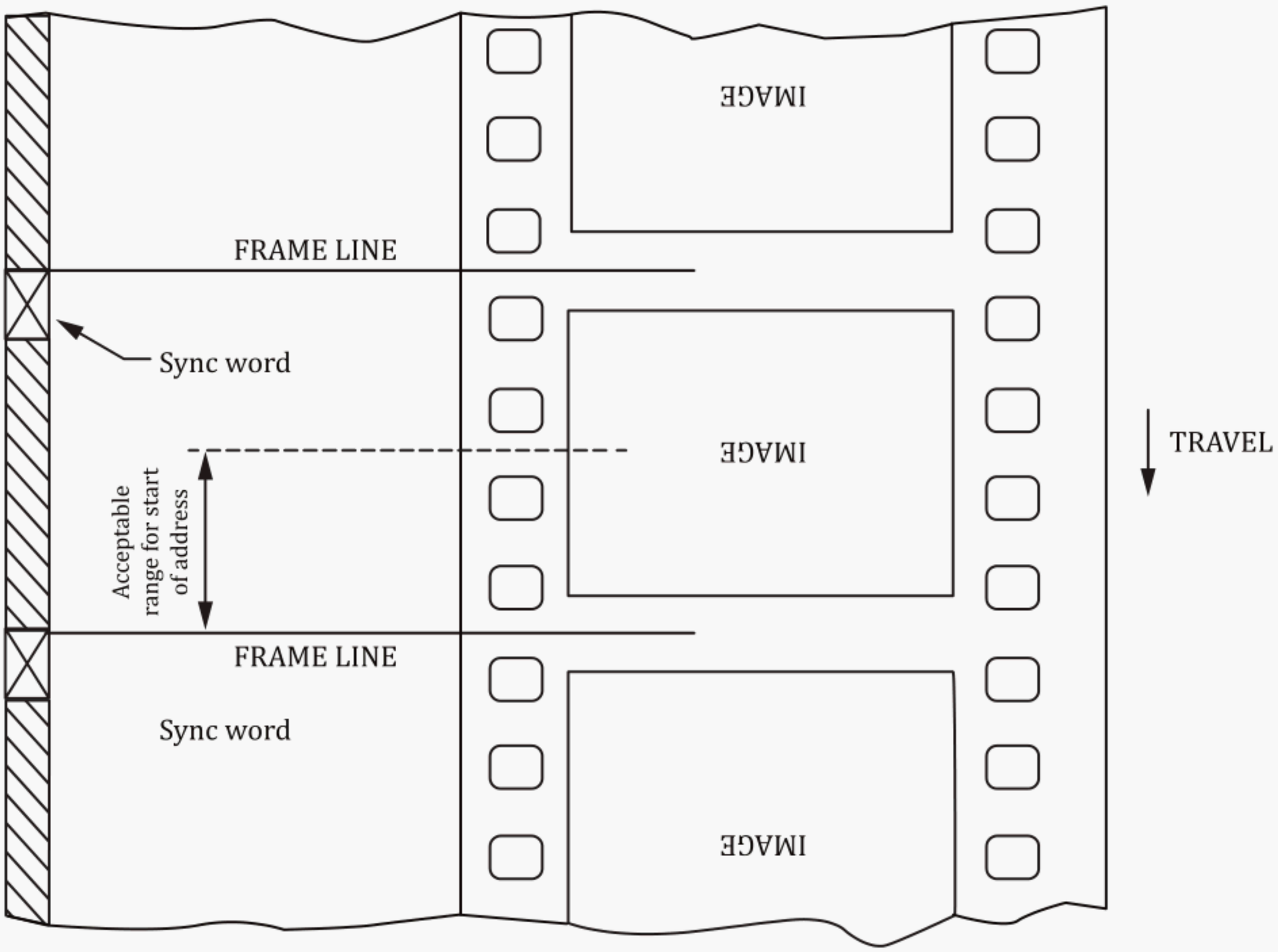



**Figure 1 — Bit assignment**




NOTE Figure 2 illustrates the preferred longitudinal placement of a frame of time code relative to the picture frame. The figure applies to all film formats, even though 35 mm film is shown.

**Figure 2 — Type C code**

## 5.2 Type 8 code format

**5.2.1** Each motion-picture frame shall be identified by a unique and complete address.

**5.2.2** The frames shall be numbered successively 0 to 23, 24 or 29 inclusive, corresponding to the frame rate being used.

**5.2.3** Each address shall consist of 112 bits numbered 0 to 111 inclusive.

**5.2.4** The bits shall be assigned as shown in the appropriate columns of Figure 1 and in Table 1.

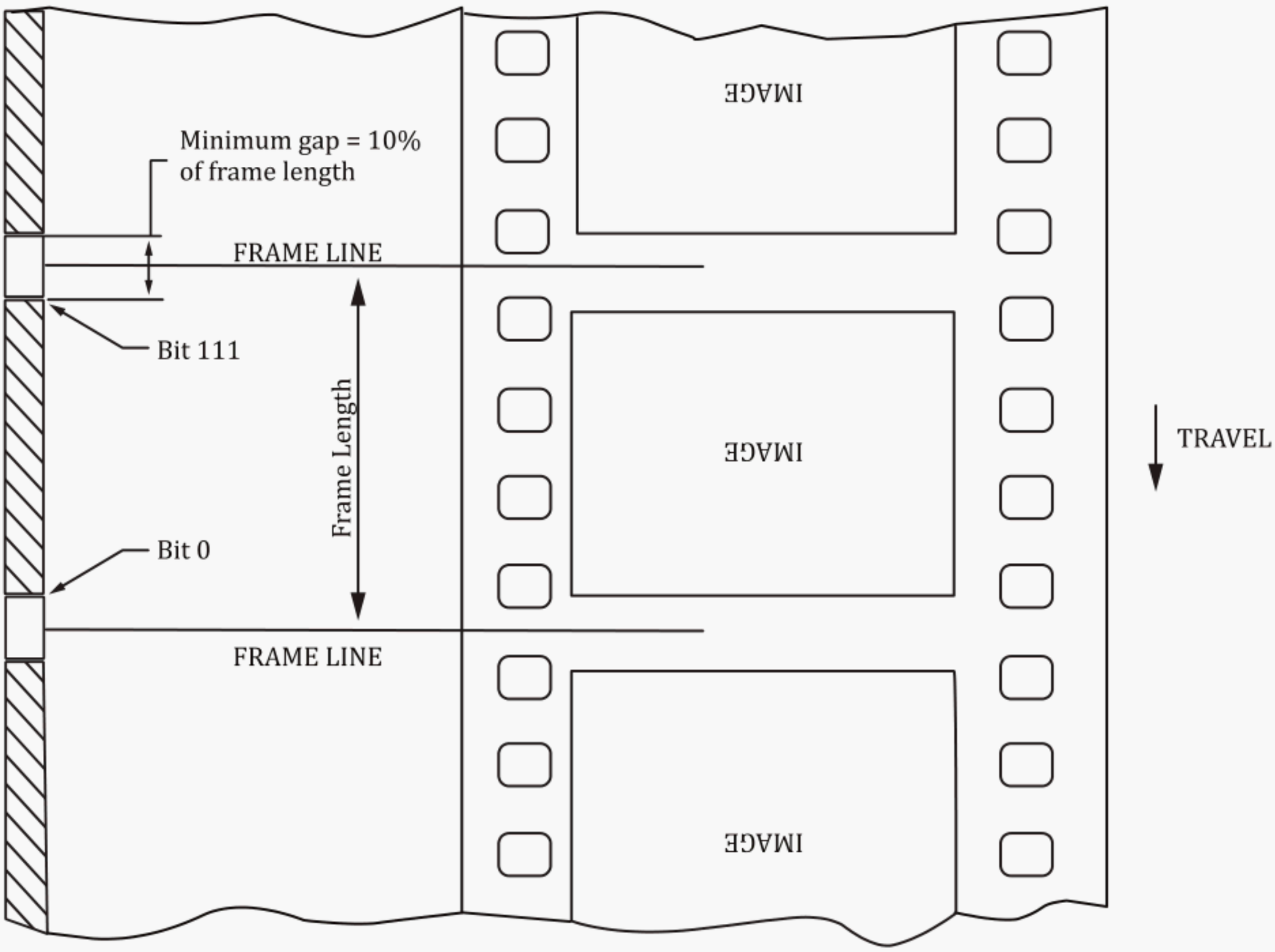
**5.2.5** The block of data for a single frame may be recorded anywhere within that frame except that no part of the block may occupy the region extending from the frameline to 5 % of a frame length on either side of it. This region is thus a gap in the data which has a minimum length of 10 % of a frame length. See Figure 3.

**5.2.6** The length of any one bit shall not differ by more than 5 % from the length of either adjacent bit. In addition, the length of no bit shall be so short as to make the recording and reproduction of that data, using practical equipment, unreliable. The length of no series of bits shall cause the total length of 112 bits to exceed 90 % of frame length.

**5.2.7** In order to reduce the d.c. content of the signal, a repetitive pattern of zeros and ones shall be recorded in as much of the gap area (the frameline region defined in 5.2.5) as is practical. This region shall not contain a sync word of the previous frame or the first sync word of the following frame and shall not be decodable as a valid time code word. The bit length tolerance in 5.2.6 does not apply to data in the gap.

## 5.3 Use of binary groups

**5.3.1** The binary groups are intended for storage of data by the users and the 32 bits within the 8 groups may be assigned in any fashion without restrictions if the character set used for the data insertion is not specified and the binary group flag bits, Nos. 43 and 59, are both zero.




NOTE Figure 3 illustrates the preferred longitudinal placement of a frame of time code relative to the picture frame. The figure applies to all film formats, even though 35 mm film is shown.

**Figure 3 — Type 8 code**

**5.3.2** Encoding of frame identification by definition provides considerable redundancy that aids in minimizing decoding errors. In the design for storage of additional data for optional user applications, consideration shall be given to encoding of appropriate redundancies. In addition, data is specifically permitted to be spread across frame lines.

The binary group flag bits 43 and 59 (67 and 83 for Type 8 code) shall be set according to Table 2.

**Table 2 — Binary group flag bits**

| | Bit 43/67 | Bit 59/83 |
|---|---|---|
| Character set not specified | 0 | 0 |
| Reserved | 0 | 1 |
| Character set as defined in ISO 2022 | 1 | 0 |
| Reserved | 1 | 1 |

### 5.4 Assigned and unassigned address bits

**5.4.1** Six bits are reserved within the address groups: four for identifying operational modes when this type of code is used for television systems, one for bi-phase correction and one unassigned, but reserved for future assignment and defined as zero until further specified.

**5.4.2** If certain numbers are being dropped to resolve the difference between real time and colour time, as defined in 5.1.2, a one shall be recorded in the drop frame flag bit (No. 10 for type C and No. 34 for Type 8).

**5.4.3** If colour frame identification has been intentionally applied, a one shall be recorded in the colour frame flag bit (No. 11 for type C and No. 35 for Type 8).

**5.4.4** The bi-phase mark phase correction bit (No. 27 for type C and No. 51 for Type 8) shall be put in a state so that every 80-bit or 112-bit word will contain an even number of logic zeros. This requirement results in the truth table given in Table 3 for bit 27 (51).

**Table 3 — Bi-phase mark correction bits**

| Number of logic zeros in bits 0 to 26 (24 to 50) and bits 28 to 63 (52 to 871) | Type C bit 27 | Type 8 bit 51 |
|---|---|---|
| Odd | 1 | 0 |
| Even | 0 | 1 |

**5.4.5** The two binary group flag bits (Nos. 43 and 59 for type C and Nos. 67 and 83 for Type 8) shall be set in accordance with Table 2.

**5.4.6** The unassigned address bit (No. 58 for type C and No. 82 for Type 8) shall be set to zero until further assignment.

## 6 Time discrepancies and colour framing in film/video transfer

### 6.1 NTSC colour recording

**6.1.1** When the film, on which the time code is recorded, is transferred from or will be transferred to television, or is otherwise used in conjunction with a 525-line/60-field television system, there can be a need to use the drop frame counting mode. In NTSC colour recording, the definitions 3.1 and 3.2 apply.

**6.1.2** Because the vertical frame rate of an NTSC colour signal is 29,97 frames per second (fps), counting of frames will yield approximately a 4 s timing error in 1 h. Therefore, two modes of operation are allowed.

a) Mode "1" (Drop frame). Compensated mode (30-frame code only).

To resolve the colour time error, the first two frame numbers (0, 1) at the start of each minute, except minutes 0, 10, 20, 30, 40 and 50, shall be omitted from the count. When this mode is used, bit No. 10 (34) of each address shall be a one as specified in 5.4.

b) Mode "0" (Non-drop frame). Uncompensated mode (30-frame code only).

During a continuous recording, no numbers shall be omitted from the chain of addresses. Each address shall be increased by 1 frame over the frame immediately preceding it. When this mode is used, bit No. 10 (34) of each address shall be a zero as specified in 5.4.

## 6.2 SECAM signals

For SECAM frames in which the second field begins with a line having the chrominance modulated by the signal $D_B$, the sum of the number of frames and seconds of the associated address shall be odd, and for SECAM frames in which the second field begins with a line having the chrominance modulated by the signal $D_R$ the sum shall be even.

## 6.3 PAL signals

For PAL frames that contain fields 1 and 2 of the sequence of four fields, the sum of the number of frames and seconds of the associated address shall be odd and for PAL frames that contain fields 3 and 4, this sum shall be even. (The numbering of the fields in the PAL system is defined in CCIR Report 407-1).

This relationship can also be defined in the following way. If bit No. 0 is *A* and bit No. 16 is *B*, then the code generator shall be locked to the incoming video signal in such a way as to fulfil the following conditions:

*Ali+ AB* = "1 " for field 1 and field 2

*Ali +AB* = "0 " for field 3 and field 4

# 7 Structure of the address bits

The basic structure of the address is based on the binary coded decimal (BCD) system. Because the count, in some cases, does not rise to 9, conservation of bits is achieved because 4 bits are not needed as in an ordinary BCD code. This structure is illustrated in Table 4 (bits shown in parentheses are for Type 8 code).

# 8 Position of the address on motion-picture film

The address shall be recorded in the data track whose location is specified in ISO 8758.

# 9 Addresses on motion-picture prints

When the time code is used on release prints, the time code of the "picture start" frame shall be 01 hours, 00 minutes, 00 seconds, 00 frames. All frames on the reel prior to the "picture start" frame shall each have the time code 01 hours, 00 minutes, 00 seconds, 00 frames. If the film is longer than one reel, the "picture start" frame and all preceding frames on the second reel shall be 02 hours, 00 minutes, 00 seconds, 00 frames. Successive reels shall be numbered likewise with the number of hours increasing sequentially and the minutes, seconds and frames being zero for the "picture start" frame.

The "picture start" frame referred to above precedes the first frame to be projected by exactly 8 s, as specified in ISO 4241.

**Table 4 — Time code bits**

| Description | Bit numbers | BCD values | Count |
|---|---|---|---|
| Frames units | 0 to 3 (24 to 27) | 1, 2, 4, 8 | 0 to 9 |
| Frames tens | 8 to 9 (32 to 33) | 1, 2 | 0 to 2 |
| Seconds units | 16 to 19 (40 to 43) | 1. 2, 4, 8 | 0 to 9 |
| Seconds tens | 24 to 26 (48 to 50) | 1, 2, 4 | 0 to 5 |
| Minutes units | 32 to 35 (56 to 59) | 1, 2, 4, 8 | 0 to 9 |
| Minutes tens | 40 to 42 (64 to 66) | 1, 2, 4 | 0 to 5 |
| Hours units | 48 to 51 (72 to 75) | 1, 2, 4, 8 | 0 to 9 |
| Hours tens | 56 to 57 (80 to 81) | 1, 2 | 0 to 2 |
| NOTE The 24-hour clock system is used; 2:00 p.m. is 14 h, 0 min. | | | |

# Bibliography

[1] IEC 60461, *Time and control code*

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