ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

ECMA STANDARD

for

DATA INTERCHANGE
ON 9 TRACK MAGNETIC TAPE
AT 31,5 BIT PER MM (800 B.P.I)

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BRIEF HISTORY

On April 30, 1965, ECMA adopted their Standard ECMA-6 for a
7 Bit Character Code for Input and Output purposes. In the
form adopted, it included no proposals for implementation in
media which were deliberately left as the subject for future
standards. The Standard ECMA-5 defined Data Interchange on
7 Track Magnetic Tape at a density of 8 bit per mm.

This new Standard ECMA-12 is directed to a Data Interchange
on 9 Track Magnetic Tape at a density of 31,5 bit per mm.

Representatives of the following Companies participated in
the work of the Task Group which prepared this Standard :

> Ampex International SA.
>
> Compagnie des Machines Bull
>
> N.V. Electrologica
>
> English Electric Computers Ltd
>
> IBM-WTEC
>
> ICT, International Computers and Tabulators Ltd
>
> ITT Europe Inc.
>
> Olivetti General Electric
>
> Minnesota Mining & Manufacturing Co. Ltd
>
> NCR, The National Cash Register Co. Ltd
>
> Siemens Aktiengesellschaft

In addition, particular attention had been given to the pro-
posals of other organizations working on this subject, spe-
cially of

> United States of America Standards Institute (USASI)
>
> International Standards Organization   (ISO)

Adopted by the General Assembly of ECMA on Nov. 28, 1967, as
Standard ECMA-12.

TABLE OF CONTENTS

FOREWORD

Standard ECMA-5 sets out the parameters for magnetic tape
which may be used to interchange data between electronic data
processing installations, at the low density of 8 rows per mm.

This Standard ECMA-12 sets out the same parameters but at the
higher density of 31,5 rows per mm.

The parameters which are required to define adequately a mag-
netic tape for data interchange fall within three sections :

> The first deals with the characteristics of the
> magnetic tape itself and of the spool on which
> it is wound.

> The second deals with the dimensional and mag-
> netic characteristics of the recording of data
> on the tape and the method of checking.

> The third deals with the relation of the bits
> on a tape to coded characters and the format
> of data files.

Section I deals with the minimum number of physical parameters
of the tape with test methods where necessary. The intention
is to ensure that the properties of tape used for data inter-
change shall not vary sufficiently to nullify the effect of
the requirements of the Standard.

Section II is based on the NRZ1 method of recording. A parti-
cularly important part of this section is the definition of
the method of checking the information; data are arranged in
blocks, with transverse and longitudinal parity-checks, to-
gether with a Cyclic Redundancy Check Character.

Section III establishes a series of conventions to ensure that
there is no ambiguity in the meaning given to the recorded
bits on tape. Standard ECMA-13 defines magnetic tape labels.

In ECMA-5, the problems encountered due to the packing density
of 8 rows per mm did not create any serious difficulty with
respect to the definitions or the quantitative values assigned
to the various parameters.

This present Standard, however, represents certain definitions
and quantitative values in clauses 2.4 and 2.5 which provide
the most meaningful checks possible at the present time. It
is emphasized that this Standard is concerned with the speci-
fication of magnetic tape and as such it is not appropriate
that it should make recommendations in relation to writing or
reading equipment. Nevertheless, when writing an interchange

tape in accordance with this Standard, and especially when reading it, certain difficulties and technical shortcomings have to be faced, some of which are set out below :

1) The positioning of the data on the tape, which is very dependent on the particular guidance geometry of the tape transports.

2) The coating thickness of the tape, which has an appreciable effect on the position of bits due to the pulse crowding factor on the tape as specified.

3) The characteristics of the head and in particular the crosstalk factor.

4) The initial transient conditions as the tape is started from rest.

5) The problem of defining and utilizing the reference edge.

6) Speed variations at the time of writing and reading which could also include different nominal speeds.

7) Timing constraints due to coding and pattern sensitivity.

Thus it has been recognized that it is not reasonable to expect a sender of magnetic tape in an exchange to be equipped to monitor the precise position of flux reversals on the tape, either longitudinally or square to the reference edge. This Standard, therefore, provides a guide to the settings of a " control device" which reads the peak flux points on the tape pass during which writing occurs.

The control device values may vary from the design centre values stated in clause 2.5.2.1 (i) and 2.5.2.1 (ii) under the circumstances summarized above. When they vary, they must vary in such a manner, that the requirement of clause 2.5.2.1 (iii) is met.

Design centre values actually used have to be chosen in such a way that the number of read errors resulting from actual variations around these centre values (i.e. the control device values) are kept within an acceptable limit. This also assumes that read errors due to unfavourable combinations of tolerances cannot reasonably be expected to occur again on a repeat (write or read) pass.

In Appendix A recommendations are made in connection with the transportation of the tape and in Appendix B notes are given concerning the use of the Cyclic Redundancy Check. These Appendices are not part of the Standard.

SCOPE

To provide a specification for 12,70 mm 9 track magnetic tape
to enable mechanical and magnetic interchangeability of tape
between information processing systems. This Standard refers
solely to magnetic tape for digital recording on which the
direction of magnetization is nominally longitudinal as opposed
to nominally transverse.

DEFINITION OF TERMS

For the purpose of this Standard the following definitions
apply :

Magnetic Tape

Tape which will accept and retain magnetic signals intended
for input, output and storage purposes on computers and asso-
ciated equipment.

Reference Tape

A tape which has been arbitrarily selected for a desirable
property.

Secondary Reference Tape

A tape intended for routine calibrating purposes, the perform-
ance of such a tape to be known and stated in relation to that
of a reference tape.

Static Skew

The average width of a band of tape, perpendicular to the re-
ference edge, containing all the bits of a row.

Reference Alignment Tape

A reference tape recorded continuously in all 9 tracks with
static skew of less than 1,27 microns (50 microinches).

Reference Field

The minimum field applied to the Reference Recording Field
Tape above which no significant increase of signal output
will result.

Reference Recording Field Tape

The Reference tape which is selected as a standard for record-
ing field.

Reference Signal Output Tape

The Reference Tape which is selected as a standard for signal output.

Reference Signal Level

The signal level which would be obtained from a Reference Signal Output Tape.

Reference Pulse Width Tape

The Reference Tape which is selected as a standard for pulse width.

Saturating Field

The minimum field which can be applied to a tape above which no significant increase of signal output will result.

Erasing Field

A unidirectional field of sufficient strength to remove the signals from the tape.

Track

A longitudinal area on the tape along which a series of magnetic signals may be recorded.

Reference Edge

The reference edge is that which is chosen arbitrarily as a reference for the layout of tracks and the siting of markers. (See Clause 2.1.)

In Contact

An operating condition in which the oxide side of a tape is in contact with magnetic head.

Leaders

Those integral parts of a complete tape which lie outside the tested portion.

Print Through

Any unwanted signals induced in one layer of tape by the field of a deliberately recorded signal in an adjacent layer or layers.

Pulse Packing Density

The number of reversals of magnetization per unit length of track.

Spools and Reels

A spool has no tape wound on it. A reel is a spool with a tape.

SECTION 1 - CHARACTERISTICS OF TAPE AND SPOOL

TEST ENVIRONMENT: Unless otherwise stated, all measurements made on a tape to check the requirements of this specification and all tests prescribed for a tape in the document will be carried out under the environmental conditions of 23ºC ± 2ºC and 50% ± 10% relative humidity, after at least 24 hours conditioning.

1.1 Width of Tape

For the purpose of this specification the width of the tape shall be 12,7 mm $+ 0 \atop - 0,1$ mm.

1.2 Tape Length

Tape which is splice free and which has been tested shall be available in any length not exceeding 753 metres and the length is required to be stated, it shall be subject to a tolerance of + 3% - 0%.

1.3 Material

The tape shall consist of a base material (oriented polyethylene terephthalate film or its equivalent), coated on one side with a strong yet flexible layer of ferro-magnetic material dispersed in a suitable binder.

1.4 Thickness of Tape

a) Base. The nominal thickness of the base material shall be 0,038 mm.

b) Overall. The overall thickness of tape and oxide coating, not including any markers, shall be 0,048 mm ± 0,005 mm with a maximum oxide coating thickness of 0,015 mm.

Other tape thicknesses would satisfy the requirements of this proposal but are not standardized at this time.

1.5 Change in Width

The material shall be such that no change in the tape width greater than 0,25% can occur when the tape has been subjected to any combination of temperature and humidity within the ranges of 10ºC to 50ºC and 20% R.H. to 80% R.H.

1.6 Elastic Properties

The elastic properties of the tape shall be such that when subjected to a tension of 10 newton for a period of three minutes under any combination of temperature and relative humidity within the ranges of 10ºC to 50ºC and 20% to 80% R.H., the permanent elongation measured with negligible tension after a second three minutes interval shall be less

than 0,5%. The elastic modulus for a single smooth applica-
tion of tension in three minutes or less, down to the time
set by the inertia of the tape itself, shall be such that
the elongation is less than 0,5% under a tension of 4,5 new-
ton. For the convenience of testing, the measurement may
be performed with a tension applied for three minutes.

1.7 Longitudinal Curvature

There shall be a minimum radius of curvature for the edge of
the tape, defined and tested by allowing a 1m length of tape
to unroll and assume its natural curvature on a flat surface
The minimum radius shall be 33 m, which, if measured over an
arc of a circle, corresponds to a deviation of 3,8 mm from a
1 m chord.

> The tape, when new, shall be tested in
> Accordance with Clauses 1.8 to 1.17

1.8 Packing Density

For the purpose of testing tape in accordance with this
specification the pulse packing density shall be not less
than that of the system with which the tape is to be used
and not more than 32 flux reversals per mm of track. In ad-
dition, for this test the flux reversals shall be uniformly
spaced.

1.9 Recording Current

The relationship between the recording current and the cur-
rent required to produce the reference field shall be 110
to 120% of the current required to produce the reference
field.

1.10 Average Peak Output

The average peak output is defined as the average peak value
of the output voltage over at least 1000 consecutive pulses.
When a tape has been recorded with a recording current de-
fined in Clause 1.9 on all tracks, then played back on a
system, each channel of which has been calibrated by means
of a Secondary Reference Signal Output Tape, the average
peak output shall be within ± 10% of the output of the Re-
ference Signal Output Tape.

When performing this test, the output signal shall be mea-
sured on a corresponding track for the same relative pass
for both Secondary Reference Output Tape and the tape under
test i.e. Read-whilst-write or Read-on-first-pass-after-writ

1.11 Ease of Erasure

When a tape has been recorded according to this specificatio
and then passed through an unidirectional steady erasure
field of 79500 ampere turns per metre (MKS units) (1000 oer-
steds) the average peak output level of the remaining un-

wanted signal plus tape noise shall not exceed 3% of the output of the Reference Signal Output Tape. The erasure field shall be reasonably uniform; e.g. the field in the middle of a selenoid.

1.12 Tests for Drop-Outs and Drop-Ins

These tests shall be carried out in the In-contact condition and over the entire tested area which shall extend from 0,2 m before the Beginning-of-tape-reflective-marker to 3 m beyond the End-of-tape-reflective-marker.

1.13 Drop-Outs

When a tape has been recorded with all permissible consecutive reversals of recording current, as defined in Clause 1.9 on all tracks, then played back on a system each channel of which has been calibrated as in Clause 1.10 any signal from any track which is less in amplitude than 50% of the output of the Reference Signal Output Tape is a drop-out.

When performing this test, the output signal shall be measured on the same relative pass for both the Secondary Reference Output Tape and the tape under test i.e. Read-whilst-write or Read-on-first-pass-after-write.

1.14 Drop-Ins

When a tape has been recorded on all tracks by a constant recording current as defined in Clause 1.9 then played back on a system calibrated as defined in Clause 1.10, any signal from any track which exceeds in amplitude 10% of the output of the Reference Signal Output Tape is a drop-in.

When performing this test, the output signal shall be measured on the same relative pass for both the Secondary Reference Output Tape and the tape under test (i.e. Read-whilst-write or Read-on-first-pass-after-write).

1.15 Rejected Regions

A rejected region is an area of tape extending across the full width of the tape and not more than 10 mm in length which contains areas of tape which on two consecutive tests exhibit drop-outs or drop-ins.

NOTE: The method proposed in this Standard for data interchange allows the use in practical conditions of tapes with rejected regions (see Clause 2.15).

1.16 Testing Tape Under Operating Conditions

Machines are available for testing the performance of tape under operating conditions. The type of machine used and the acceptable level of the numerical values obtained within

the framework of this Standard shall be determined by
arrangement between the user and the manufacturer or sup-
plier.

1.17 Magnetic Properties

The magnetic properties of the tape shall be those defined
by the testing procedures in Clauses 1.8 to 1.14 inclusive
and not as defined by B-H loops or similar parameters.

1.18 Print-Through

A tape for testing shall be stored for 8 hours at 60°C
during which time changes shall be made to the relative
humidity within the range 20 to 80%. Immediately after the
end of this period the peak print-through signal shall not
exceed 1% of the reference signal.

1.19 Reflective Markers

Reflective markers used to indicate beginning and end of
tape shall be placed on the side of the tape which does not
carry the oxide coating. The Beginning-of-tape-marker shall
be adjacent to the reference edge, and the End-of-tape-
marker shall be adjacent to the opposite edge. (See Clause
2.1 and Fig. 1.)

The width of the markers shall be 4,8 mm $\pm$ 0,4 mm, length
30,0 mm $\pm$ 5 mm and their thickness when measured in situ,
shall not exceed 0,013 mm.

The beginning of tape marker shall be placed 4,6 m $\pm$ 0,3 m
from the beginning of the tape and the end of tape marker
shall be placed 7,6 m + 1,5 m - 0 m from the end of the tape.

The surface of the reflective marker shall be non-conduct-
ive.

1.20 Spool and Reel

Spools shall be constructed such, that any profile section
taken through the centre axis of the spool conforms to
Fig. 2 except where taken so as to pass through the relieved
portion of the write-enable ring groove. The section shall,
in this case, conform to the profile of Fig. 2 with appro-
priate deviations permitted at the ring groove relief as
illustrated in the detail of Fig. 2A.

All dimensions shown in Fig. 2 and 2A, including those in
detail sections, shall be held to the tolerances specified
in Table 1.

Thickness of the flange portion of spools may be varied, but
must fall entirely within the cross-hatched envelopes
defined by dimensions J, K and M.

Hub and flanges need not be integral, but may be separate
parts at the manufacturer's option as long as all other

requirements of this Standard are met.

Bosses, ribs or raised designs are permitted on the outside surfaces of the flanges, providing they do not extend beyond the cross-hatched envelope of Fig. 2.

The spool should be balanced about its normal axis of rotation irrespective of the existence or lack of flange holes. Any amount by which the reel is out of static balance shall not exceed 1,5 g cm.

Size and shape of flange holes shall be optional having such a minimum dimension as not to inhibit the usual techniques of manual threading.

Spools may be constructed from any suitable material or materials as long as the dimensional and inertia requirements of this Standard are maintained.

Spools are not symmetrical, the flange differing primarily as to the presence or absence of the write-enable ring, which must be adjacent to the mounting pedestal for correct machine operation.

The outside cylindrical surface of the hub shall be concentric with the centre bore (dimensions C and A respectively of Fig. 1) within 0,25 mm.

Dimension A shall not reduce below 93,5 mm when loaded with a full reel of tape wound at 350 g constant tension.

The moment of inertia of the reel shall not exceed $102,5 \cdot 10^3$ g cm^2. The maximum moment of inertia of any spool shall not exceed $50 \cdot 10^3$ g cm^2.

As an option, the ring groove relief may be eliminated if dimension " L " is made a minimum of 136,50 mm.

TABLE I

Dimension	Nominal (mm)	Tolerance (mm)
A	93,68	+0,13 -0,08
B	267,00	±0,50
C	130,10	maximum
	114,00	minimum
D	98,43	±0,15
E	111,13	±0,15
F	6,35	+0,25 -0,00
H	19,00	±0,40
J	2,48	maximum
K	3,20	maximum
L	115,90	minimum
M	18,24	±0,10
P	4 degrees	+15 minutes or arc
R	42,60	±0,25

SECTION 2 - FORM OF RECORDING

2.1   Reference Edge

When a tape is lying flat with the oxide side uppermost and
the direction of movement for recording from left to right,
the reference edge is the one farthest from an observer or
nearer the top of a page (see Fig. 1).

2.2   Track Configuration

There will be nine tracks on the tape. The written track
width shall be 1,09 mm minimum and 1,12 mm maximum. The
distance from the centre line of any track to the reference
edge shall be 1,397 (n-1) + 0,73 mm $\pm$ 0,050 mm where n is
the track number.

2.3   Track Identification

The tracks shall be numbered consecutively from 1 to 9,
with track 1 adjacent to the reference edge. (See Fig. 3.)

2.4   Density of Recording

The nominal density shall be 31,5 transverse rows per mm.

The maximum written row spacing variation allowed shall be
$\pm$ 3% of the nominal spacing of 31,75 microns (1250 micro-
inches). The capability of a machine in this respect shall
be measured over a 10 second period, at the extremes of
operating conditions, reading a continuously and evenly
recorded tape with 31,5 flux reversals per mm in all tracks.

2.5   Skew

Skew is defined as the deviation of the bits within the
recorded row during reading from time coincidence (con-
verted to apparent length) when measured in the control
device.

2.5.1 Static Skew

The equipment used for recording tapes at 31,5 r.p.mm
must be capable of recording 4,71 microns (150 micro-
inches) or less absolute static skew. This capability
shall be measured on a tape which has been recorded
continuously with 31,5 flux reversals per mm in all
tracks. This maximum static deviation within a char-
acter is the value of static recorded skew. Both char-
acter polarities must meet this criterion.

2.5.2 Write Quality Check

During the writing of a 31,5 r.p.mm interchange tape,

the write check operation will determine bit timing (converted to apparent length) and signal amplitude.

NOTE: On equipment that is not capable of reading during the write pass, bit timing and signal amplitude may be checked on the first read pass on the same equipment.

2:5.2:1 Bit Timing (converted to apparent length)

To determine bit timing, from leading edge to leading edge, the following conditions must be considered together :

(i)   The timing between the first detected bit of successive rows shall be measured greater than a design centre value which shall exceed 22,9 microns (900 micro-inches).

(ii)   The timing between the first detected bit and the last detected bit of a row shall be measured less than a design centre value which shall not exceed 10,8 microns (425 microinches).

(iii)   There shall be a minimum apparent space between any bits of successive rows of 11,2 microns (440 microinches).

2.5.2.2 Signal Amplitude

No " 1" bit amplitude level shall be less than 35% of the average signal level on the Write Quality Check.

2.6   Block Length

All blocks for data interchange shall consist of not less than 18 data rows and not more than 2048 data rows and in addition a cyclic redundancy check row and a longitudinal check row. Blocks of less than 18 rows may exist on a data interchange tape, but do not form part of the data to be interchanged.

2.7   Cyclic Redundancy Check

At the end of each block (except Tape Mark function blocks) a character shall be written on tape for the possible recovery of single track errors. This character shall be called the Cyclic Redundancy Check (CRC) character. In tape mark blocks zero bits are written in all tracks for the CRC character.

Consider the contents of a 9 position register to be C_1 to C_9 with the following track assignment:

Track No.	9	8	7	6	5	4	3	2	1
Bit Register	C_6	C_8	C_2	C_3	C_4	C_1	C_5	C_9	C_7

The CRC character can be considered as being constructed as follows :

a) All data rows in the block are added to the CRC register without carry (bit position n exclusive OR ed to C_n).

b) Between additions the CRC register is shifted one position C_1 to C_2 etc. to C_9 to C_1.

c) If shifting causes C_1 to become 1, then the bits being shifted into positions C_4, C_5, C_6 and C_7 are inverted.

d) After the last data row has been added, the CRC register is shifted once more in accordance with b) and c).

e) To write the CRC character on tape, the contents of all positions except C_4 and C_6 are inverted. The parity of the CRC character will be odd for an even number of data rows in the block and even for an odd number of data rows in the block. The CRC character may be all zeroes. See Appendix B.

2.8 Parity of Data Rows

The parity track shall be track 4 and all data rows shall have overall odd parity.

2.9 Longitudinal Check Row

This row, written at the end of a block including the CRC characters, shall make the longitudinal parity of each track even for that block.

2.10 Check Row Gaps

There shall be gaps of 0,127 mm $\pm$ 0,030 mm between the last row of recorded data and the cyclic redundancy check character; and between the cyclic redundancy check character and the longitudinal check row.

2.11 Inter-block Gap

The gap shall be 15,25 mm nominal
12,70 mm minimum
17,60 mm maximum

2.12 Erase Length

The minimum erase length shall be 51 mm.

The maximum erase length shall be the length occupied by ten erase operations.

One erase operation is defined as erasing of a length of tape not greater than the length of the original block + 57 mm.

2.13 Load Point Gap

There shall be a minimum load point gap of 75 mm and a maximum of 0,76 metres from the lagging end of the Beginning-of-tape-reflective-marker to first row on tape.

There shall be no magnetic signals on the tape between the leading end of this marker and the first row.

The recording area on the tape shall not extend more than 3 metres beyond the leading edge of the End-of-tape-marker.

2.14 Method of Recording

The Non Return to Zero Mark (NRZI) method of recording shall be used where a one is represented by a change of direction of magnetization.

The recording field shall be between 110% and 120% of the reference field.

The tape shall be magnetized such that the beginning of tape is a North seeking Pole and the end of tape is a South seeking Pole, at end of recorded section of tape. This requirement shall apply also to erase sections and interblock gaps.

The full width of the tape is DC erased in the specified direction.

2.15 Quality of Tape for Data Interchange

Information written must be valid at 35% of the reference signal level. Tape shall not be employed for data interchange where the number of gaps which have been elongated due to erase instructions exceeds two or 0,5% of the total number of blocks written, whichever is larger. No permanent parity errors are permissible in the data to be interchanged.

2.16 Data Content

All 256 binary combinations are permissible in the 8 data tracks of each row.

2.17 Identification

A labelling area shall be provided on the front flange of a spool to identify ownership.

NOTE 1: The manufacturer's identification may be placed as well on the spool.

NOTE 2: The tape manufacturer's identification may be placed on one or both ends of the tape.

2.18 Transportation

Responsibility for ensuring that adequate precautions against damage taken during shipment shall lie with the sender.
Since it is essential for a data bearing tape to be received in the same condition as it was sent out, guidance is given in Appendix A.

SECTION 3

RELATION OF RECORDED BITS ON TAPE TO CODED CHARACTERS

3.1 Recording Conventions

The following conventions shall be adopted to relate binary digits recorded on the tape to coded characters or to digits within computers or similar equipment. (These also cover the case of data arranged as sequences of arbitrary binary digits.)

Any arrangement of data, which is to be interchanged, shall comply with the conventions of clauses 3.2, 3.3 and 3.4.

3.2 Significance of Binary Digits

Within any one row on tape, the direction of increasing significance of the binary digits shall be from b_1 to b_n and in accordance with the track identification in Clause 3.4.

3.3 Filling of Unused Positions on Tape

In certain cases the arrangement of binary digits in groups of 8, within each row on tape, may not fit in exactly with the sizes of groups of digits in the equipment with which the data-interchange tape is used. In these cases it may be necessary to use " fill in" digits on the tape. Then:

i) The " fill in" digits shall be zeroes
ii) The " fill in" digits shall be placed at the more significant bit position of a row.

3.4 Representation of ECMA 7-Bit Coded Characters

3.4.1 Sequence of coded Characters

Considering the recorded data as being in character form, the sequence of characters from the start towards the finish of a block shall correspond to the normal left to right sequence of a written line.

3.4.2 Arrangement of ECMA 7-Bit Coded Characters

The 7-bit relationship to the 8 positions of the environment is :

No. of the 7 bits of the code	0	7	6	5	4	3	2	1

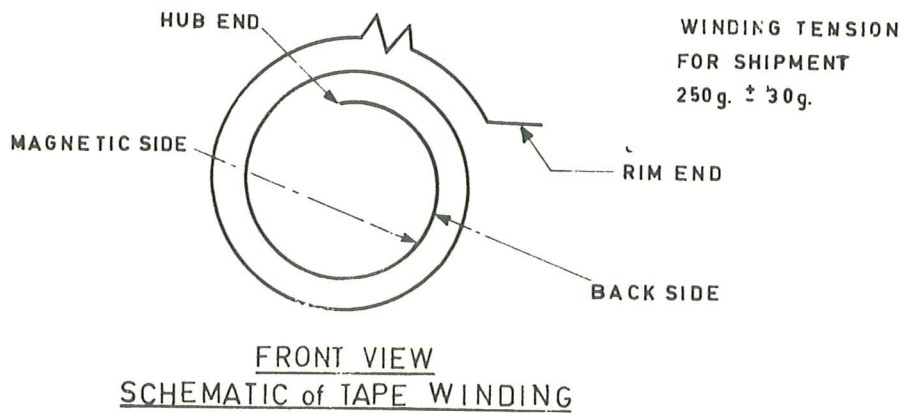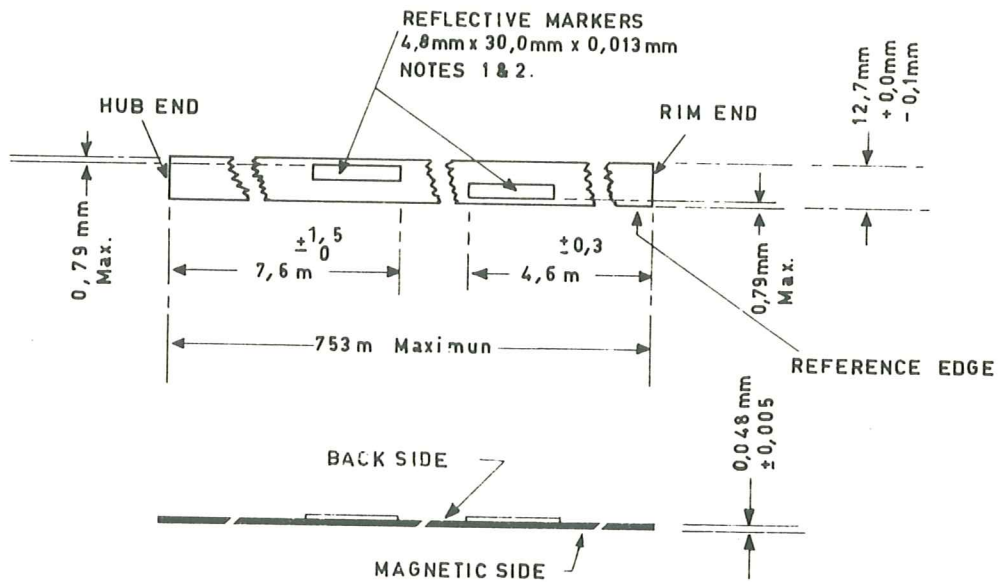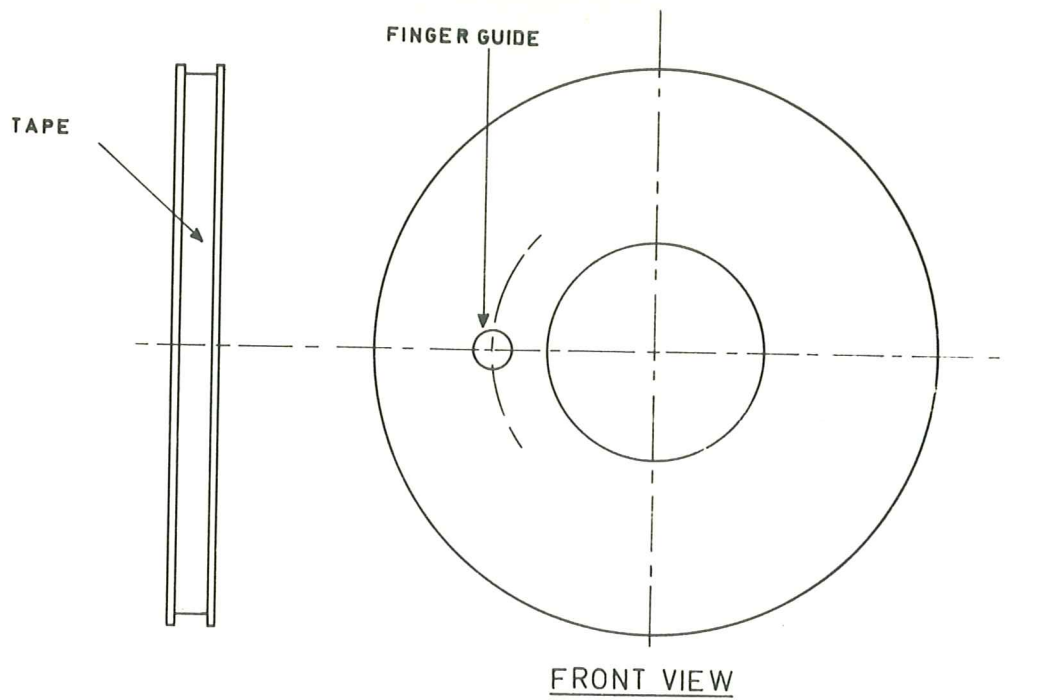| No. of the 8 positions of the environment	8	7	6	5	4	3	2	1

where $\boxed{0}$ is a high-order bit with value 0.

The relationship of the 9 tracks of the 8 positions
of the environment and of the parity position is :

Parity (P) and No. of the 8 positions of the environment	P	8	7	6	5	4	3	2	1
No. of the 9 tracks		4	7	6	5	3	9	1	8	2

3.5 Control Blocks

For the purpose of separating data, a single row control
block (known as a Tape Mark) shall be allowed. This block
shall be accompanied by a longitudinal check row. The Tape
Mark shall be represented by "ONE" bits in tracks 2, 3
and 8 only.

FINGER GUIDE

TAPE

FRONT VIEW

REFLECTIVE MARKERS
4,8mm x 30,0mm x 0,013mm
NOTES 1 & 2.

HUB END

RIM END

12,7mm
+ 0,0mm
− 0,1mm

0,79 mm
Max.

±1,5
0

7,6 m

±0,3

4,6 m

0,79mm
Max.

753 m Maximun

REFERENCE EDGE

BACK SIDE

0,048 mm
± 0,005

MAGNETIC SIDE

HUB END

MAGNETIC SIDE

WINDING TENSION
FOR SHIPMENT
250 g. ± 30 g.

RIM END

BACK SIDE

FRONT VIEW
SCHEMATIC of TAPE WINDING

NOTES:

1. Reflector shall be firmly attached to tape with its
own adhesive back and shall be free of wrinkles.

2. Reflector shall not protrude beyond edge of tape.
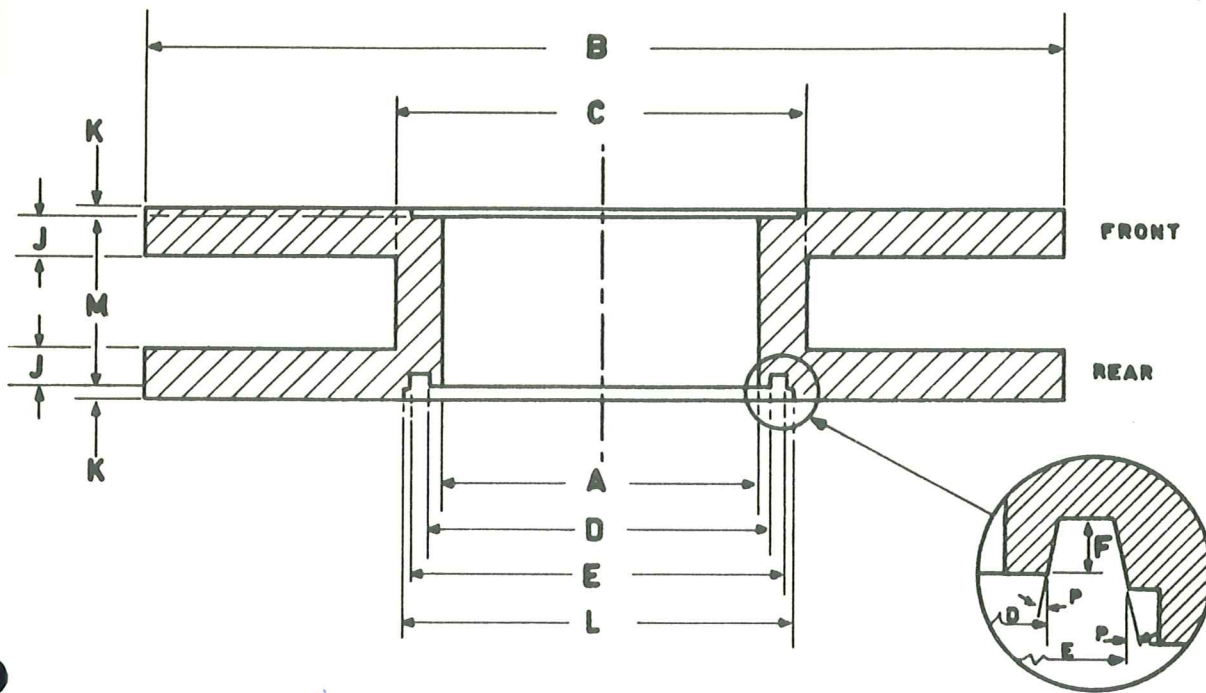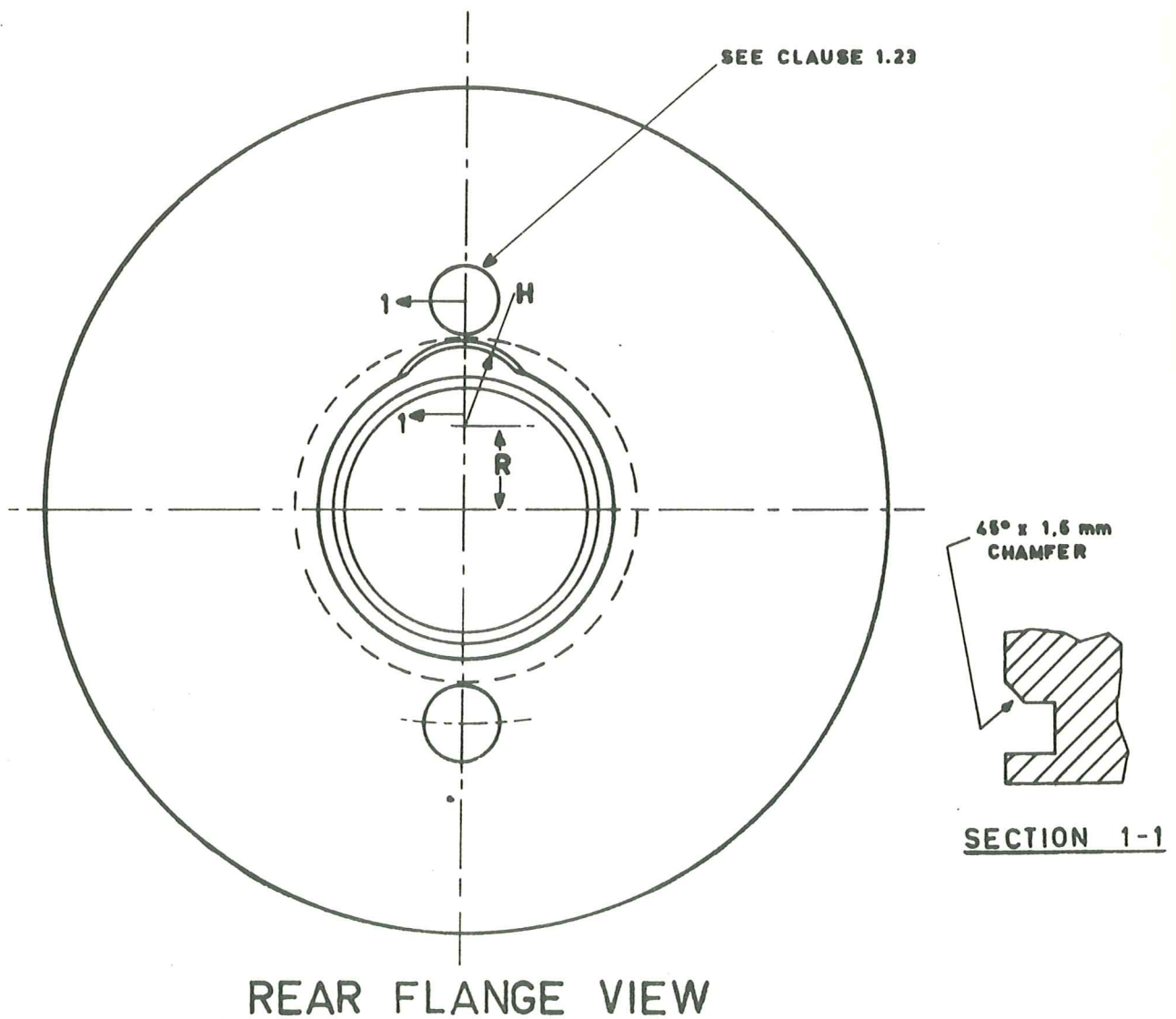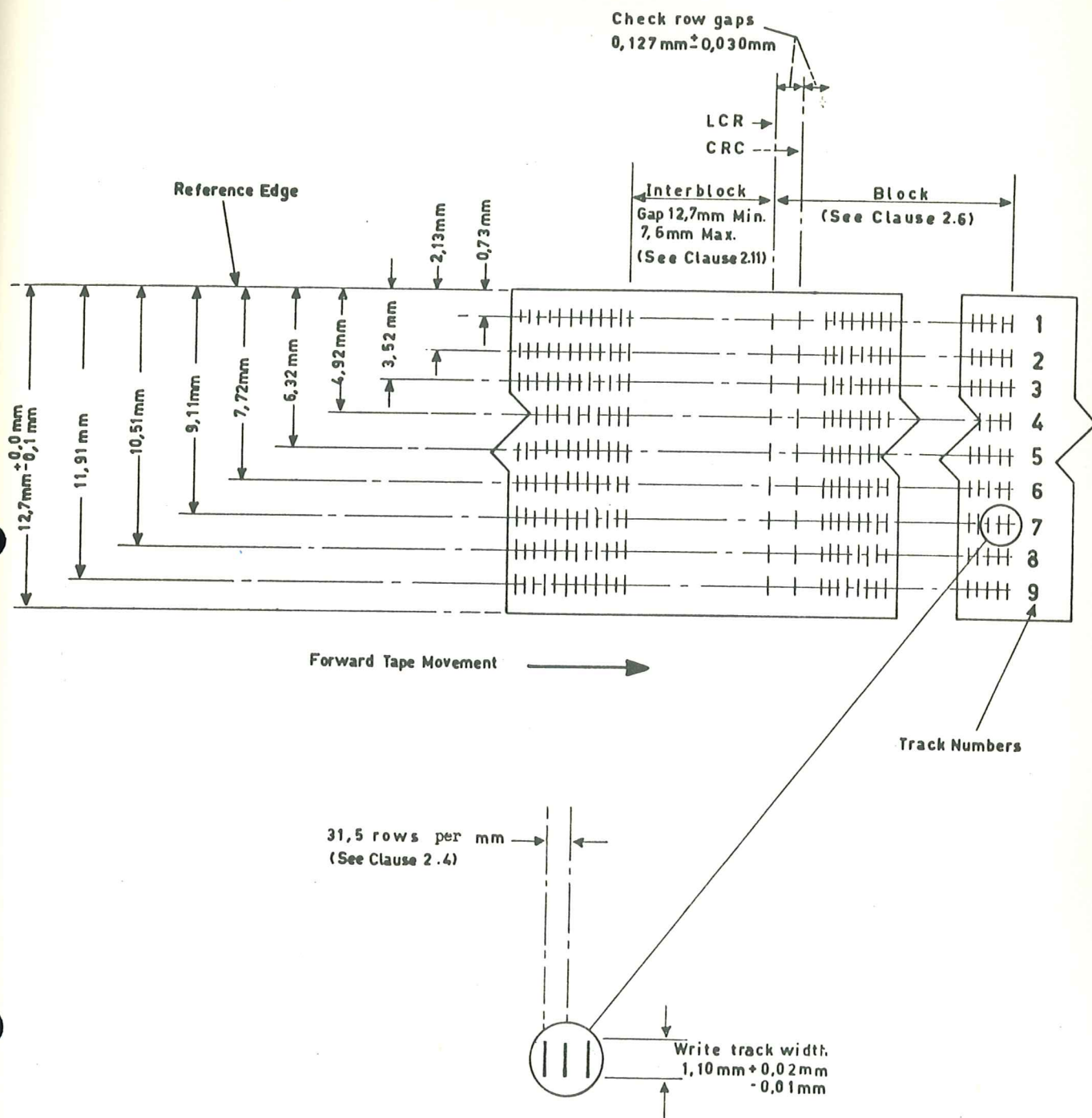
Fig. 1

Fig. 2

SEE CLAUSE 1.23

45° x 1,6 mm
CHAMFER

SECTION 1-1

REAR FLANGE VIEW

Fig. 2 A

Fig. 3

NOTES:

Tape is shown with oxide side up, Read/Write head on same side as oxide. Tape shown representing 1 bits in all tracks, NRZ 1 recording, 1 bit produced by reversals of flux polarity, tape fully saturated in each direction.

Transportation of data bearing magnetic tape involves three
basic potential hazards :

1. IMPACT LOADS AND VIBRATIONS: which could cause damage to the
    spool, or movement within the tape pack, with consequential
    loss of wind tension.

    RECOMMENDATION

    1.1 The free end of the tape should be secured to prevent
        any tendency to unwind.

    1.2 The use of a rigid plastic container free from dust or
        other extraneous matter.

    1.3 The plastic container(s) to be fitted into a rigid box
        containing adequate shock absorbent material.

    1.4 The final box must have a clean interior and a lid con-
        struction that provides sufficient sealing to prevent
        the ingress of dirt and water.

    1.5 The orientation of the spools within the final box
        should be such that their axes are horizontal.

    1.6 The final box should be clearly marked to indicate its
        correct orientation.

2. EXTREMES OF TEMPERATURE AND HUMIDITY: which could set up
    stresses within the body of the tape.

    RECOMMENDATION

    2.1 Extreme changes in temperature and humidity should be
        avoided wherever possible.

    2.2 After completion of the writing operation, the tape
        should be wound fully on to the take-up spool and then
        completely rewound on to the spool to be interchanged,
        at a tension of 220 to 280 g.

    2.3 Whenever a tape is received it should be conditioned
        in the computer environment for a period of 2-6 hours,
        depending upon the type of transportation used.

3. EFFECTS OF STRAY MAGNETIC FIELDS: which would possibly
    cause corruption of data.

    RECOMMENDATION

    A nominal spacing of not less than 8 cm should exist bet-
    ween the magnetic tape spool and the outer surface of the
    final container in which case it is considered that the
    risk of corruption will be negligible.

When reading, the CRC register is controlled as it was for
writing until the last data character has been added and the final
shift made. The CRC character on tape is then added to it.

To test for an error, the register is read out inverting all
positions except 4 and 6. If the masked output of any position
is a " one" an error has been detected.

To determine whether the errors occurred in a single bit position
and, if so, which, an Error Pattern must be generated. This pat-
tern must then be compared with the error indicating pattern in
the CRC register.

Consider the contents of a 9 position error pattern register to
be E_1 to E_9 corresponding to C_1 to C_9 of the CRC register. The
error pattern can be considered as being constructed as follows:

(a) Whenever a character parity error is detected for a
data row or CRC character, a one is added without
carry to E_9 (1 exclusive or E_9).

(b) Between the reading of each character the error pattern
register is shifted one position E_1 to E_2 etc. to E_9 to
E_1.

(c) If, at the time of shifting, $E_9 = 1$ shifts to $E_1 = 1$,
E_3, E_4, E_5 are inverted to E_4, E_5, E_6 and E_7.

To determine the track in error, a series of comparisons is made
between the contents of the error pattern register and the CRC
register. The CRC register, read out through the mask which in-
verts all positions except C_4 and C_6, is compared with the error
pattern register.

The first comparison is direct: E_1 to C_1. If all positions match,
the error was in the track associated with C_9 (b_1).

The CRC register is then shifted once, according to the rules b)
and c) above, between each comparison. This is continued until
a match is obtained or until a maximum of nine comparisons (eight
shifts) have been made. The bit position in error corresponds to
C_9 through C_1 for a match on the first through nine comparisons
respectively.

There are two conditions for the final contents of the CRC re-
gister for which an uncorrectable error has been detected and
for which an incorrect track in error indication will be ob-
tained if comparisons are made. These are:

(a) C_1 through C_9 all zero
(b) C_4 and C_6 zero, all other positions containing " one"
(the read-out mask).

Comparison must not be made when either of these two conditions
exist. If a track in error indication is obtained, the error
block may be re-read. The output of the track in error is then
inverted whenever the parity of a character is incorrect.