

INTERNATIONAL STANDARD

ISO/IEC
14840

First edition
1996-08-01

Information technology — 12,65 mm wide magnetic tape cartridge for information interchange — Helical scan recording — Data-D3-1 format

*Technologies de l'information — Cartouche de bande magnétique de
12,65 mm de large pour l'échange d'information — Enregistrement par
balayage en spirale — Format de données-D3-1*



Reference number
ISO/IEC 14840:1996(E)



Documents

Document Sharing Hub

Contents	Page
Section 1 - General	1
1 Scope	1
2 Conformance	1
2.1 Magnetic tape cartridge	1
2.2 Generating system	1
2.3 Receiving system	1
3 Normative References	1
4 Definitions	2
4.1 a.c. erase	2
4.2 algorithm	2
4.3 Average Signal Amplitude	2
4.4 azimuth	2
4.5 back surface	2
4.6 Beginning of Tape (BOT)	2
4.7 Beginning of Tape Sense Slot	2
4.8 byte	2
4.9 cartridge	2
4.10 character	2
4.11 Codeword Digital Sum (CDS)	2
4.12 Cyclic Redundancy Check (CRC) Character	2
4.13 Data Area Reference Point	2
4.14 Data Records	2
4.14.1 Logical Data Record (LDR)	2
4.14.2 Processed Data Record (PDR)	2
4.14.3 User Data Record (UDR)	2
4.15 Digital Sum Variation (DSV)	2
4.16 End of Tape (EOT)	3
4.17 End of Tape Sense Slot	3
4.18 Error Correcting Code (ECC)	3
4.19 File safe	3
4.20 Fixed Scan Group Header	3

© ISO/IEC 1996

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

ISO/IEC Copyright Office * Case Postale 56 * CH-1211 Genève 20 * Switzerland
Printed in Switzerland

4.21	flux transition position	3
4.22	flux transition spacing	3
4.23	Helical Time Code (HTC)	3
4.24	Internal Leader Header (ILH)	3
4.25	Logical Block Number	3
4.26	magnetic tape	3
4.27	Master Standard Reference Tape	3
4.28	Packet	3
4.29	Packet Identifier	3
4.30	Packet Trailer	3
4.31	physical recording density	3
4.32	Postamble	3
4.33	Preamble	3
4.34	processed data	3
4.35	Reference Fields	3
4.36	resolution	3
4.37	Scan Group	3
4.38	Scan Group Pair	3
4.39	Scan Group Start Data (SGSD)	3
4.40	Secondary Standard Reference Tape	3
4.41	Standard Reference Amplitudes (SRA)	3
4.42	Standard Reference Currents (Ir)	4
4.43	Tape Reference Edge	4
4.44	Test Recording Currents (TRC)	4
4.45	track	4
4.46	track angle	4
4.47	Typical Field (TF)	4
4.48	Variable Scan Group Header	4
4.49	zero crossing	4
5	Conventions and Notations	4
5.1	Representation of numbers	4
5.2	Names	5
6	Acronyms	5
7	Environment and Safety	5
7.1	Testing environment	5
7.2	Operating environment	5
7.3	Storage environment	5
7.4	Transportation	6
7.5	Safety	6
7.6	Flammability	6
Section 2	Requirements for the Cartridge	7
8	Dimensional and Mechanical Characteristics of the Cartridge	7
8.1	Elements of the cartridge	7
8.2	Reference Planes of the case	7
8.3	Dimensions of the case	7
8.3.1	Overall dimensions	7
8.3.2	Locating areas	8
8.3.3	Reference points for Plane Y	8
8.3.4	Reference point for Plane Z	8
8.3.5	Locating notches	8

8.3.6	Mis-insertion protection	9
8.3.7	Stacking ribs	9
8.3.8	Recognition notches	9
8.3.9	Write-inhibit mechanism	10
8.3.10	Label areas of the top side	10
8.3.11	Label areas of the rear side	11
8.3.12	Label area on the right hand side	11
8.3.13	Label area on the bottom side	12
8.3.14	Central window	12
8.3.15	Case opening	12
8.3.16	Tapers of the case	13
8.4	Flexibility of the case	13
8.4.1	Requirements	13
8.4.2	Procedure	13
8.5	Tape reel	14
8.5.1	Locking mechanism	14
8.5.2	Axis of rotation of the reel	14
8.5.3	Metallic insert	14
8.5.4	Toothed rim	14
8.5.5	Hub of the reel	15
8.5.6	Relative positions of hub and case	15
8.5.7	Characteristics of the toothed rim	16
8.6	Magnetic tape	16
8.6.1	Tape wind	16
8.6.2	Wind tension	16
8.6.3	Circumference of the tape reel	16
8.6.4	Moment of inertia	16
8.7	Leader block	17
8.7.1	Dimensions of the leader block	17
8.7.2	Attachment of the tape to the leader block	17
8.7.3	Latching the leader block	17
8.8	Reflection density of the case	18
8.8.1	Requirement	18
8.8.2	Test Equipment	19
8.8.3	Test method	18
8.9	Colour	19
Section 3	Requirements for the Unrecorded Tape	27
9	Mechanical, physical and dimensional characteristics of the tape	27
9.1	Materials	27
9.2	Tape length	27
9.3	Tape width	27
9.4	BOT and EOT Sense Slots	27
9.5	Discontinuities	27
9.6	Thickness	27
9.7	Longitudinal curvature	27
9.8	Straightness	28
9.9	Cupping	28
9.10	Out-of-plane distortions	28
9.11	Coating adhesion	28
9.12	Layer-to-layer adhesion	29

9.13	Young's Modulus for the tape	29
9.14	Surface roughness	29
9.15	Electrical resistance of coated surfaces	30
9.16	Tensile strength	30
9.16.1	Breaking strength	30
9.16.2	Offset yield strength	30
9.17	Residual elongation	31
9.18	Light transmittance of the tape	31
10	Magnetic Recording Characteristics	31
10.1	General	31
10.2	Basis for measuring the magnetic recording characteristics of the unrecorded tape.	31
10.3	Test conditions	31
10.4	Typical Field	32
10.5	Signal Amplitude	32
10.6	Resolution	32
10.7	Ease of Erasure	32
10.8	Narrow-band Signal-to-Noise Ratio (NB-SNR)	32
10.9	Tape Quality	33
10.9.1	Missing pulses	33
10.9.2	Missing pulse zones	33
Section 4	Requirements for an Interchanged Tape	34
11	Format of a helically recorded track	34
11.1	General description of the write data path	34
11.1.1	Formation of Packets	34
11.1.2	Formation of Scan Groups	34
11.1.3	Channel separation	34
11.1.4	Interleave buffer	34
11.1.5	Sync Blocks	34
11.1.6	Randomization	34
11.1.7	Logical helical track	34
11.1.8	Byte translation	34
11.1.9	Recording of tracks	34
11.2	Packet format	36
11.2.1	Packet definition	36
11.2.2	Packet ID	36
11.2.3	UDR	37
11.2.4	Packet Trailer	37
11.3	Scan Group	38
11.3.1	Scan Group Start Data (SGSD)	39
11.3.2	Helical Time Code (HTC)	39
11.3.3	Header	40
11.3.4	Data Part	44
11.3.5	Trailer	44
11.3.6	Types of Scan Group	44
11.3.7	Protection of Scan Groups	47
11.4	Write data channel	48
11.4.1	Scan Group sections	48
11.4.2	Interleave Buffer	49

11.4.3 Sync Blocks	52
11.4.4 Layout of a logical helical track	53
11.4.5 Byte translation	54
12 Track geometry	55
12.1 General	55
12.2 Helically recorded tracks	56
12.2.1 Track width	56
12.2.2 Adjacent track pitch	56
12.2.3 Track angle	56
12.2.4 Straightness of a track	56
12.2.5 Track length	56
12.2.6 Azimuth angles	56
12.2.7 Location of positive azimuth tracks	56
12.2.8 Location of Data Area Reference Point	56
12.3 Time Code Track	57
12.3.1 Track location	57
12.3.2 Azimuth	57
12.4 Servo Control Track	57
12.4.1 Track location	57
12.4.2 Azimuth	57
12.5 Reserved Longitudinal Track	57
13 Method of recording helical tracks	59
13.1 Tape condition before recording	59
13.2 Method of recording	59
13.3 Physical Recording Densities	59
13.4 Nominal Bit Cell Length	60
13.5 Long-term Average Bit Cell Length	60
13.6 Short-term Average Bit Cell Length (STA)	60
13.7 Rate of Change of the STA	60
13.8 Bit shift	60
13.9 Read signal amplitude	60
14 Servo Control Track	60
14.1 Format	60
14.2 Relative locations of Pulse Pairs and Scan Group Pairs	60
14.3 Polarity of magnetisation	60
14.4 Read signal amplitude	60
14.5 Quality of the Servo Control Track	61
15 Time Code Track	61
15.1 Format	61
15.1.1 Count bits	61
15.1.2 Supplementary Data	61
15.1.3 Phase bit	61
15.1.4 Synchronizing pattern	61
15.2 Extent of a Time Code	61
15.3 Relative locations of the Time Code and Scan Group Pairs	61
15.4 Form of recording	61
15.4.1 Nominal bit density	62
15.4.2 Nominal bit cell length	62

15.4.3 Bit shift	62
15.5 Read signal amplitude	62
15.6 Quality of the Time Code Track	62
16 Tape format	63
16.1 Layout of the magnetic tape	63
16.2 Data Area	64
16.2.1 Capacity of tape sectors	64
16.2.2 Sequence of Scan Groups on the tape	64
16.2.3 Write skips	66
16.2.4 Appended Data	66
16.3 EOD	66
Annexes	
A - Representation of the CRC used in 11.2 - Packet Format	67
B - Representation of the CRC used in 11.3 - Scan Group	68
C - Representation of 8-bit bytes by 14-bit patterns	69
D - Generation of Outer ECC and Inner ECC	81
E - Measurement of the geometry of helical tracks	83
F - Measurement of Bit Shift	86
G - Label - Media type	90
H - Reflection density of the case	96
J - Measurement of light transmittance of tape	97
K - Recommendations for transportation	100
L - Guidelines for handling tape cartridges	101
M - Helical and Longitudinal Time Codes	102
N - Representation of the CRC used in 11.3.2 - HTC	104
P - Bibliography	105

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 14840 was prepared by ECMA (as Standard ECMA-210) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to D, F, G, J, M and N form an integral part of this International Standard. Annexes E, H, K, L and P are for information only.

Information technology - 12,65 mm wide magnetic tape cartridge for information interchange - Helical scan recording - Data-D3-1 format

Section 1 - General

1 Scope

This International Standard specifies the physical and magnetic characteristics of a magnetic tape cartridge, using magnetic tape 12,65 mm wide, so as to provide physical interchangeability of such cartridges. It also specifies the quality of the recorded signals, the recording method and the recorded format, thereby allowing data interchange between drives by means of such magnetic tape cartridges.

This International Standard specifies three types of cartridge which, for the purposes of this International Standard, are referred to as Type A, Type B and Type C.

For Type A, the magnetic tape has a nominal length of 91 m and a nominal capacity of 10 GBytes.

For Type B, the magnetic tape has a nominal length of 204 m and a nominal capacity of 25 GBytes.

For Type C, the magnetic tape has a nominal length of 392 m and a nominal capacity of 50 GBytes.

Together with a Standard for Volume and File Structure this International Standard provides for full data interchange between data processing systems.

2 Conformance

2.1 Magnetic tape cartridge

A claim of conformance with this International Standard shall specify the Type of the cartridge. It shall be in conformance with this International Standard if

- the cartridge meets all the requirements of clause 4 and clauses 7 to 10
- the recording on the tape meets the requirements of clauses 11 to 16
- for each recorded Packet the algorithm used for processing the data therein, if the recorded data has been processed, has been registered and the registered identification is included in Byte 13 of the Packet ID of this Packet (see 11.2.2)

2.2 Generating system

A system generating a magnetic tape cartridge for interchange shall be entitled to claim conformance with this International Standard if all the recordings that it makes, on all three Types of cartridge, meet the mandatory requirements of this International Standard. A claim of conformance shall state whether or not one, or more, registered algorithm(s) is (are) implemented and, if so, the registered number(s) of (all) the implemented algorithm(s).

2.3 Receiving system

A system receiving a magnetic tape cartridge for interchange shall be entitled to claim conformance with this Standard if it is able to handle any recording made on the tape according to this International Standard, and for all three Types.

A claim of conformance shall state whether or not one, or more, registered algorithm(s) is (are) implemented and, if so, the registered number(s) of (all) the implemented algorithm(s).

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/R 527:1966

Plastics - Determination of tensile properties.

ISO 1001:1986	<i>Information processing - File structure and labelling of magnetic tapes for information interchange.</i>
ISO 1302:1992	<i>Technical drawings - Method of indicating surface texture.</i>
ISO 683-13:1986	<i>Heat-treatable steels, alloy steels and free-cutting steels - Part 13: Wrought stainless steels.</i>
ISO/IEC 11576:1994	<i>Information technology - Procedure for the registration of algorithms for the lossless compression of data.</i>
IEC 950:1995	<i>Safety of information technology equipment, including electrical business equipment.</i>

4 Definitions

For the purposes of this International Standard, the following definitions apply.

- 4.1 a.c. erase:** A process of erasure utilizing alternating magnetic fields of decaying intensity.
- 4.2 algorithm:** A set of rules for transforming the logical representation of data.
- 4.3 Average Signal Amplitude:** The average peak-to-peak value of the signal output of a read head measured over a minimum of 3 000 flux transitions, exclusive of missing pulses.
- 4.4 azimuth:** The angular deviation, in degrees of arc, of the recorded flux transitions on a track from the line normal to the track centreline.
- 4.5 back surface:** The surface of the tape opposite to the magnetic coating used to record data.
- 4.6 Beginning of Tape (BOT):** The point along the tape indicated by the start of the density identification burst.
- 4.7 Beginning of Tape Sense Slot:** A slot on the centreline of the tape indicating the beginning of usable tape.
- 4.8 byte:** An ordered set of 8 bits acted upon as a unit.
- 4.9 cartridge:** A case containing a single reel of magnetic tape with a leader attached at the BOT end.
- 4.10 character:** A unit of information represented by one or more bytes.
- 4.11 Codeword Digital Sum (CDS):** The value of the Digital Sum Variation (DSV) taken over a single 14-bit pattern.
- 4.12 Cyclic Redundancy Check (CRC) Character:** Two bytes derived from information contained in the data bytes, pad bytes and other bytes.
- 4.13 Data Area Reference Point:** The physical position of the start of the first Outer ECC Sync Block of a positive azimuth helical track.
- 4.14 Data Records**
 - 4.14.1 Logical Data Record (LDR):** The data entity received by the generating system from the host. It may consist of one, or several, Host Data Record(s) depending upon the action taken by the host to use extended blocks.
 - 4.14.2 Processed Data Record (PDR):** The data entity resulting from the application of an algorithm to an LDR.
 - 4.14.3 User Data Record (UDR):** The data entity available to the Packet generator. When the data has been processed it is a PDR. When the data has not been processed it is an LDR.
- 4.15 Digital Sum Variation (DSV)**

The integrated value of Channel Bits, taken from the point at which byte translation commences, i.e. at the start of each helical track, and counting a ONE as +1 and a ZERO as -1.

- 4.16 End of Tape (EOT):** The point towards the hub end of the tape beyond which no recording shall be made.
- 4.17 End of Tape Sense Slot:** A slot on the centreline of the tape indicating the end of usable tape.
- 4.18 Error Correcting Code (ECC):** A mathematical procedure yielding bits used for the detection and correction of errors.
- 4.19 File safe:** The designation for a tape that allows data to be appended to data that has already been written, but which prevents such previously written data from being overwritten.
- 4.20 Fixed Scan Group Header:** A header which is not changed when the Scan Group is rewritten.
- 4.21 flux transition position:** That point along a track that exhibits the maximum free-space flux density normal to the tape surface.
- 4.22 flux transition spacing:** The distance along a track between successive flux transitions.
- 4.23 Helical Time Code (HTC):** A time code added to a Scan Group, recorded in the helical tracks and used to ensure that a particular Scan Group Pair can be located if the longitudinal Time Code has been lost.
- 4.24 Internal Leader Header (ILH):** A pair of Scan Groups containing volume information.
- 4.25 Logical Block Number:** A count of the number of blocks of data transferred from the host to the tape system and the number of Tape Marks requested by the host.
- 4.26 magnetic tape:** A tape which will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.
- 4.27 Master Standard Reference Tape:** A tape selected as the standard for Reference Field, Signal Amplitude and Resolution.

Note 1 - The Master Standard Reference Tape has been established at Pericomp Corporation.

- 4.28 Packet:** A UDR with a Packet Identifier and a Packet Trailer added.
- 4.29 Packet Identifier:** The group of 32 bytes added to the beginning of a UDR when forming a Packet.
- 4.30 Packet Trailer:** The group of bytes of variable size appended to a UDR when forming a Packet.
- 4.31 physical recording density:** The number of recorded flux transitions per unit length of track, specified as flux transitions per millimetre (ftpm).
- 4.32 Postamble:** A sequence of 8-bit bytes at the end of a logical helical track.
- 4.33 Preamble:** A sequence of 8-bit bytes at the beginning of a logical helical track.
- 4.34 processed data:** Data which has been processed by an algorithm.
- 4.35 Reference Fields:** The Typical Field of the Master Standard Reference Tape. There are three Reference Fields, RF1, RF2 and RF3.
- 4.36 resolution:** The ratio of the average signal amplitude at a high physical recording density to that at a lower physical recording density.
- 4.37 Scan Group:** A set of 6 contiguously recorded helical tracks.
- 4.38 Scan Group Pair:** Two contiguous Scan Groups, the first of which is even-numbered and the second is odd-numbered.
- 4.39 Scan Group Start Data (SGSD):** A series of bytes defining the start of a Scan Group.
- 4.40 Secondary Standard Reference Tape:** A tape the performance of which is known and stated in relation to that of the Master Standard Reference Tape.

Secondary Standard Reference Tapes can be ordered under Part Number #SMRT/Rdwd-PC95, until the year 2006, from Pericomp Corporation, 14 Huron Drive, Natick, MA 01760, USA.

Telephone: +1-508 655 7660
Facsimile: +1-508 653 9288

It is intended that these be used for calibrating tertiary reference tapes for use in routine calibration.

- 4.41 Standard Reference Amplitudes (SRA):** The Average Signal Amplitude derived from the Master Standard Reference Tape when using the appropriate Test Recording Current and the appropriate recording density.

There are three SRAs:

SRA1 is derived from a helically recorded track, recorded at 2 597 ft/mm with TRC1.

SRA2 is derived from the Servo Control Track, recorded at 2,146 ftpmm with TRC2.

SRA3 is derived from the Time Code Track, recorded at 57,2 ftpmm with TRC3.

Traceability to the SRAs is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

4.42 Standard Reference Currents (Ir): The current that produces the Reference Field.

There are three Standard Reference Currents:

Ir1 is the current producing RF1 on a helically recorded track.

Ir2 is the current producing RF2 on the Servo Control Track.

Ir3 is the current producing RF3 on the Time Code Track.

4.43 Tape Reference Edge: The lower edge of the tape when viewing the recording surface of the tape with the supply reel to the observer's right.

4.44 Test Recording Currents (Technical Report): The recording current used to record an SRA.

There are three Test Recording Currents:

TRC1 is 1,7 times Ir1

TRC2 is 2,3 times Ir2

TRC3 is 2,3 times Ir3

4.45 track: A narrow, defined area on the tape along which a series of magnetic transitions may be recorded. A track may be parallel to the Tape Reference Edge or positioned at an angle to it.

4.46 track angle: The angle between the centreline of a helically recorded track and the Tape Reference Edge.

4.47 Typical Field (TF): In the plot of Average Signal Amplitude against the Recording Field at a specified physical recording density, the minimum field that causes an Average Signal Amplitude equal to a specified percentage of the maximum Average Signal Amplitude.

There are three TFs:

TF1 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 2 597 ftpmm on a helically recorded track.

TF2 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 2,146 ftpmm on the Servo Control Track.

TF3 is the field giving an Average Signal Amplitude equal to 90% of the maximum Average Signal Amplitude at the Physical Recording Density of 57,2 ftpmm on the Time Control Track.

4.48 Variable Scan Group Header: A header which changes when the Scan Group is rewritten.

4.49 zero crossing: A point at which the amplitude of the read signal passes through zero.

5 Conventions and Notations

5.1 Representation of numbers

- A measured value is rounded off to the least significant digit of the corresponding specified value. It implies that a specified value of 1,26 with a positive tolerance of +0,01, and a negative tolerance of -0,02 allows a range of measured values from 1,235 to 1,275.
- Letters and digits in parentheses represent numbers in hexadecimal notation.
- The setting of a bit is denoted by ZERO or ONE.
- Numbers in binary notation and bit combinations are represented by strings of ZEROs and ONES.
- Numbers in binary notation and bit combinations are shown with the most significant byte to the left, and with the most significant bit in each byte to the left.
- Negative values of numbers in binary notation are given in TWO's complement.
- In each field the data is processed so that the most significant byte (byte 0) is processed first. Within each byte the least significant bit is numbered 0 and is processed last, the most significant bit (numbered 7 in an 8-bit byte) is processed first.

This order of processing applies also to the data input to the Error Detection and Correction circuits and to their output, unless otherwise stated.

5.2 Names

The names of entities, e.g. specific tracks, fields, etc., are given with a capital initial.

6 Acronyms

ASA	Average Signal Amplitude
BOT	Beginning of Tape
CDS	Codeword Digital Sum
CRC	Cyclic Redundancy Check
DID	Density Identification
DSV	Digital Sum Variation
ECC	Error Correcting Code
EOT	End of Tape
HTC	Helical Time Code
ILH	Internal Leader Header
LDR	Logical Data Record
PDR	Processed Data Record
PEOT	Physical End Of Tape
SGSD	Scan Group Start Data
SEP	Separator
SRA	Standard Reference Amplitude
TF	Typical Field
TRC	Test Recording Current
UDR	User Data Record

7 Environment and Safety

The conditions specified below refer to the ambient conditions immediately surrounding the cartridge.

Cartridges exposed to environments outside these limits may still be able to function usefully; however, such exposure may cause permanent damage.

7.1 Testing environment

Unless otherwise specified, tests and measurements made on the cartridge to check the requirements of this International Standard shall be carried out under the following conditions

temperature	: 23°C ± 2°C
relative humidity	: 40 % to 60 %
conditioning period before testing	: 24 h

7.2 Operating environment

Cartridges used for data interchange shall be capable of operating under the following conditions

temperature	: 16°C to 32°C
relative humidity	: 20 % to 80 %
wet bulb temperature	: 25°C max.

The average temperature of the air immediately surrounding the tape shall not exceed 45°C.

Conditioning before operating: If a cartridge has been exposed during storage and/or transportation to conditions outside the above values, it shall be conditioned for a period of at least 24 h.

7.3 Storage environment

For long-term or archival storage the following conditions shall be observed

temperature	: 5°C to 32°C
relative humidity	: 40 % to 60 %

stray magnetic field : shall not exceed 4 000 A/m at any point on the tape

There shall be no deposit of moisture on or in the cartridge.

7.4 Transportation

Recommended limits for the environments to which a cartridge may be subjected during transportation, and the precautions to be taken to minimize the possibility of damage, are provided in annex K.

7.5 Safety

The cartridge shall satisfy the safety requirements of ECMA-129 when used in the intended manner or in any foreseeable use in an information processing system.

7.6 Flammability

The cartridge shall be made from materials that comply with the flammability class for HB materials, or better, as specified in ECMA-129.

Section 2 - Requirements for the Cartridge

8 Dimensional and Mechanical Characteristics of the Cartridge

8.1 Elements of the cartridge

The cartridge shall consist of the following elements:

- a case
- recognition notches
- a write inhibit mechanism
- a reel for magnetic tape
- a locking mechanism for the reel
- a magnetic tape wound on the hub of the reel
- a leader block
- a latching mechanism for the leader block

Dimensional characteristics are specified for those parameters deemed to be mandatory for interchange and compatible use of the cartridge. Where there is freedom of design, only the functional characteristics of the elements described are indicated. In the figures a typical implementation is represented in third angle projection.

- | | |
|------------------|--|
| Figure 1 | is a general view of the cartridge |
| Figure 2 | illustrates the Reference Planes |
| Figure 3 | shows the front side of the case, which lies in Plane Z |
| Figure 4 | shows the top side of the case |
| Figure 5 | shows the rear side of the case |
| Figure 6 | shows the left side of the case, which lies in Plane Y |
| Figure 7 | is Section A-A of figure 4 |
| Figure 8 | is Section B-B of figure 3 |
| Figure 9 | shows the bottom side of the case, which lies in Plane X |
| Figure 10 | shows the right side of the case |
| Figure 11 | is Detail C of figure 10 |
| Figure 12 | is a cross-section of the hub and brake assembly with the cartridge held in the hand |
| Figure 13 | is a cross-section of the hub and brake assembly with the cartridge in the drive |
| Figure 14 | shows a view of the teeth of the locking mechanism |
| Figure 15 | is Detail W of figure 13 |
| Figures 16 to 24 | show details of the leader block |

8.2 Reference Planes of the case (figure 2)

Where they are purely descriptive, the dimensions are referenced to three orthogonal References Planes - X, Y and Z. Where the dimensions are related to the position of the cartridge mounted in the drive, they may be referenced to another plane of the cartridge, Plane P.

Plane X is defined by three circular locating areas, X_1 , X_2 and X_3 , in the bottom side of the case. Plane Y is perpendicular to Plane X and is determined by two reference points, Y_1 and Y_2 , on the left hand side of the case. Plane Z is perpendicular to Plane X; reference point Z_1 shall lie in Plane Z.

8.3 Dimensions of the case

The dimensions of the case shall be measured in the Test Environment. The dimensions of the case in any operating environment can be estimated from the dimensions specified in this clause.

8.3.1 Overall dimensions (figures 3, 4 and 5)

The total length of the case shall be

$$l_1 = 125,00 \text{ mm} \pm 0,32 \text{ mm}$$

The width of the case shall be

$$l_2 = 109,00 \text{ mm} \pm 0,32 \text{ mm}$$

The distance from the top of the case to Reference Plane X shall be

$$l_3 = 24,50 \text{ mm} \pm 0,41 \text{ mm}$$

The front vertical edges of the case shall be rounded with a radius

$$r_1 = 3,81 \text{ mm} \pm 0,25 \text{ mm}$$

The rear vertical edges of the case shall be rounded with a radius

$$r_2 = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

The top left and top right hand edges shall be rounded with a radius

$$r_3 = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

The bottom left and bottom right hand edges shall be rounded with a radius

$$r_4 = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.2 Locating areas (figure 9)

The three circular locating areas X_1 , X_2 and X_3 shall lie in the same plane within 0,25 mm.

Area X_1 shall have a diameter

$$d_1 = 14,00 \text{ mm} \pm 0,25 \text{ mm}$$

The position of its centre shall be defined by

$$l_4 = 54,50 \text{ mm} \pm 0,05 \text{ mm}$$

$$l_5 = 31,25 \text{ mm} \pm 0,05 \text{ mm}$$

Areas X_2 and X_3 shall have diameters

$$d_2 \text{ and } d_3 = 10,00 \text{ mm} \pm 0,25 \text{ mm}$$

The positions of their centres shall be defined by

$$l_6 = 108,50 \text{ mm} \pm 0,05 \text{ mm}$$

$$l_7 = 3,50 \text{ mm} \pm 0,05 \text{ mm}$$

$$l_8 = 101,98 \text{ mm} \pm 0,05 \text{ mm}$$

8.3.3 Reference points for Plane Y (figure 6)

The position of Reference Point Y_1 shall be defined by

$$l_9 = 12,70 \text{ mm} \pm 0,05 \text{ mm}$$

$$l_{10} = 10,41 \text{ mm} \pm 0,05 \text{ mm}$$

The position of Reference Point Y_2 shall be defined by

$$l_{11} = 88,90 \text{ mm} \pm 0,05 \text{ mm} \text{ and } l_{10}$$

8.3.4 Reference point for Plane Z (figure 3)

The position of Reference Point Z_1 shall be defined by

$$l_{12} = 54,51 \text{ mm} \pm 0,05 \text{ mm}$$

$$l_{13} = 8,13 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.5 Locating notches (figures 6, 9, 10 and 11)

There shall be two locating notches, open towards the bottom side. The depth of the notches shall be defined by

$$l_{14} = 2,50 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{15} = 104,00 \text{ mm} \pm 0,25 \text{ mm}$$

For each notch the side further from Plane Z shall be spaced from Plane Z by

$$l_{16} = 111,07 \text{ mm} \pm 0,25 \text{ mm}$$

the width at Plane X shall be

$$l_{17} = 5,21 \text{ mm} \pm 0,08 \text{ mm}$$

it shall extend a distance from Plane X

$$l_{18} = 7,00 \pm 0,25 \text{ mm}$$

The sides shall have a taper

$$\alpha_1 = 2^\circ 0' \pm 30'$$

which shall start at a distance from Plane X

$$l_{19} = 2,54 \text{ mm} \pm 0,13 \text{ mm}.$$

8.3.6 Mis-insertion protection (figures 4 and 6)

The cartridge shall have a notch in the top side of the case to prevent the cartridge from being inserted into the drive upside-down. This feature further prevents the use of unsuitable cartridges of similar, but not identical, construction.

The depth of the notch shall be determined by

$$l_{20} = 16,97 \text{ mm} \pm 0,50 \text{ mm}$$

Its length, measured from Plane Z shall be

$$l_{21} = 27,20 \text{ mm} \pm 0,25 \text{ mm}$$

Its length, measured from Plane Y shall be

$$l_{22} = 13,51 \text{ mm} \pm 0,25 \text{ mm}$$

The inside corner shall have a radius

$$r_5 = 54,36 \text{ mm} \pm 0,51 \text{ mm}$$

8.3.7 Stacking ribs (figures 5 and 9)

The bottom side of the case shall have two parallel stacking ribs; the dimensions shall be

$$l_{23} = 5,00 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{24} = 74,50 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{25} = 1,00 \text{ mm} \pm 0,16 \text{ mm}$$

The corners shall have a radius

$$r_6 = 0,89 \text{ mm} \pm 0,25 \text{ mm}$$

The locations shall be defined by

$$l_{26} = 7,50 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{27} = 31,00 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{28} = 79,50 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.8 Recognition notches (figures 3 and 4)

Five locations for cartridge recognition notches, numbered 1 to 5, are defined in the front side of the case.

The width of each location shall be

$$l_{29} = 3,81 \text{ mm} \pm 0,08 \text{ mm}$$

The overall width of the five locations shall be

$$l_{30} = 19,05 \text{ mm} \pm 0,08 \text{ mm}$$

The distance of location 5 from Plane Y shall be

$$l_{31} = 46,88 \text{ mm} \pm 0,64 \text{ mm}$$

The depth of a notch, measured from the top of the case shall be

$$l_{32} = 7,09 \text{ mm} \pm 0,25 \text{ mm}$$

The depth of a notch, measured from Plane Z shall be

$$l_{33} = 3,30 \text{ mm} \pm 0,38 \text{ mm}$$

In table 1 the presence of a notch is represented by 0 and the absence of a notch by 1.

Table 1 - Assignment of Recognition Notches

Cartridge Type	Notch condition				
	1	2	3	4	5
Type A	0	1	0	0	0
Type B	0	1	0	0	1
Type C	0	1	0	1	0

Note 2 - Notch condition 0 1 1 0 0 is assigned to a cleaning cartridge.

8.3.9 Write-inhibit mechanism (figures 3 and 4)

The write-inhibit mechanism occupies the space of two further notch locations, 6 and 7. It extends beyond notch location 5 a distance

$$l_{34} = 7,62 \text{ mm} \pm 0,08 \text{ mm}$$

The mechanism shall enable notch location 6 to be open or closed, as required. When the notch is closed, writing is permitted and a suitable visual indication shall be displayed. When the notch is open, writing is inhibited and an alternative visual indication shall be displayed.

The mechanism to close or open the notch shall operate when a force of between 2,0 N and 9,0 N is applied parallel to the front side of the cartridge.

The surface of the closure shall not protrude outside the front side of the cartridge, nor be recessed more than 0,13 mm behind it.

8.3.10 Label areas of the top side (figure 4)

There shall be two label areas, 1 and 2, on the top side of the case.

8.3.10.1 Label area 1 is provided for the user.

Its dimensions shall be

$$l_{35} = 75,00 \text{ mm} \pm 0,20 \text{ mm}$$

$$l_{36} = 80,06 \text{ mm} \pm 0,25 \text{ mm}$$

Its distance from Reference Plane Z shall be

$$l_{37} = 31,00 \text{ mm} \pm 0,25 \text{ mm}$$

Its distance from Reference Plane Y shall be

$$l_{38} = 6,88 \text{ mm} \pm 0,13 \text{ mm}$$

8.3.10.2 Label area 2 is reserved for use by the manufacturer.

Its dimensions shall be l_{36} and

$$l_{39} = 11,58 \text{ mm} \pm 0,20 \text{ mm}$$

Its distance from Reference Plane Z shall be

$$l_{40} = 120,37 \text{ mm} \pm 0,30 \text{ mm}$$

Its distance from Reference Plane Y shall be l_{38}

Both label areas shall be recessed from the top side by

$$l_{41} = 0,51 \text{ mm} \pm 0,25 \text{ mm}$$

The corners of both label areas shall have a radius

$$r_7 = 0,84 \text{ mm} \pm 0,13 \text{ mm}$$

8.3.11 Label areas of the rear side (figure 5)

There shall be two label areas, 3 and 4, on the rear side of the case.

They shall extend from the top of the case for a distance

$$l_{42} = 12,29 \text{ mm} \pm 0,25 \text{ mm}$$

They shall be recessed from the rear side by l_{41} .

They shall be tapered at an angle

$$\alpha_2 = 2^\circ 0' \pm 30'$$

The radii of the four lower corners shall be

$$r_8 = 0,89 \text{ mm} \pm 0,10 \text{ mm}$$

The distance of the right hand edge of label area 3 (as shown in figure 5) from the right side of the case shall be

$$l_{43} = 21,97 \text{ mm} \pm 0,31 \text{ mm}$$

The width of label area 3 shall be

$$l_{44} = 17,55 \text{ mm} \pm 0,13 \text{ mm}$$

Label area 4 shall be separated from label area 3 by a barrier of width

$$l_{45} = 2,41 \text{ mm} \pm 0,13 \text{ mm}$$

The width of label area 4 shall be

$$l_{46} = 80,09 \text{ mm} \pm 0,23 \text{ mm}$$

A label bearing a letter and its associated bar code, and complying with the requirements of annex G, shall be affixed to label area 3, as shown in figure 5.

The letter shall be : for Type A : A
 for Type B : B
 for Type C : C

8.3.12 Label area on the right hand side (figure 10)

The distance of the bottom edge of label area 5 from Reference Plane X shall be

$$l_{47} = 11,91 \text{ mm} \pm 0,25 \text{ mm}$$

The area shall extend to the radius r_3

The distance of the label area from Reference Plane Z shall be

$$l_{48} = 30,76 \text{ mm} \pm 0,25 \text{ mm}$$

Its length shall be

$$l_{4q} = 35,18 \text{ mm} \pm 0,25 \text{ mm}$$

It shall be recessed by

$$l_{50} = 0,51 \text{ mm} \pm 0,25 \text{ mm}$$

It shall be tapered at an angle

$$\alpha_3 = 2^\circ 0' \pm 30'$$

The corners shall have a radius

$$r_q = 0,89 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.13 Label area on the bottom side (figure 9)

Label area 6 is reserved for use by the manufacturer. The distance of one edge of the label area from Reference Plane Z shall be

$$l_{51} = 105,49 \text{ mm} \pm 0,25 \text{ mm}$$

The distance of one end from the right hand stacking rib shall be

$$l_{52} = 8,76 \text{ mm} \pm 0,25 \text{ mm}$$

Its length shall be,

$$l_{53} = 61,98 \text{ mm} \pm 0,25 \text{ mm}$$

Its width shall be

$$l_{54} = 5,08 \text{ mm} \pm 0,25 \text{ mm}$$

Its depth shall be

$$l_{55} = 0,41 \text{ mm} \pm 0,13 \text{ mm}$$

The four corners of the label area shall have a radius

$$r_{10} = 0,89 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.14 Central window (figure 9)

The bottom side of the case shall have a central window to allow penetration of the drive spindle into the hub.

Its diameter shall be

$$d_4 = 43,50 \text{ mm} \pm 0,23 \text{ mm}$$

Its centre shall be defined by

$$l_{56} = 61,01 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{57} = 54,51 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.15 Case opening (figures 3 and 4)

The case shall have an opening for the tape, into which the leader block can be inserted (see also figure 23).

The opening shall be defined by

$$l_{58} = 105,16 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{59} = 6,35 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{60} = 87,10 \text{ mm} \pm 0,38 \text{ mm}$$

$$l_{61} = 7,72 \text{ mm} \pm 0,38 \text{ mm}$$

$$r_{11} = 3,18 \text{ mm} \pm 0,25 \text{ mm}$$

$$r_{12} = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

$$\alpha_4 = 45^\circ \pm 1^\circ$$

Figure 7 shows, at a larger scale, details of the case opening at the left hand side of figure 4.

$$l_{62} = 8,66 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{63} = 0,76 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{64} = 15,24 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{65} = 17,90 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{66} = 3,33 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{67} = 4,67 \text{ mm} \pm 0,10 \text{ mm}$$

Figure 8 shows, at a larger scale, details of the top left hand corner of figure 3.

$$l_{68} = 1,14 \pm 0,08 \text{ mm}$$

$$l_{69} = 6,00 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{70} = 16,18 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_{71} = 32,28 \text{ mm} \pm 0,13 \text{ mm}$$

$$l_{72} = 25,15 \text{ mm} \pm 0,13 \text{ mm}$$

$$r_{13} = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

$$r_{14} = 3,56 \text{ mm} \pm 0,13 \text{ mm}$$

$$\alpha_5 = 45^\circ \pm 2^\circ$$

8.3.16 Tapers of the case (figure 6)

8.3.16.1 The top and bottom sides of the case shall be tapered at the front by a curve of radius

$$r_{15} = 145,50 \text{ mm} \pm 0,25 \text{ mm}$$

the centres of which are defined by

$$l_{73} = 26,01 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.16.2 The bottom side of the case shall be tapered at an angle

$$\alpha_6 = 30^\circ 0' \pm 30'$$

The taper shall start at a distance from Reference Plane Z

$$l_{74} = 113,20 \text{ mm} \pm 0,25 \text{ mm}$$

The edges of the taper shall be rounded off with radii

$$r_{16} = 3,05 \text{ mm} \pm 0,25 \text{ mm}$$

$$r_{17} = 1,00 \text{ mm} \pm 0,25 \text{ mm}$$

8.3.16.3 The front side of the case shall be tapered each side of the centreline by the angle α_2

The front edges of the case shall be rounded with radius r_{16} .

8.3.16.4 The rear side of the case shall be tapered above the centreline by the angle

$$\alpha_7 = 3^\circ 0' \pm 30'$$

The top edge shall be rounded with the radius r_{16} .

8.4 Flexibility of the case

The flexibility of the top and bottom sides of the case (see figure 1) is the amount of deflection observed when they are submitted to a perpendicular force F .

8.4.1 Requirements

The amount of deflection d shall meet the following requirements when applying a force F

where $4,5 \text{ N} < F < 54,0 \text{ N}$

Deflection of the top side

$$d \leq 0,38 + 0,054 F$$

Deflection of the bottom side

$$d \leq 0,38 + 0,040 F$$

where d is the measured deflection in millimetres.

8.4.2 Procedure

The flexibility of the case shall be measured in a universal testing machine operating in the compression mode.

Use a suitable load cell for the test.

Apply a single point load with a radius of $10 \text{ mm} \pm 1 \text{ mm}$ to the top side of the case at the point shown in figure 4 and specified by

$$l_{75} = 86,9 \text{ mm nominal}$$

$$l_{76} = 54,5 \text{ mm nominal}$$

Repeat for the bottom side at the point shown in figure 9 and specified by

$$l_{75} \text{ and } l_{76}$$

8.5 Tape reel (figures 12 and 13)

Figures 12 and 13 show the tape reel mounted within the case. Figure 12 specifies the dimensions of the reel when the cartridge is held in the hand. Figure 13 specifies the dimensions when the cartridge is mounted in a drive. For clarity, the stacking ribs are not shown.

8.5.1 Locking mechanism (figures 14 and 15)

This International Standard does not specify the actual implementation of the locking mechanism. Functionally it shall satisfy the following requirements in the locked position:

- the angular resolution shall not be greater than 6° .
- the reel shall not rotate by more than 10° when a torque not greater than $0,32 \text{ N}\cdot\text{m}$ is applied in the direction that will cause the tape to unwind,

The button of the locking mechanism shall be made of nylon 6/6 with $2 \% \pm 1 \%$ molybdenum disulphide. The dimensions of the button shall be

$$d_5 = 2,0 \text{ mm} \pm 0,5 \text{ mm}$$

$$d_6 = 10,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$\alpha_8 = 15^\circ \pm 2^\circ$$

8.5.2 Axis of rotation of the reel

The axis of rotation of the reel shall be perpendicular to Plane P (see 8.5.7) and pass through the centre of the central window as specified by l_{56} and l_{57} .

8.5.3 Metallic insert (figures 12 and 13)

The reel shall have a metallic insert made of stainless steel (ISO 683/XIII Type 3 or 7).

The thickness shall be

$$l_{77} = 1,51 \text{ mm} \pm 0,10 \text{ mm}$$

The outer diameter shall be

$$d_7 = 35,00 \text{ mm} \begin{matrix} + 0,20 \text{ mm} \\ - 1,20 \text{ mm} \end{matrix}$$

The inner diameter shall be

$$d_8 = 11,15 \text{ mm} \pm 0,51 \text{ mm}$$

and shall be concentric with the axis of rotation within $0,15 \text{ mm}$.

The metallic insert shall be parallel to Plane P within $0,15 \text{ mm}$.

It shall withstand a pull out force of 300 N min .

8.5.4 Toothed rim (figure 12)

The reel shall have a toothed rim accessible through the central window; its dimensions shall be

$$d_9 = 36,0 \text{ mm} \begin{matrix} + 0,5 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

$$d_{10} = 41,0 \text{ mm} \pm 0,25 \text{ mm}$$

$$\alpha_9 = 11^\circ 3' \pm 5'$$

8.5.5 Hub of the reel (figure 12)

The diameter of the hub shall be

$$d_{11} = 50,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,2 \text{ mm} \end{matrix}$$

The distance between the flanges of the reel, measured at the surface of the hub, shall be

$$l_{78} = 12,90 \text{ mm} \pm 0,05 \text{ mm}$$

The distance between the flanges, measured at any other radius, shall be

$$l_{79} = 13,46 \text{ mm} \pm 0,20 \text{ mm}$$

The radius at the intersections of the flanges and the outer surface of the hub shall be

$$r_{18} = 0,08 \text{ mm max.}$$

The hub shall meet the following requirements

- the straightness of the hub surface shall be within 0,04 mm
- the perpendicularity to Plane P through the pitch line of the teeth of the rim (see 8.5.7) shall be within 0,07 mm
- for any two sections taken perpendicular to the axis of the hub, the ratio of the differences between the two values of d_{11} to the distances between the sections shall not exceed 0,003 8
- the rate of change across the width of the hub surface shall not exceed 0,025 mm per mm
- the total runout of the hub relative to the cylinder perpendicular to the circular pitch line (see 8.5.7) of the teeth of the toothed rim shall not exceed 0,2 mm total indicator reading (TIR).

8.5.6 Relative positions of hub and case

8.5.6.1 With the cartridge held in the hand (figure 12)

The distance from the tip of the button of the locking mechanism to Reference Plane X shall be

$$l_{80} = 1,91 \text{ mm} \begin{matrix} + 1,40 \text{ mm} \\ - 0,89 \text{ mm} \end{matrix}$$

The distance from the bottom surface of the metallic insert to Reference Plane X shall be

$$l_{81} = 0,41 \text{ mm} \begin{matrix} + 1,00 \text{ mm} \\ - 0,51 \text{ mm} \end{matrix}$$

8.5.6.2 With the cartridge in the hand or in the drive (figures 12 and 13)

The distance from the bottom surface of the metallic insert to Plane P shall be

$$l_{82} = 2,27 \text{ mm} \pm 0,12 \text{ mm}$$

The distance from the inside of the lower flange of the reel, measured at the surface of the hub, to Plane P shall be

$$l_{83} = 0,72 \text{ mm} \pm 0,05 \text{ mm}$$

When measured at any other radius this distance shall be

$$l_{84} = 0,43 \text{ mm} \pm 0,10 \text{ mm}$$

8.5.6.3 With the cartridge in the drive (figure 13)

The distance from the tip of the button of the locking mechanism to Reference Plane X shall be

$$l_{85} = 8,10 \text{ mm} \pm 0,20 \text{ mm}$$

The force required to move the button into this position shall not exceed 12,25 N

The distance from the centreline of the tape to Reference Plane X shall be

$l_{86} = 12,24$ mm nominal

The distance from Reference Plane X to Plane P (see 8.5.7) shall be

$l_{87} = 5,03$ mm $\pm 0,20$ mm

8.5.7 Characteristics of the toothed rim (figure 14)

The toothed rim shall comprise 60 teeth spaced at an angle of

$6^{\circ}0' \pm 5'$ non-cumulative

The teeth are specified at the pitch diameter d_{10} such that the planes at which the lines joining the surfaces of teeth intersect are spaced a distance l_{88} apart

Plane P is defined as being spaced equi-distant between these two planes

$l_{88} = 4,00$ mm $\pm 0,05$ mm

$l_{89} = 2,00$ mm $\pm 0,05$ mm

$\alpha_{10} = 30^{\circ}$ nominal

The pitch line is the circumference of the teeth in Plane P.

The blend radius at the bottom of the teeth shall be

$r_{19} = 0,25$ mm max.

The blend radius at the tips of the teeth shall be defined by

$0,10$ mm $< r_{20} < 0,30$ mm

8.6 Magnetic tape

8.6.1 Tape wind

When the cartridge is viewed from the top side, the tape shall be wound clockwise and with the recording surface away from the hub.

The end of the tape shall not be attached to the hub.

8.6.2 Wind tension

The tape shall be wound with a tension of

$0,31$ N $\pm 0,05$ N

8.6.3 Circumference of the tape reel

The circumference of a wound tape shall be

For	Type A	between	197 mm and 205 mm
	Type B		239 mm and 249 mm
	Type C		297 mm and 314 mm

8.6.4 Moment of inertia

The moment of inertia of the tape reel is the ratio of the torque applied to it (complete with tape, hub and flanges) when it is free to rotate about a given axis, to the angular acceleration thus produced about that axis.

The moment of inertia of the reel and tape shall be:

For the empty reel $36,00 \times 10^{-6}$ kg·m² $\pm 3,63 \times 10^{-6}$ kg·m²

For Type A between 48×10^{-6} kg·m² and 68×10^{-6} kg·m²

Type B 88×10^{-6} kg·m² and 112×10^{-6} kg·m²

Type C 175×10^{-6} kg·m² and 240×10^{-6} kg·m²

Procedure

Torsionally oscillate the reel on an inertial dynamics unit. The period of oscillation shall be measured electronically with a universal counter. Convert the period of oscillation to its rotational value.

8.7 Leader block

8.7.1 Dimensions of the leader block (figures 16 to 24)

The leader block shall have the following dimensions

- $l_{90} = 2,24 \text{ mm} \pm 0,13 \text{ mm}$
- $l_{91} = 31,85 \text{ mm} \pm 0,25 \text{ mm}$
- $l_{92} = 3,18 \text{ mm} \pm 0,03 \text{ mm}$
- $l_{93} = 14,73 \text{ mm} \pm 0,13 \text{ mm}$
- $l_{94} = 6,35 \text{ mm} \pm 0,05 \text{ mm}$
- $l_{95} = 1,27 \text{ mm} \pm 0,13 \text{ mm}$
- $l_{96} = 19,05 \text{ mm} \pm 0,25 \text{ mm}$
- $l_{97} = 27,83 \text{ mm} \pm 0,13 \text{ mm}$
- $l_{98} = 25,00 \text{ mm} \pm 0,10 \text{ mm}$
- $l_{99} = 3,18 \text{ mm} \pm 0,05 \text{ mm}$
- $l_{100} = 3,30 \text{ mm} \pm 0,05 \text{ mm}$
- $l_{101} = 2,03 \text{ mm} \pm 0,05 \text{ mm}$
- $l_{102} = 2,29 \text{ mm} \pm 0,05 \text{ mm}$
- $l_{103} = 9,65 \text{ mm} \pm 0,08 \text{ mm}$
- $r_{21} = 3,30 \text{ mm} \pm 0,25 \text{ mm}$
- $r_{22} = 25,00 \text{ mm} \pm 0,05 \text{ mm}$
- $r_{23} = 1,27 \text{ mm} \pm 0,05 \text{ mm}$
- $r_{24} = 5,00 \text{ mm} \pm 0,25 \text{ mm}$
- $r_{25} = 0,76 \text{ mm} \pm 0,08 \text{ mm}$
- $r_{26} = 0,51 \text{ mm} \pm 0,13 \text{ mm}$
- $d_{12} = 4,57 \text{ mm} \pm 0,05 \text{ mm}$
- $\mu_1 = 45^\circ 0' \pm 30'$
- $\mu_2 = 45^\circ 0' \pm 30'$
- $\mu_3 = 10^\circ 0' \pm 30'$
- $\mu_4 = 15^\circ 0' \pm 30'$

8.7.2 Attachment of the tape to the leader block (figure 24)

There shall be a rectangular insert for attaching the tape to the leader block. It shall cover the full width of the tape over the distance

$l_{104} = 13,97 \text{ mm min.}$ but shall not protrude beyond the surfaces of the leader block.

The bottom edge of the tape shall be parallel to the bottom edge of the leader block within 0,12 mm over the distance

$l_{105} = 914,00 \text{ mm} \pm 2,54 \text{ mm}$ and shall be at a distance

$l_{106} = 1,02 \text{ mm} \pm 0,20 \text{ mm}$

from it, when measured whilst the tape is under a tension within the range 0,29 N to 0,33 N.

The leader block shall remain attached to the tape when a force of 10 N is applied at an angle of $0^\circ \pm 2^\circ$, relative to the plane of the tape.

8.7.3 Latching the leader block

This International Standard does not specify the actual implementation of the latching mechanism for the leader block. It specifies the position of the leader block when latched and the forces required to pull out and insert it.

8.7.3.1 Leader block pickup position

When the leader block is latched into the case, the point defined by l_{98} and l_{99} (see figure 17) shall fall within a circle of radius 0,5 mm max., the centre of which is defined by the intersection of the two lines specified by l_{60} and l_{61} (see figure 4).

8.7.3.2 Leader block insertion force

The insertion force is the force required to push the leader block into its latched position in the case. Its value shall be $4,45 \text{ N} \pm 2,20 \text{ N}$

throughout the insertion angle

$\mu_5 = 45^\circ \pm 2^\circ$ (see figure 23).

Procedure

Clamp the cartridge in a fixture such that the leader block can be inserted by a universal testing machine at values of μ_5 from 43° to 47° (see figure 23).

The universal testing machine shall have a pin that fits into diameter d_{12} and the slot width l_{100} (see figure 17). The leader block shall pivot freely on the pin.

Seat the r_{22} end of the leader block (figure 20) in the opening of the case and latch the r_{21} end of the leader block using a jaw speed of 10 mm/min.

Measure the force required.

8.7.3.3 Leader block pull-out force

The pull-out force is the force required to unlatch the leader block from the case. Its value shall be $4,45 \text{ N} \pm 2,20 \text{ N}$.

Procedure

Clamp the cartridge in a fixture such that the leader block can be extracted by a universal testing machine at values of μ_5 from 43° to 47° .

The universal testing machine shall have a pin that fits into diameter d_{12} and the slot width l_{100} . The leader block shall pivot freely on the pin.

Set the jaw separation speed to 10 mm/min. and pull the leader block out of the case.

Measure the force required.

8.8 Reflection density of the case

8.8.1 Requirement

The reflection density shall be greater than 1,20 D. (see annex H)

8.8.2 Test Equipment

Measurements shall be made using a colour reflection densitometer⁴, which has the following general specification :

- bandwidth Status T bandwidth (380 nm to 780 nm)
- measuring range 0,00 D to 2,50 D
- accuracy $\pm 0,02 \text{ D}$
- repeatability $\pm 0,01 \text{ D}$
- aperture diameter 3,4 mm
- filter Visual

Note 3 - A suitable densitometer is available from X-Rite, Incorporated, 3100 44th Street, S.W., Grandville, Michigan 49418 USA.

Tel. +1-616-534-7663

Fax. +1-616-534-9212

8.8.3 Test method

a) Using the colour reflection reference, check that the densitometer is correctly calibrated,

white shall measure $0,08 \text{ D} \pm 0,02 \text{ D}$

black shall measure $1,78 \text{ D} \pm 0,02 \text{ D}$

If these figures are not achieved, recalibrate the densitometer according to the manufacturer's instructions.

The colour reflection reference shall be stored in its protective envelope when not in use.

b) Take three measurements in label area 4, before a label is affixed, and calculate the average.

Consecutive measurements shall not vary by more than 0,10 D for translucent cartridges or by more than 0,05 D for non-translucent cartridges.

8.9 Colour (figures 3 and 4)

In the areas defined, on the top side by

$$l_{126} = 36,83 \pm 0,25 \text{ mm}$$

$$l_{107} = 35,56 \text{ mm} \pm 0,25 \text{ mm}$$

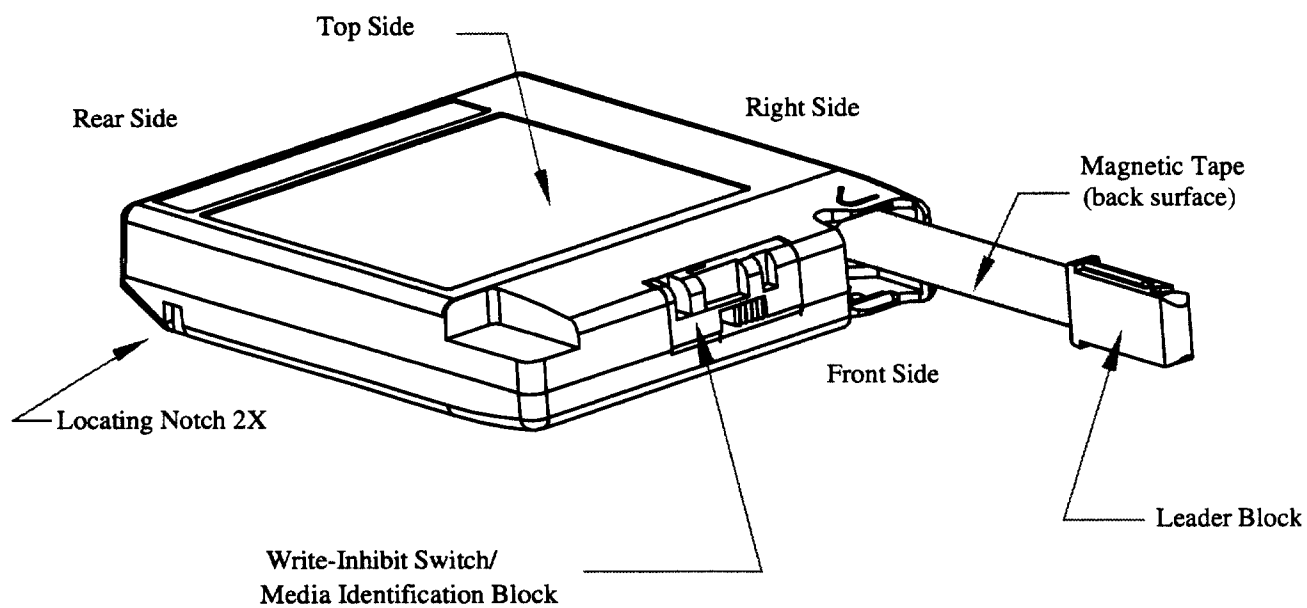
$$l_{108} = 7,62 \text{ mm} \pm 0,25 \text{ mm}$$

and on the front side by l_{107} , l_{126} and

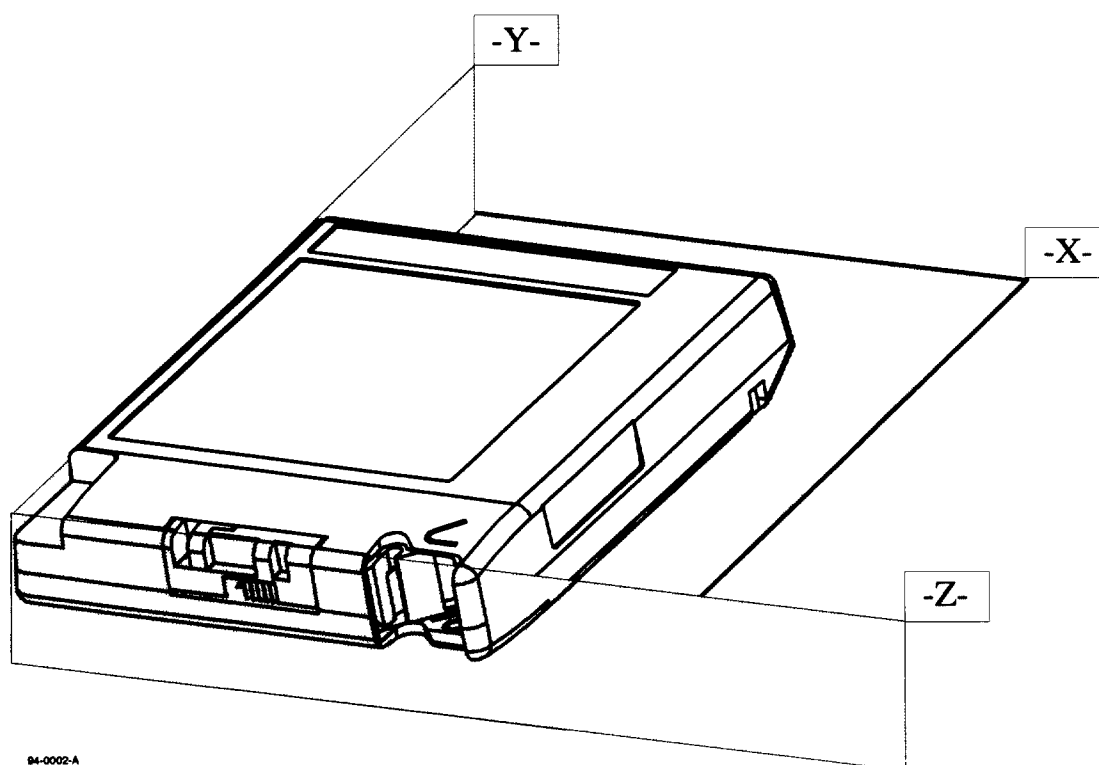
$$l_{109} = 14,43 \text{ mm} \pm 0,25 \text{ mm}$$

the colour shall be red according to PMS 187C (Pantone matching system for colours). The write-inhibit mechanism shall be 100 % Pantone Process Black.

In other areas the colour is not specified, except that the reflection density shall meet the requirements specified in 8.8.



94-0001-A

Figure 1 - General view of the cartridge

94-0002-A

Figure 2 - Reference planes

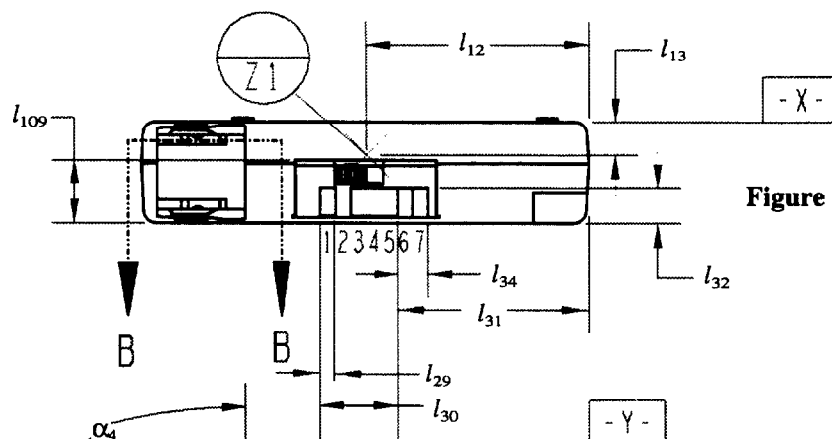


Figure 3 - Front side of case

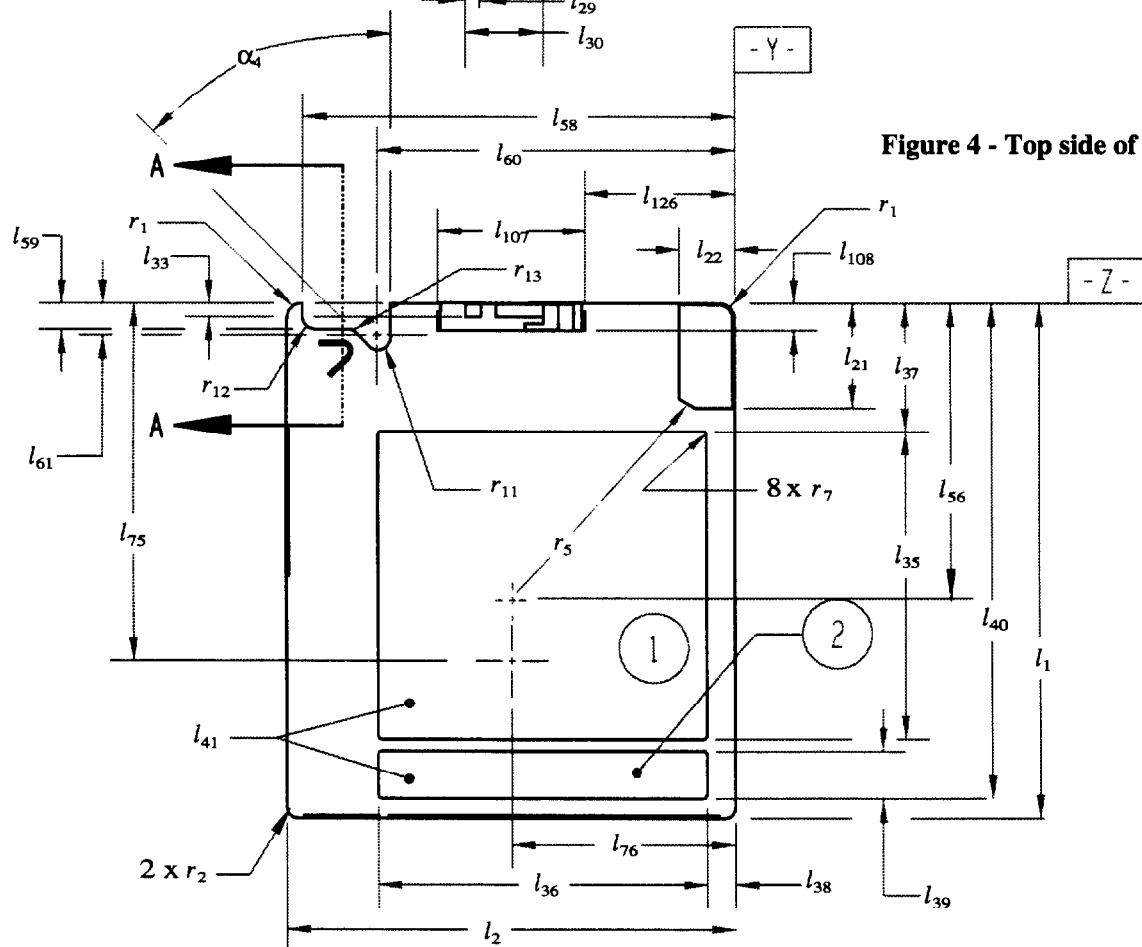


Figure 4 - Top side of case

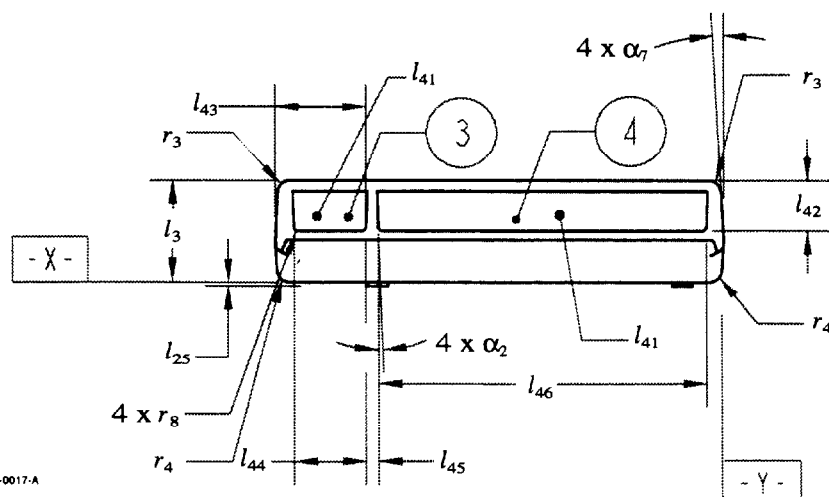


Figure 5 - Rear side of case

94-0017-A

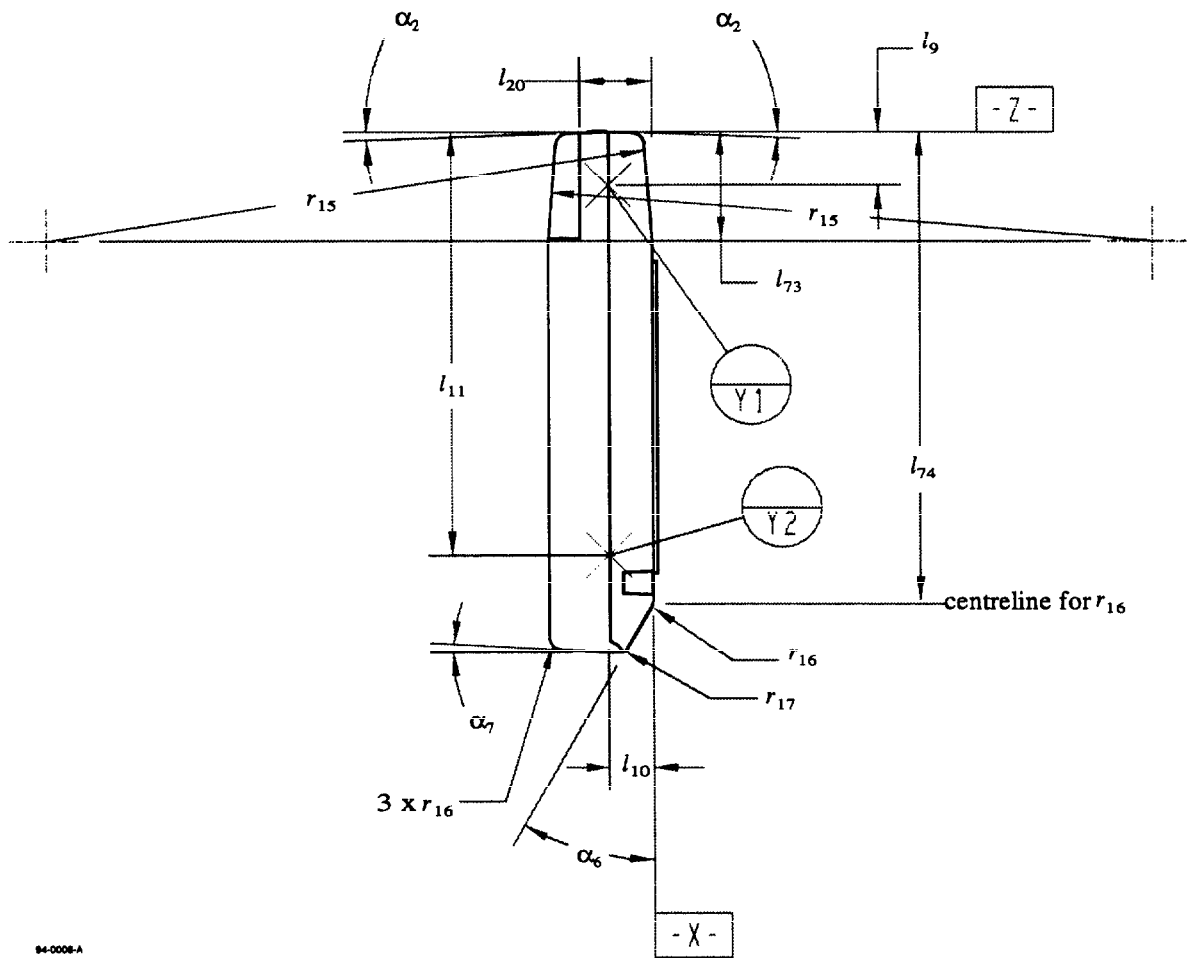


Figure 6 - Left side of case

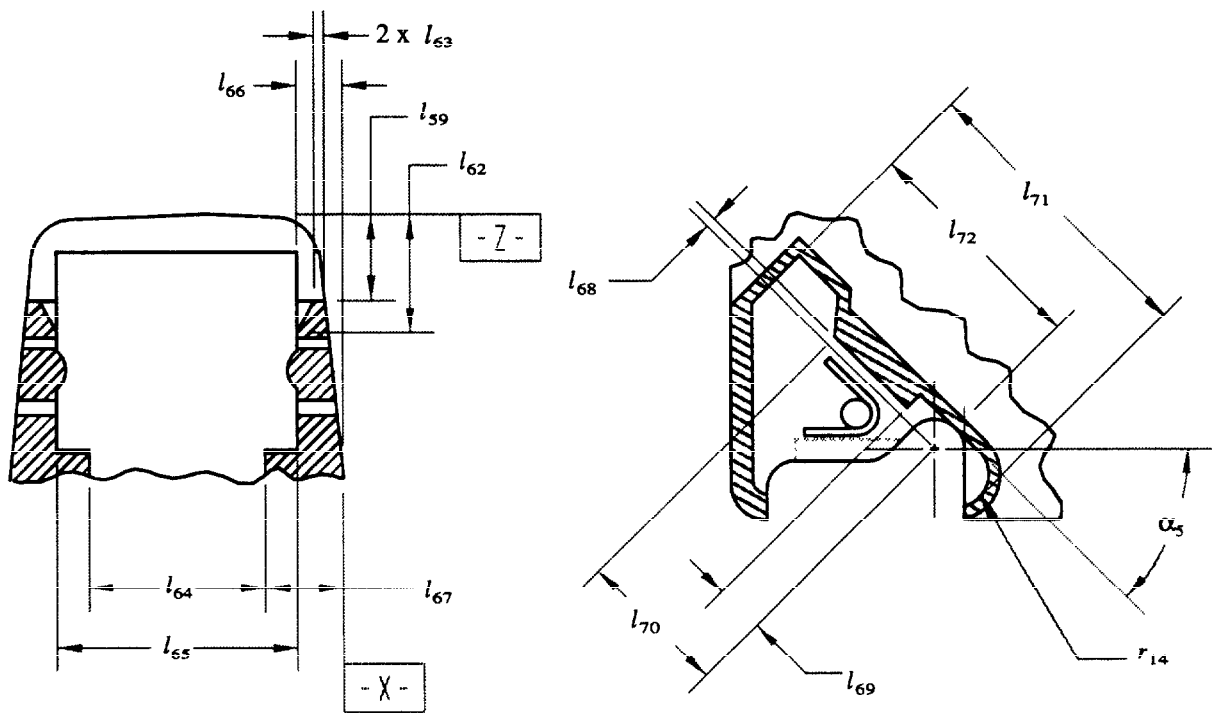


Figure 7 - Section A-A in figure 4

Figure 8 - Section B-B in figure 3

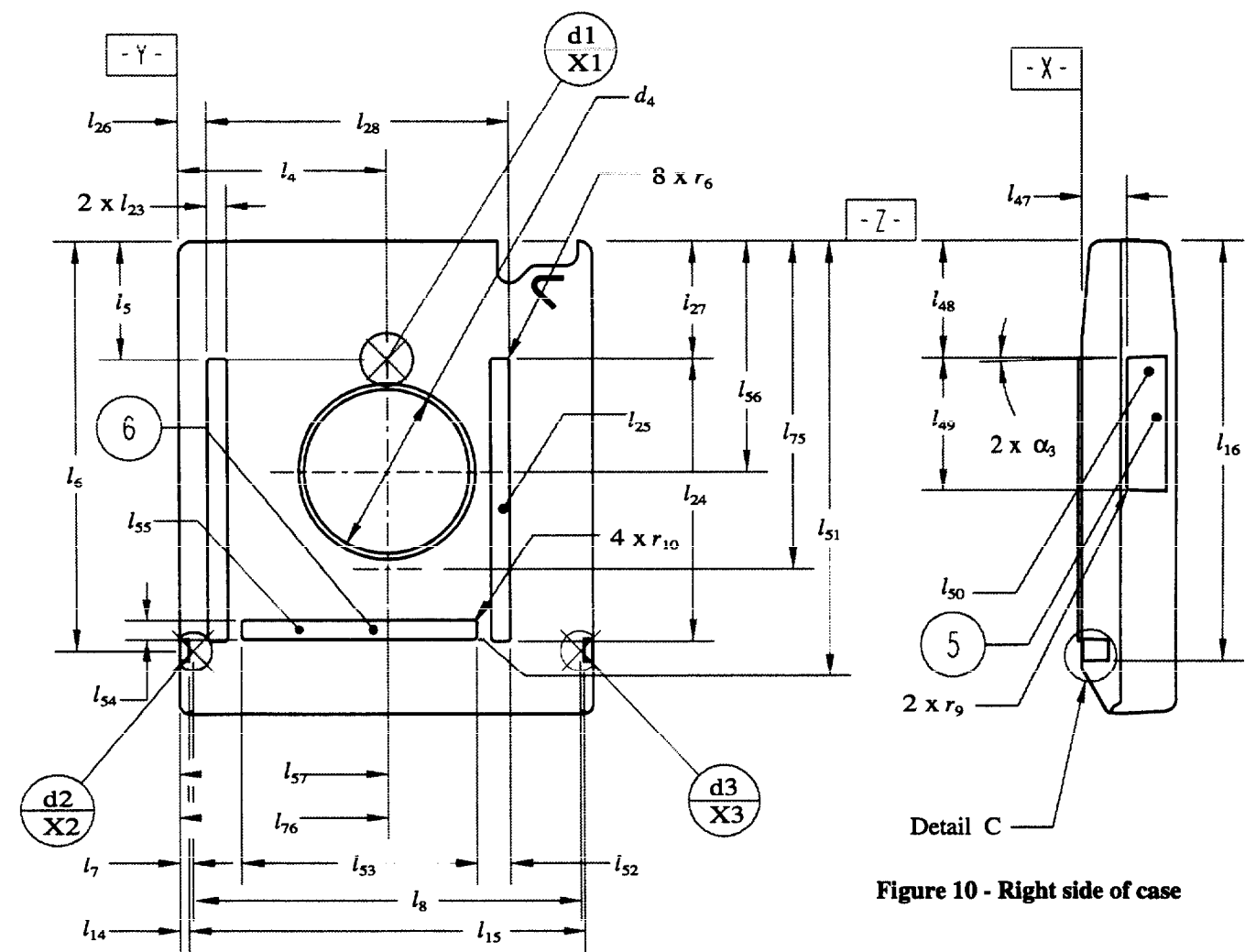


Figure 9 - Bottom side of case

Figure 10 - Right side of case

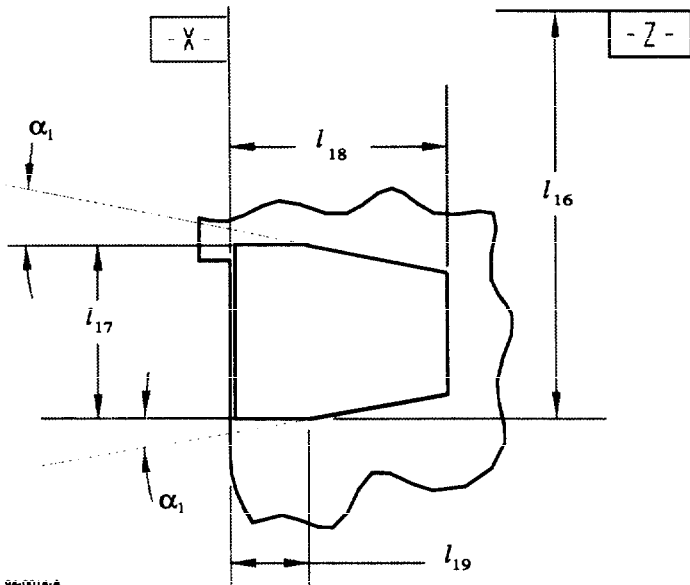


Figure 11 - Detail C of figure 10

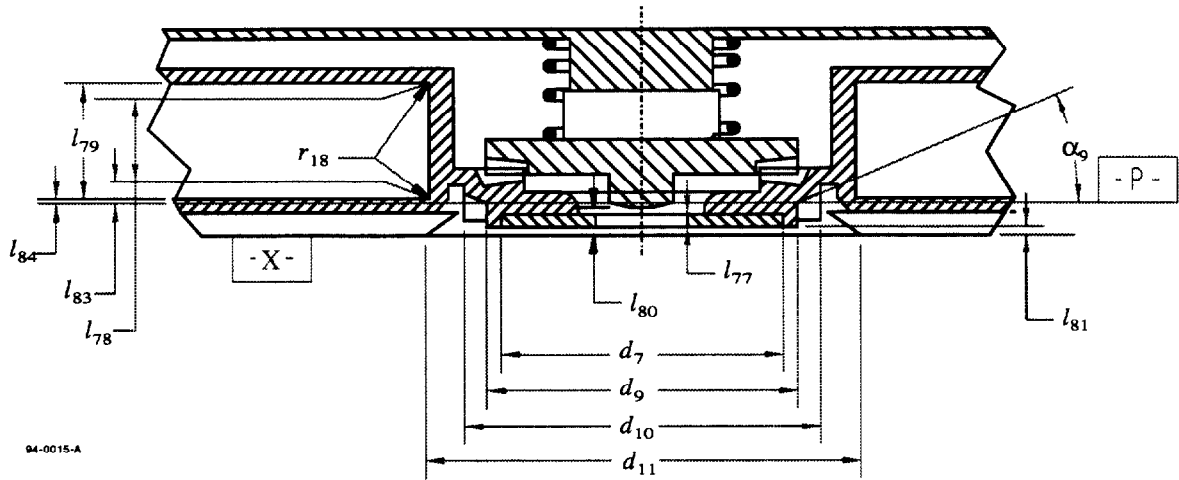


Figure 12 - Cross-section of the cartridge held in the hand

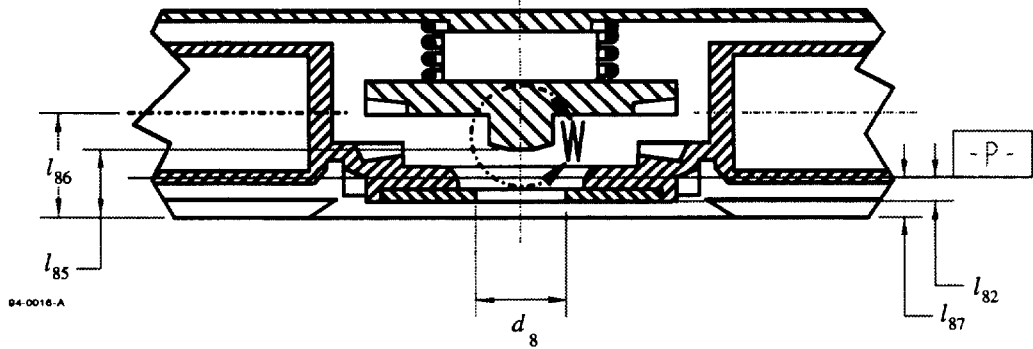


Figure 13 - Cross-section of the cartridge in the drive

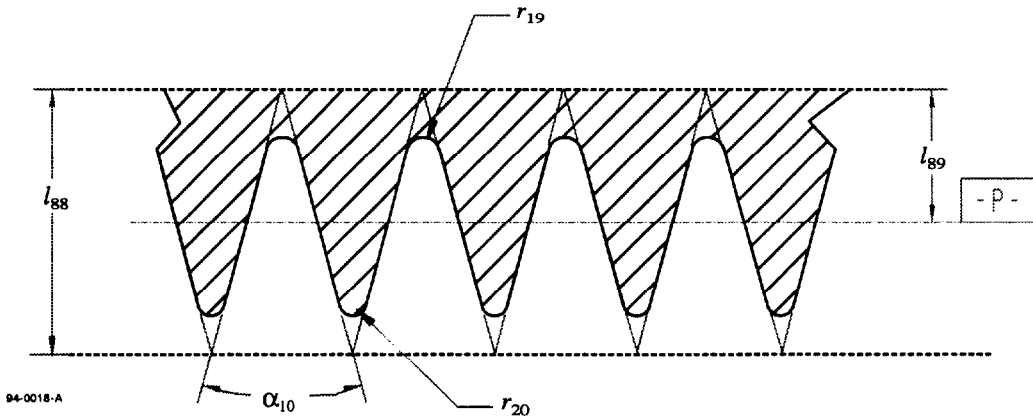


Figure 14 - View at the 41 mm reference diameter showing profile of gear teeth

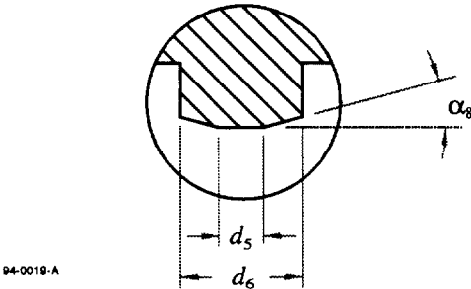


Figure 15 - Detail W of figure 13

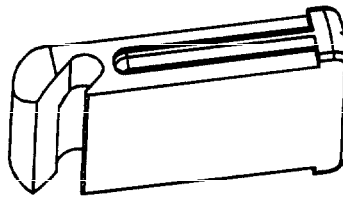


Figure 16 - General view of the leader block

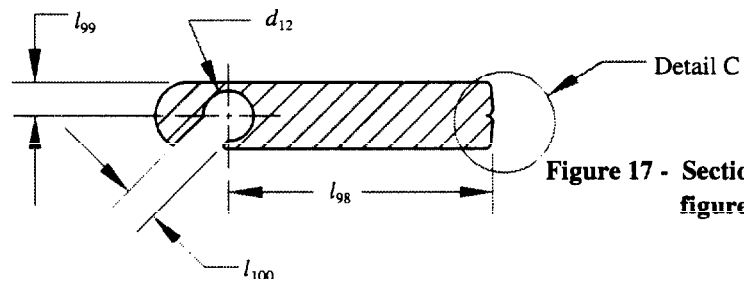
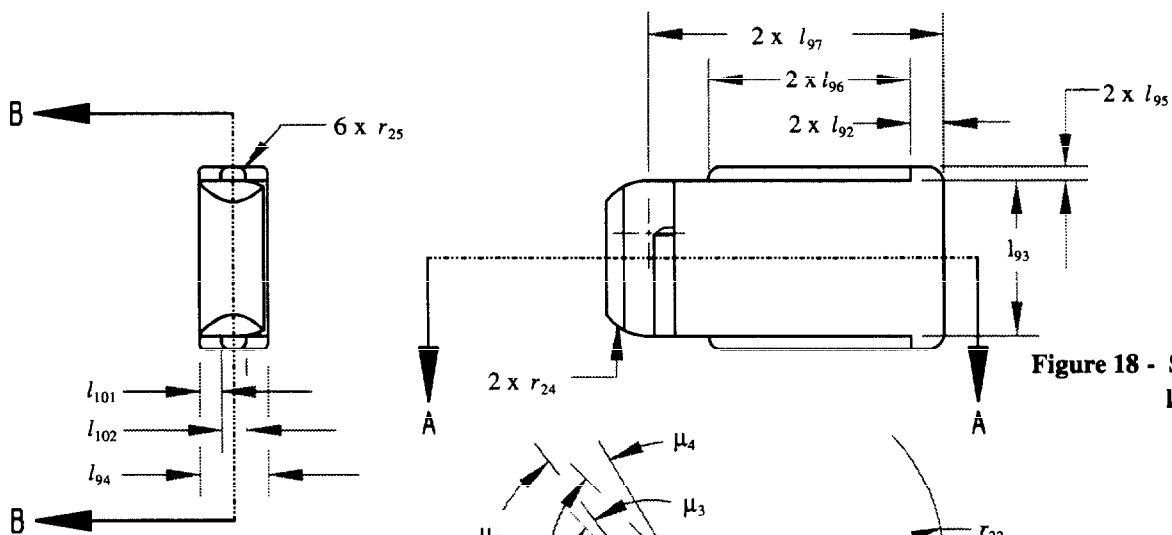
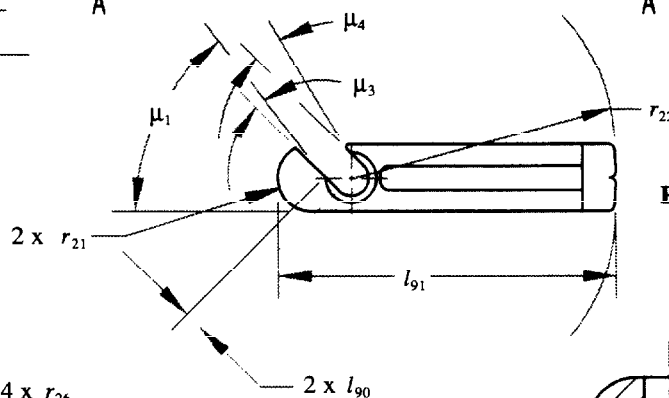
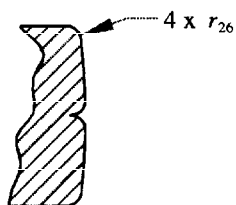
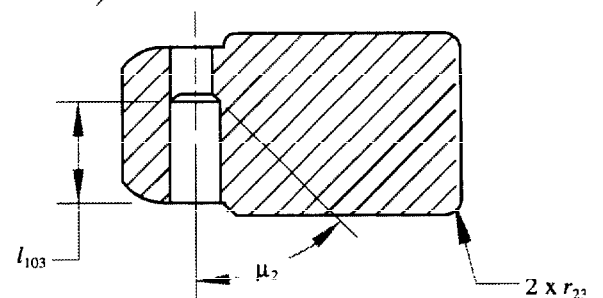
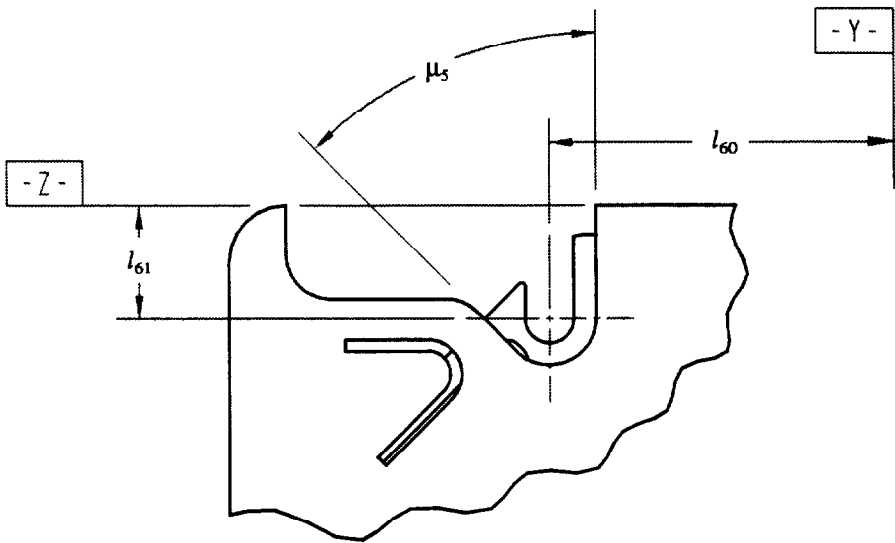
Figure 17 - Section A-A of
figure 18Figure 18 - Side view of
leader blockFigure 19 - Front view of
leader blockFigure 20 - Bottom view of
leader block

Figure 22 - Detail C of figure 17

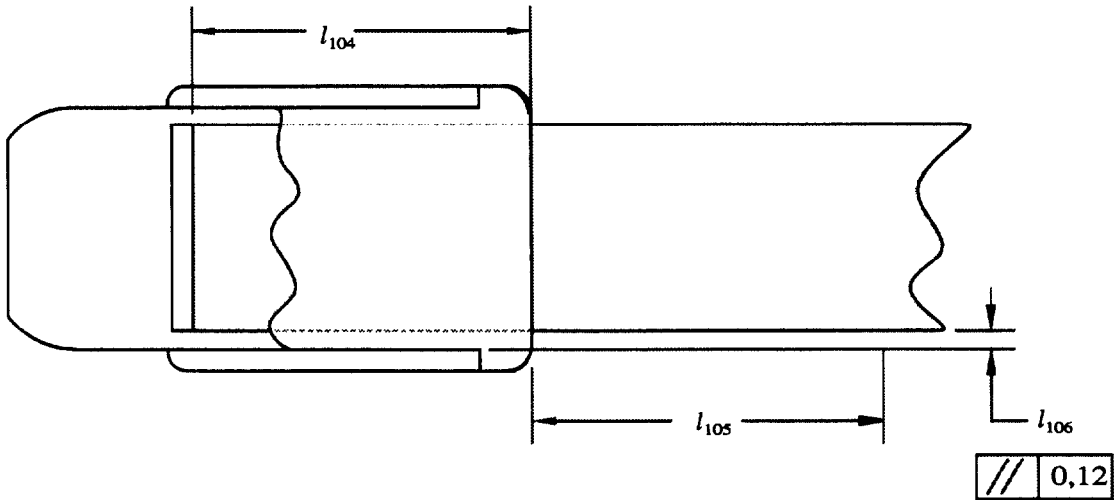
Figure 21 - Section B-B of
figure 19

94-0020-A



94-0021-A

Figure 23 - Details of leader block inserted into the case



94-0022-A

Figure 24 - Mechanical requirements of the leader block assembly

Section 3 - Requirements for the Unrecorded Tape

9 Mechanical, physical and dimensional characteristics of the tape

9.1 Materials

The recordable area of the tape shall consist of a base material (oriented polyethylene terephthalate film or an equivalent) coated on one side with a strong yet flexible layer of ferromagnetic material dispersed in a suitable binder. If the back surface of the tape is coated, only a non-magnetic material shall be used.

9.2 Tape length

The length of magnetic tape between the leader block and the hub shall be in the range

For Type A	: 91,00 m to 95,55 m
For Type B	: 204,00 m to 214,20 m
For Type C	: 392,00 m to 411,60 m

9.3 Tape width

The width shall be measured across the tape from edge to edge. The width of the magnetic tape shall be $W = 12,650 \text{ mm} \pm 0,008 \text{ mm}$. The fluctuations of the tape width shall be no more than $5 \text{ } \mu\text{m}$ peak-to-peak.

Procedure for measuring the width of the tape.

- Cover a section of the tape with a glass microscope slide.
- Measure the width with no tension applied to the tape, using a calibrated microscope, profile projector, or equivalent, having an accuracy of at least $1 \text{ } \mu\text{m}$.
- Repeat the measurement at five or more different positions along a length of tape of 1 m min.
- The tape width is the average of the widths measured.

Procedure for measuring the fluctuations in the width of the tape.

- Cover a section of the tape at BOT with a glass microscope slide, apply a tension of $0,31 \text{ N} \pm 0,05 \text{ N}$ and measure the width as above.
- Repeat 9 times at points separated by 100 mm over the first 900 mm of tape.
- Reject the maximum and minimum values.
- The fluctuation of the tape width is the difference between the maximum and minimum of the remaining 8 measurements.

9.4 BOT and EOT Sense Slots

The BOT and EOT Sense Slots are located as shown in figure 45. The distance of the centreline of the slots from the Tape Reference Edge shall be

$$l_{127} = 6,35 \text{ mm} \pm 0,25 \text{ mm}$$

The dimensions of the slots shall be

$$l_{110} = 4,74 \text{ mm} \pm 0,10 \text{ mm}$$

$$l_{111} = 3,18 \text{ mm} \pm 0,20 \text{ mm}$$

$$r_{27} = 1,590 \text{ mm} \pm 0,050 \text{ mm}$$

9.5 Discontinuities

There shall be no discontinuities in the tape between the BOT and EOT Sense Slots, such as those produced by tape splicing or perforations.

9.6 Thickness

The total thickness of the tape is made up of the base film, the magnetic coating, and the back coating if present.

The total thickness at any point along the length of the tape shall be between $13,0 \text{ } \mu\text{m}$ and $14,0 \text{ } \mu\text{m}$.

9.7 Longitudinal curvature

The radius of curvature of the edge of the tape shall not be less than 33 m.