International Standard 6068

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Information processing — Recording characteristics of instrumentation magnetic tape (including telemetry systems) — Interchange requirements

Traitement de l'information — Caractéristiques d'enregistrement de la bande magnétique de mesure (y compris les systèmes de télémesure) — Spécifications d'échanges

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6068 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

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Contents

Annexes

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Information processing — Recording characteristics of instrumentation magnetic tape (including telemetry systems) — Interchange requirements

1 Scope and field of application

This International Standard specifies the tape and recorder/reproducer characteristics and modes of recording to enable users of different systems to interchange information recorded on instrumentation magnetic tape.

Modulation patterns are described in clause 6.

Test procedures recommended for use in measuring performance parameters of magnetic tape recorder and reproducer systems are described in annex B.

Annexes C to F provide additional information but do not form part of this International Standard. The characteristics of unrecorded tape are specified in ISO 6371.

2 References

ISO 1858, *Information processing — General purpose hubs and reels, with 76 mm (3 in) centre hole, for magnetic tape used in interchange instrumentation applications.*

ISO 1860, *Information processing — Precision reels for magnetic tape used in interchange instrumentation applications.*

ISO 3802, *Information processing — General purpose reels with 8 mm (5/16 in) centre hole for magnetic tape for interchange instrumentation applications.*

ISO 6371, *Information processing — Interchange practices and test methods for unrecorded instrumentation magnetic tape.*

3 Definitions

The following terms have a special technical meaning in this International Standard, and no attempt is made to lay down definitive terminologies outside the specific context of this International Standard.

3.1 bi-phase (or Bi-Φ) : Form of representation for binary "1" and "0" in pulse code modulation (PCM). Three variants, known as "level", "mark" and "space", are defined in 6.3.3 and figure 1.

3.2 data azimuth[1] : Angle in the plane of the tape, at any instant in time, between a line perpendicular to the reference edge of the tape and either of the two parallel lines defining data scatter.

NOTE — Data azimuth may be expressed as the sum of static and dynamic components in the form :

$$A + Bf(t)$$

where

$$\int_0^t f(t)\,dt = 0$$

3.3 data azimuth (dynamic)[1] : Maximum angular deviation, over a period of time, of the data azimuth from its mean value as defined by data azimuth (static). For the purposes of this definition, the word maximum is interpreted as being at the 95 % probability level. For a Gaussian distribution, this is two standard deviations (2σ).

NOTE — Data azimuth (dynamic) is the maximum value of the quantity $Bf(t)$ in the note on data azimuth.

3.4 data azimuth (static)[1] : Mean value, over a period of time, of the data azimuth.

NOTE — Data azimuth (static) is the quantity A in the note on data azimuth.

3.5 data scatter[1] : Minimum distance between two parallel lines, in the plane of the tape, between which all data transitions recorded in the same head, at the same time, shall fall.

3.6 data spacing : Distance on the tape between simultaneous events recorded on odd and even numbered tracks, when interlaced heads are used.

NOTE — On recording, this is equal to the head spacing, but on reproducing is only exactly equal to head spacing when record and reproduce tensions are equal. Different record and reproduce tensions will give rise to small errors in time correlation between the signals from the two heads.

1) The errors in location and angular relation among transient data recorded simultaneously on all odd or even tracks are defined by the terms : data azimuth, data scatter, and individual track data azimuth difference. These are approximately equivalent to the terms : head azimuth, gap scatter and head segment gap azimuth difference; however, guiding misalignment is included in the data location error definitions.

3.7 duty factor (of a pulse) : Percentage occupancy of pulse duration within a pulse period or time-slot.

3.8 edge margin (M) : Distance between the outside edge of the highest numbered track and the tape edge (see figure 5).

3.9 edge margin, minimum (M_m) : Minimum allowable value of edge margin.

NOTE — This value places an additional constraint on track configurations since, in general, the simultaneous application of all worst case tolerances for track width, track location and tape width will result in a value of edge margin less than M_m.

3.10 frequency division multiplex (FDM) : Multiplexing technique in which modulated subcarriers are combined in such a way that each of a number of data channels occupies a unique and defined section of the available bandwidth.

3.11 frame, major : The minimum overall repetitive sequence of pulses, in which each input channel is sampled at least once. The period of the major frame is determined by the length of the longest submultiple frame(s).

3.12 frame, minor : A group of data pulses or samples; it includes and ends with a synch. pulse or pattern. The minor frame is an integral submultiple of the major frame and, in the absence of subcommutation, is repetitive and equal to the major frame.

3.13 frame, submultiple : A repetitive group of subcommutated data pulses. Supercommutation within a submultiple frame is possible (see figure 2).

3.14 gap length : Distance from the leading edge to the trailing edge of the head gap measured perpendicular to the track width (see figure 3).

3.15 gap scatter : Minimum distance between two parallel lines, in the plane of the tape, between which gap trailing edges in a recorder head shall fall (see figure 3).

3.16 head : Grouping of individual head segments in a fixed assembly with the gap lines on a common plane.

3.17 head azimuth : Angle formed, in the plane of the tape, between a line passing through the gap centres of the two outside head tracks and a line perpendicular to the head reference plane (see figure 3).

3.18 head numbering : Head 1 of a pair of heads is the first head over which an element of tape passes when moving in the normal operating direction.

3.19 head reference plane : The plane, which may be imaginary (for some head designers, it is the nominal head mounting surface), parallel to the reference edge of the tape and perpendicular to the plane of the tape (see figure 3). (For the purpose of the definition, the tape shall be considered as perfect.)

3.20 head segment : Single transducer which records or reproduces one track on magnetic tape (see figure 3).

3.21 head segment gap azimuth : The angle, in the plane of the tape, between a line perpendicular to the head reference plane and the gap trailing edge in a record head segment (see figure 3).

3.22 head segment gap azimuth difference : Angular deviation of the azimuth of head segment gaps, in a head, from the head azimuth (see figure 3).

3.23 head segment numbering : Numbering of a head segment shall correspond to the track number on the magnetic tape on which that head segment normally operates. Head 1 of a pair will contain all odd-numbered segments while head 2 will contain all even-numbered segments (see figures 3 and 4).

3.24 head spacing (S) : The distance along the tape path between the gap centre lines of head 1 and head 2, when interlaced heads are used (see figure 4).

3.25 head tilt : Angle, between the plane tangent to the front (active) surface of the head at the centre-line of the head segment gaps, and a line perpendicular to the head reference plane (see figure 3).

3.26 heads in-line : For in-line recording, only one record head and one reproduce head will be used.

3.27 heads interlaced : Head placement for interlaced recording is to locate the head segments (both record and reproduce) for alternate tracks in separate heads. Thus, to record on all tracks of a tape, two record heads will be used; to reproduce all tracks on a tape, two reproduce heads will be used.

The two heads of a pair of record or of reproduce heads for interlaced recording shall be mounted in such a manner that the centre-line through the head segment gaps of each head are parallel and spaced according to the head spacing (S) (see figure 4).

3.28 individual track data azimuth difference[1] : Angular deviation of the data azimuth of individual odd or even recorded tracks from the data azimuth of all odd or even tracks.

The difficulty of making direct optical angular measurements requires this error to be expressed as the loss of signal amplitude permitted when the tape is reproduced on an ideal reproducing head, whose gap is aligned to coincide with the data azimuth of all odd or even tracks, as compared to the maximum signal amplitude obtainable by optimizing the reproduce head azimuth for the individual tracks (see figure 3).

3.29 mode : In telemetry systems, one of two techniques generally used for recording on a given track on magnetic tape; direct recording and single-carrier FM (frequency modulation).

NOTE — Single-carrier FM (and PCM) may itself be recorded by either direct recording (with bias) or saturation (without bias) techniques, and in other instrumentation systems may be regarded as a modulation pattern.

3.30 modulation pattern : Form in which data is encoded prior to transmission or recording, for example, multiple-carrier FM, PAM, PCM. See note accompanying the definition of mode on single-carrier FM (see 3.2.9).

3.31 NRZ (non-return-to-zero) : Form of representation for binary "1" and "0" in pulse-code modulation (PCM). Three variants, known as "level", "mark" and "space", are defined in 6.3.3 and figure 1.

3.32 pulse amplitude modulation (PAM) : Time Division Multiplexing (TDM) technique in which pulses in a sequence are amplitude-modulated, so that the pulse amplitudes represent samples of analogue-variable parameters.

3.33 PAM/FM : Frequency modulation of a radio-frequency carrier by a PAM waveform.

3.34 PAM/FM/FM : Frequency modulation of a radio-frequency carrier by an FDM set of subcarriers, which in turn are frequency-modulated by PAM waveforms.

3.35 pulse code modulation (PCM) : Time Division Multiplexing (TDM) technique in which samples of data are represented in binary form by a group of discrete pulses (words) (see figure 1).

3.36 PCM/FM : Frequency modulation of a radio-frequency carrier by a PCM waveform.

3.37 PCM/FM/FM : Frequency modulation of a radio-frequency carrier by an FDM set of subcarriers, which in turn are frequency-modulated by PCM waveforms.

3.38 pseudo-noise (PN) waveform : Non-random waveform having mean, variance, and other properties resembling random noise (see annex C).

3.39 reference edge : Edge of the tape nearest track 1 (see figure 5).

3.40 reference track location (G) : Location of the centre-line of track 1 relative to the reference edge of the tape (see figure 5).

3.41 standard tensile force : Reference longitudinal tensile force in magnetic tape in the vicinity of the head(s) during recording or reproducing.

3.42 subcommutation : Assigning more than one input channel (data source) to the same time-slot in successive minor frames. The sources assigned to such a time-slot recur in a repetitive sequence.

3.43 supercommutation : Assigning an input channel (data source) to more than one time-slot within each minor frame.

3.44 synchronization : Establishing the timing of a data sequence. A number of different synch formats may be required to identify minor frames, major frames (submultiple frames) and (in PCM) bits and words.

3.45 tape speed, actual (V_{act}) **:** Tape speed during recording or reproducing. In general the actual tape speed will not be equal to the standard tape speed.

3.46 tape speed, effective (V_{eff}) **:** Actual tape speed after applying corrections for the effects on the tape of differences between operating and standard conditions, i.e. tensile force, tape materials and thickness, and environment (temperature and humidity). The effective tape speed should be equal to one of the standard tape speeds.

NOTE — Environmental effects on the recorder/reproducer system are not included in this definition.

3.47 tape speed, standard (V_{std}) **:** Range of defined nominal tape speeds for tapes operating at the standard tensile force and in standard environmental conditions.

3.48 tape tensile force : Tape tensile force applied to the tape during operation. The value of this tensile force is not necessarily the standard tensile force but it is assumed to be applied uniformly across the width of the tape.

3.49 time division multiplex (TDM) : Multiplexing technique in which data samples are transmitted or recorded sequentially in time, each sample occupying a unique and defined period or time-slot within the sequence.

3.50 time-slot : A channel interval; the period allocated for each pulse or sample within a minor frame.

3.51 track location (H_n) **:** Distance from the centre-line of the reference track (track 1) to the centre-line of the recorded track (n) (see figure 5).

1) The errors in location and angular relation among transient data recorded simultaneously on all odd or even tracks are defined by the terms : data azimuth, data scatter, and individual track data azimuth difference. These are approximately equivalent to the terms : head azimuth, gap scatter and head segment gap azimuth difference; however, guiding misalignment is included in the data location error definitions.

3.52 track numbering : Tracks on tape shall be numbered consecutively, starting with track 1, from top to bottom when viewing the magnetic surface of the tape with the earlier portion of the recorded signal to the observer's right (bottom to top if the earlier portion of the recorded signal is to the observer's left) (see figure 5).

3.53 track spacing (D) : Centre-to-centre distance between adjacent recorded tracks (see figure 5).

3.54 track width (W) : Mechanical width of the common interface of the record head segment at the gaps. This does not include the effects of fringing fields which will tend to increase the recorded track width by small amount (see figures 3 and 5).

4 Tape and recorder/reproducer characteristics

4.1 General

This clause specifies the tape and recorder/reproducer characteristics required to assure interchange, so that tapes recorded at one facility may be successfully reproduced at another. Recommended test procedures for magnetic tape recording/reproducing equipment are given in annex A.

4.2 Tape and reel characteristics

4.2.1 Tape widths

Standard tape widths are specified in table 1.

Table 1 — Standard tape widths

mm	in
$6{,}30\ ^{0{,}00}_{-\ 0{,}06}$	$0.248\ ^{0.000\ 0}_{-\ 0.002\ 5}$
$12{,}70\ ^{0{,}00}_{-\ 0{,}10}$	$0.500\ ^{0.000}_{-\ 0.004}$
$25{,}40\ ^{0{,}00}_{-\ 0{,}10}$	$1.000\ ^{0.000}_{-\ 0.004}$
$50{,}80\ ^{0{,}00}_{-\ 0{,}10}$	$2.000\ ^{0.000}_{-\ 0.004}$

4.2.2 Reels

Tapes shall be wound on hubs or reels complying with the requirements of ISO 1860, ISO 1858 or ISO 3802.

4.3 Tape speeds

4.3.1 Standard tape speeds

The standard tape speeds (V_{std}) for instrumentation magnetic tape recorders are as specified in table 2.

Table 2 — Standard tape speeds

mm/s	in/s
6 096	240
3 048	120
1 524	60
762	30
381	15
190,5	7 1/2
95,2	3 3/4
47,6	1 7/8
23,8	15/16

4.3.2 Effective tape speeds

The effective tape speed (V_{eff}) throughout a reel (in the absence of tape-derived servo speed control) shall be within ± 0,5 % of the required standard speed for low-band DR recorders and ± 0,2 % for intermediate-band and wide-band DR recorders (see 5.1.1.1). Tape speed errors are defined as departures of average speed from the standard value.

Recommended methods for measuring effective tape speed are given in A.2.2.

NOTE — Errors at frequencies above 0,5 Hz are known as flutter (see 4.6).

4.4 Track configurations

Track configurations are illustrated in figure 5 and specified in tables 2 to 9. It should be noted that although a tape reference edge is specified, edge guiding of the tape is not an implied requirement of the recorder/reproducer.

The head spacing for adjustable heads refers to equipment having facilities for adjusting the azimuth of reproduce heads; these are required for wide-band DR recorder/reproducers (see 5.1.1.1).

4.5 Recorder/reproducer characteristics

4.5.1 Data scatter

The maximum data scatter shall be as follows :

Tape width	Maximum data scatter
6,3 mm (0.25 in)	1,25 µm (50 µin)
12,7 mm (0.5 in)	2,5 µm (100 µin)
25,4 mm (1 in)	5,0 µm (200 µin)
50,8 mm (2 in)	10,0 µm (400 µm)

It is the responsibility of an equipment manufacturer to decide whether or not data scatter may be equated to gap scatter (see figure 3 and the footnote to 3.2).

4.5.2 Data azimuth (static)

Data azimuth (static) shall be not greater than ± 0,3 mrad (± 1′ of arc). It is the responsibility of an equipment manufacturer to decide whether or not data azimuth (static) may be equated to head azimuth (see figure 3 and the footnote to 3.2).

4.5.3 Data azimuth (dynamic)

Data azimuth (dynamic) shall be not greater than ± 0,3 mrad (± 1′ of arc) as determined from measurements of the dynamic interchannel time displacement error (ITDE) between outer tracks on the same head. It is the responsibility of an equipment manufacturer to decide whether or not data azimuth (dynamic) may be equated to the mechanical restriction placed on tape angular motion by the tape guides; the guides shall not cause damage to the tape. (See the footnote to 3.2.) A recommended method for the measurement of ITDE is given in A.2.4.

4.5.4 Individual track data azimuth difference

The maximum signal loss due to individual track data azimuth difference shall be not greater than 1 dB (excluding reproduce head error) at the shortest wavelength specified for the equipment. The overall record/reproduce error shall not be greater than 2 dB.

4.5.5 Head tilt

Head tilt shall be not greater than ± 0,9 mrad (± 3′ of arc) for low- and intermediate-band DR recorders (see 5.1.1.1) and ± 0,3 mrad (± 1′ of arc) for wide-band DR recorders (see figure 3).

4.5.6 Head interchangeability

Where rapid interchangeability of heads is specified, the method of head mounting, locating and securing shall ensure that all alignment and location requirements are satisfied without shimming or mechanical adjustment, except for azimuth adjustment of the reproduce head (wide band).

4.5.7 Head polarity

(Refer to A.2.1 for a recommended polarity test and B.2 for further information.)

4.5.7.1 Record head

Each record head winding shall be connected to its respective amplifier in such a manner that a positive-going pulse with respect to system ground, at the record amplifier input, will result in the generation of a specific magnetic pattern on a segment of tape passing the record head in the normal direction of tape motion. The resulting magnetic pattern shall consist of a polarity sequence of south-north north-south.

4.5.7.2 Reproduce head

Each reproduce head winding shall be connected to its respective amplifier in such a manner that a segment of tape exhibiting a south-north north-south magnetic pattern will produce a positive-going pulse, with respect to system ground, at the output of the reproduce amplifier.

4.5.8 Standard tensile force

For tapes using a polyethyleneterephthalate (PET) base, standard tensile force shall be 0,131 N/mm (12 ozf/in) of tape width. For ideal interchange, recorder/reproducer operating tape tensile forces should be equal to standard tensile force; as the operating tensile force departs from standard tensile force, the corrections to be applied to make the effective tape speed (V_{eff}) equal to the standard tape speed (V_{std}) become increasingly unreliable due to non-linearities, etc.

NOTE — It is current practice in some countries to use a standard tensile force of 0,175 N/mm (16 ozf/in) tape width. Interchange parties should exercise caution when defining tests involving this parameter.

4.6 Other characteristics

Reference has been made in 4.3.2 to flutter, and other related characteristics are time-base error (TBE) and pulse-to-pulse jitter. Requirements for these characteristics are not specified in this International Standard since they depend on the intended application, but recommended test methods for measuring such characteristics are given in A.2.3 (flutter), A.2.5 (TBE) and A.2.6 (pulse-to-pulse jitter).

Table 3 — Dimensions — Recorded tape format, 4 tracks in line on 6,3 mm (1/4 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,686		0,584	0.025 ± 0.002
Track spacing (D)		1,778		0.070
Reference track location (G)	0,483		0,381	0.017 ± 0.002
Track location tolerance (H_n tolerance)	0,051		−0,051	± 0.002

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	1,829		1,727	0.070
3	3,607		3,505	0.140
4	5,385		5,283	0.210

Table 4 — Dimensions — Recorded tape format, 7 tracks interlaced on 6,3 mm (1/4 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,660		0,610	0.025 − 0.001
Track spacing (D)		0,889		0.035
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Ajustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_n)		0,025		0.001
Reference track location (G)	0,470		0,394	0.017 0 ± 0.001 5
Track location tolerance (H_n tolerance)	0,038		0,038	± 0.0015

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0,000
2	0,927		0,851	0.035
3	1,816		1,740	0.070
4	2,705		2,629	0.105
5	3,594		3,518	0.140
6	4,483		4,407	0.175
7	5,372		5,296	0.210

Table 5 — Dimensions — Recorded tape format, 7 tracks interlaced on 12,7 mm (1/2 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	1,40		1,14	0.050 ± 0.005
Track spacing (D)		1,778		0.070
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,127		0.005
Reference track location (G)	1,067		0,965	0.040 ± 0.002
Track location tolerance (H_n tolerance)	0,051		−0,051	± 0.002

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	1,829		1,727	0.070
3	3,607		3,505	0.140
4	5,385		5,283	0.210
5	7,163		7,061	0.280
6	8,941		8,839	0.350
7	10,719		10,617	0.420

Table 6 — Dimensions — Recorded tape format, 14 tracks interlaced on 12,7 mm (1/2 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,660		0,610	0.025 ± 0.001
Track spacing (D)		0,889		0.035
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,127		0.005
Reference track location (G)	0,546		0,470	0.020 0 ± 0.001 5
Track location tolerance (H_n tolerance)	0,038		−0,038	± 0,001 5

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	0,927		0,851	0.035
3	1,816		1,740	0.070
4	2,705		2,629	0.105
5	3,594		3,518	0.140
6	4,483		4,407	0.175
7	5,372		5,296	0.210
8	6,261		6,185	0.245
9	7,150		7,074	0.280
10	8,039		7,963	0.315
11	8,928		8,852	0.350
12	9,817		9,741	0.385
13	10,706		10,630	0.420
14	11,595		11,519	0.455

Table 7 — Dimensions — Recorded tape format, 21 tracks interlaced on 12,7 mm (1/2 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,483		0,432	0.018 ± 0.001
Track spacing (D)		0,584		0.023
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,178		0.007
Reference track location (G)	0,470		0,394	0.017 0 ± 0.001 5
Track location tolerance (H_n tolerance)	0,025		−0,025	± 0.001

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	0,610		0,559	0.023
3	1,194		1,143	0.046
4	1,778		1,727	0.069
5	2,362		2,311	0.092
6	2,946		2,896	0.115
7	3,531		3,480	0.138
8	4,115		4,064	0.161
9	4,699		4,648	0.184
10	5,283		5,232	0.207
11	5,867		5,817	0.230
12	6,452		6,401	0.253
13	7,036		6,985	0.276
14	7,620		7,569	0.299
15	8,204		8,153	0.322
16	8,788		8,738	0.345
17	9,373		9,322	0.368
18	9,957		9,906	0.391
19	10,541		10,490	0.414
20	11,125		11,074	0.437
21	11,709		11,659	0.460

Table 8 — Dimensions — Recorded tape format, 14 tracks interlaced on 25,4 mm (1 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	1,40		1,14	0.050 ± 0.005
Track spacing (D)		1,778		0.070
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum(M_m)		0,279		0.011
Reference track location (G)	1,168		1,067	0.044 ± 0.002
Track location tolerance (H_n tolerance)	0,051		−0,051	± 0,002

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	1,829		1,727	0.070
3	3,607		3,505	0.140
4	5,385		5,283	0.210
5	7,163		7,061	0.280
6	8,941		8,839	0.350
7	10,719		10,617	0.420
8	12,497		12,395	0.490
9	14,275		14,173	0.560
10	16,053		15,951	0.630
11	17,831		17,729	0.700
12	19,609		19,507	0.770
13	21,387		21,285	0.840
14	23,165		23,063	0.910

Table 9 — Dimensions — Recorded tape format, 28 tracks interlaced on 25,4 mm (1 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,660		0,610	0.025 ± 0.001
Track spacing (D)		0,89		0.035
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,229		0.009
Reference track location (G)	0,698		0,622	0.026 0 ± 0.001 5
Track location tolerance (H_n tolerance)	0,038		−0,038	± 0.001 5

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	0,927		0,851	0.035
3	1,816		1,740	0.070
4	2,705		2,629	0.105
5	3,594		3,518	0.140
6	4,483		4,407	0.175
7	5,372		5,296	0.210
8	6,261		6,185	0.245
9	7,150		7,074	0.280
10	8,039		7,963	0.315
11	8,928		8,852	0.350
12	9,817		9,741	0.385
13	10,706		10,630	0.420
14	11,595		11,519	0.455
15	12,484		12,408	0.490
16	13,373		13,297	0.525
17	14,262		14,186	0.560
18	15,151		15,075	0.595
19	16,040		15,964	0.630
20	16,929		16,853	0.665
21	17,818		17,742	0.700
22	18,707		18,631	0.735
23	19,596		19,520	0.770
24	20,485		20,409	0.805
25	21,374		21,298	0.840
26	22,263		22,187	0.875
27	23,152		23,076	0.910
28	24,041		23,965	0.924

Table 10 — Dimensions — Recorded tape format, 42 tracks interlaced on 25,4 mm (1 in) wide tracks
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,483		0,432	0.018 ± 0.001
Track spacing (D)		0,584		0.023
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,305		0.012
Reference track location (G)	0,737		0,660	0.027 5 ± 0.001 5
Track location tolerance (H_n tolerance)	0,025		−0,025	± 0.001

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	0,610		0,559	0.023
3	1,194		1,143	0.046
4	1,778		1,727	0.069
5	2,362		2,311	0.092
6	2,946		2,896	0.115
7	3,531		3,480	0.138
8	4,115		4,064	0.161
9	4,699		4,648	0.184
10	5,283		5,232	0.207
11	5,867		5,817	0.230
12	6,452		6,401	0.253
13	7,036		6,985	0.276
14	7,620		7,569	0.299
15	8,204		8,153	0.322
16	8,788		8,738	0.345
17	9,373		9,322	0.368
18	9,957		9,906	0.391
19	10,541		10,490	0.414
20	11,125		11,074	0.437
21	11,709		11,659	0.460
22	12,294		12,243	0.483
23	12,878		12,827	0.506
24	13,462		13,411	0.529
25	14,046		13,995	0.552
26	14,630		14,580	0.575
27	15,215		15,164	0.598
28	15,799		15,748	0.621
29	16,383		16,332	0.644
30	16,967		16,916	0.667
31	17,551		17,501	0.690
32	18,136		18,085	0.713
33	18,720		18,669	0.736
34	19,304		19,253	0.759
35	19,888		19,837	0.782
36	20,472		20,422	0.805
37	21,057		21,006	0.828
38	21,641		21,590	0.851
39	22,225		22,174	0.874
40	22,809		22,758	0.897
41	23,393		23,343	0.920
42	23,978		23,927	0.943

Table 11 — Dimensions — Recorded tape format, 84 tracks interlaced on 50,8 mm (2 in) wide tape
(see figure 5)

Dimension	mm			in
	max.	nom.	min.	
Track width (W)	0,483		0,432	0.018 ± 0.001
Track spacing (D)		0,584		0.023
Head spacing (S)				
Fixed heads	38,125		38,075	1.500 ± 0.001
Adjustable heads	38,151		38,049	1.500 ± 0.002
Edge margin, minimum (M_m)		0,711		0.028
Reference track location (G)	1,168		1,092	0.044 5 ± 0.001 5
Track location tolerance (H_n tolerance)	0,025		−0,025	± 0.001

Track number	Location for nth track (H_n)			
	mm			in
	max.	nom.	min.	
1 (reference)		0,000		0.000
2	0,610		0,559	0.023
3	1,194		1,143	0.046
4	1,778		1,727	0.069
5	2,362		2,311	0.092
6	2,946		2,896	0.115
7	3,531		3,480	0.138
8	4,115		4,064	0.161
9	4,699		4,648	0.184
10	5,283		5,232	0.207
11	5,867		5,817	0.230
12	6,452		6,401	0.253
13	7,036		6,985	0.276
14	7,620		7,569	0.299
15	8,204		8,153	0.322
16	8,788		8,738	0.345
17	9,373		9,322	0.368
18	9,957		9,906	0.391
19	10,541		10,490	0.414
20	11,125		11,074	0.437
21	11,709		11,659	0.460
22	12,294		12,243	0.483
23	12,878		12,827	0.506
24	13,462		13,411	0.529
25	14,046		13,995	0.552
26	14,630		14,580	0.575
27	15,215		15,164	0.598
28	15,799		15,748	0.621
29	16,383		16,332	0.644
30	16,967		16,916	0.667
31	17,551		17,501	0.690
32	18,136		18,085	0.713
33	18,720		18,669	0.736
34	19,304		19,253	0.759
35	19,888		19,837	0.782
36	20,472		20,422	0.805
37	21,057		21,006	0.828
38	21,641		21,590	0.851
39	22,225		22,174	0.874
40	22,809		22,758	0.897
41	23,393		23,343	0.920
42	23,978		23,927	0.943
43	24,562		24,511	0.966
44	25,146		25,095	0.989
45	25,730		25,679	1.012
46	26,314		26,264	1.035
47	26,899		26,848	1.058
48	27,483		27,432	1.081
49	28,067		28,016	1.104
50	28,651		28,600	1.127
51	29,235		29,185	1.150
52	29,820		29,769	1.173
53	30,404		30,353	1.196
54	30,988		30,937	1.219
55	31,572		31,521	1.242
56	32,156		32,106	1.265
57	32,741		32,690	1,288
58	33,325		33,274	1,311
59	33,909		33,858	1,334
60	34,493		34,442	1,357
61	35,077		35,027	1,380
62	35,662		35,611	1,403
63	36,246		36,195	1,426
64	36,830		36,779	1,449
65	37,414		37,363	1,472
66	37,998		37,948	1,495
67	38,583		38,532	1,518
68	39,167		39,116	1,541
69	39,751		39,700	1,564
70	40,335		40,284	1,587
71	40,919		40,869	1,610
72	41,504		41,453	1,633
73	42,088		42,037	1,656
74	42,672		42,621	1,679
75	43,256		43,205	1,702
76	43,840		43,790	1,725
77	44,425		44,374	1,748
78	45,009		44,958	1,771
79	45,593		45,542	1,794
80	46,177		46,126	1,817
81	46,761		46,711	1,840
82	47,346		47,295	1,863
83	47,930		47,879	1,886
84	48,514		48,463	1,909

5 Modes of recording

5.1 Direct recording (DR)

5.1.1 Bandwidths

5.1.1.1 Wavelengths on tape

For the purposes of this International Standard, four bandwidths are designated :

a) low-band DR : direct recording response to a minimum recorded wavelength of 15,2 µm (600 µin).

NOTE — For recording subcarrier bands above proportional bandwidth channel 18 or constant bandwidth channel 11 B, intermediate-band recorders are recommended (see 6.1.1 and 6.1.2).

b) intermediate band DR : direct recording response to a minimum recorded wavelength of 6 µm (240 µin);

c) wide-band 1,5 MHz DR : direct recording response to a minimum recorded wavelength of 2 µm (80 µin);

d) wide-band 2,0 MHz DR : direct recording response to a minimum recorded wavelength of 1,5 µm (60 µin).

NOTE — Interchange of tapes between wide-band DR and low- or intermediate-band DR machines is not recommended.

See B.1.1 for notes on extended wide-band DR recording.