

# INTERNATIONAL STANDARD

# ISO/IEC 11559

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## Information technology — Data interchange on 12,7 mm wide 18-track magnetic tape cartridges — Extended format

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*Technologies de l'information — Échange de données sur cartouche de  
bande magnétique de 12,7 mm de large à 18 pistes — Format étendu*

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Contents	Page
<b>Section 1 - General</b>	<b>1</b>
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	2
4 Definitions	2
4.1 algorithm	2
4.2 Average Signal Amplitude	2
4.3 back surface	2
4.4 Beginning of Tape (BOT)	2
4.5 byte	2
4.6 cartridge	2
4.7 Cyclic Redundancy Check Character	2
4.8 Data Block	2
4.9 Data Records	2
4.9.1 Processed Data Record (PDR)	2
4.9.2 Host Data Record	2
4.9.3 Logical Data Record (LDR)	3
4.9.4 User Data Record (UDR)	3
4.10 Error Correcting Code	3
4.11 flux transition position	3
4.12 flux transition spacing	3
4.13 magnetic tape	3
4.14 Master Standard Reference Tape	3
4.15 Packet	3
4.16 Packet Identifier	3
4.17 Packet Trailer	3

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4.18	pad byte	3
4.19	physical recording density	3
4.20	Postamble	3
4.21	Preamble	3
4.22	Processed Data	3
4.23	processing	3
4.24	Reference Field	3
4.25	Secondary Standard Reference Tape	3
4.26	Standard Reference Amplitude (SRA)	4
4.27	Standard Reference Current	4
4.28	Test Recording Current	4
4.29	track	4
4.30	Typical Field	4
4.31	transformation	4
5	Conventions and notations	4
5.1	Representation of numbers	4
5.2	Names	4
5.3	Acronyms	4
6	Environment and safety	5
6.1	Cartridge/Tape testing environment	5
6.2	Cartridge operating environment	5
6.3	Cartridge storage environment	5
6.4	Safety requirements	5
6.4.1	Safeness	5
6.4.2	Flammability	5
6.5	Transportation	5
<b>Section 2 - Characteristics of the tape</b>		<b>6</b>
7	Characteristics of the tape	6
7.1	Material	6
7.2	Tape length	6
7.3	Tape width	6
7.4	Tape discontinuity	6
7.5	Total thickness of tape	6
7.6	Base material thickness	6
7.7	Longitudinal curvature	6
7.8	Out-of-plane distortions	6
7.9	Cupping	6
7.10	Dynamic frictional characteristics	7
7.10.1	Frictional drag between the recording surface and the tape back surface	7
7.10.2	Frictional drag between the tape recording surface and ferrite after environmental cycling	7
7.11	Coating adhesion	7
7.12	Flexural rigidity	8
7.13	Electrical resistance of coated surfaces	8
7.14	Tape durability	9
7.15	Inhibitor tape	9

7.16	Tape abrasivity	9
7.17	Pre-recording condition	10
7.18	Magnetic recording characteristics	10
7.18.1	Typical Field	10
7.18.2	Signal amplitude	10
7.18.3	Resolution	10
7.18.4	Overwrite	10
7.18.5	Narrow-band signal-to-noise ratio (NB-SNR)	11
7.19	Tape quality	11
7.19.1	Missing pulses	12
7.19.2	Missing pulse zones	12
7.19.3	Coincident missing pulse zones	12
<b>Section 3 - Cartridge</b>		12
8	Dimensional and mechanical characteristics of the cartridge	12
8.1	Overall dimensions	13
8.2	Write-inhibit mechanism	13
8.3	Label area of the rear side	14
8.4	Label area of the top side	14
8.5	Case opening	14
8.6	Locating notches	15
8.7	Locating areas	15
8.8	Inside configuration of the case around the case opening	15
8.9	Other external dimensions of the case	15
8.10	Central window	16
8.11	Stacking ribs	16
8.12	Flexibility of the case	16
8.12.1	Requirements	16
8.12.2	Procedure	16
8.13	Tape reel	17
8.13.1	Locking mechanism	17
8.13.2	Axis of rotation of the reel	17
8.13.3	Metallic insert	17
8.13.4	Toothed rim	17
8.13.5	Hub of the reel	17
8.13.6	Relative positions	18
8.13.7	Characteristics of the toothed rim	19
8.14	Leader block	19
8.15	Attachment of the tape to the header block	20
8.16	Latching mechanism	20
8.17	Tape wind	20
8.18	Wind tension	20
8.19	Circumference of the tape reel	21
8.20	Moment of inertia	21
<b>Section 4 - Recording method and formats</b>		28
9	Method of recording	28

9.1	Physical recording density	28
9.2	Bit cell length	28
9.3	Average bit cell length	28
9.4	Long-term average bit cell length	28
9.5	Short-term average bit cell length (STA)	28
9.6	Rate of change	28
9.7	Bit shift	28
9.8	Total character skew	29
9.9	Read signal amplitude	29
9.10	Coincident missing pulse zones	29
10	Track format	29
10.1	Number of tracks	29
10.2	Reference edge	29
10.3	Track positions	29
10.4	Track width	29
10.5	Azimuth	30
11	Packet format	30
11.1	Packet elements	30
11.2	Packet ID	30
11.3	UDR	31
11.4	Packet Trailer	31
11.4.1	Packet Trailer when data has been processed	31
11.4.2	Packet Trailer when data has not been processed	31
12	Data Block format	32
12.1	Data Part	32
12.1.1	Packet Bytes	32
12.1.2	Count Field Bytes	32
12.1.3	Block-ID Bytes	32
12.2	Allocation of Data Bytes to frames	33
12.2.1	Prefix Frames	34
12.2.2	Data Frames	34
12.2.3	Residual Frame 1	35
12.2.4	Residual Frame 2	35
12.2.5	Suffix Frames	37
12.3	Error Correcting Code (ECC)	37
12.3.1	Diagonal Redundancy Check (DRC)	38
12.3.2	Vertical Redundancy Check (VRC)	38
12.3.3	ECC Format	38
12.3.4	Summary of ECC2)	39
12.4	Recording of 8-bit bytes on the tape	40
12.5	Recorded Data Block	40
12.5.1	Preamble	40
12.5.2	Beginning of Data Mark (BDM)	41

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<b>12.5.3</b>	<b>Resync Control Frame</b>	<b>41</b>
<b>12.5.4</b>	<b>End of Data Mark (EDM)</b>	<b>41</b>
<b>12.5.5</b>	<b>Postamble</b>	<b>41</b>
<b>12.6</b>	<b>Data Density</b>	<b>41</b>
<b>13</b>	<b>Tape format</b>	<b>41</b>
<b>13.1</b>	<b>Density Identification Burst</b>	<b>42</b>
<b>13.2</b>	<b>ID Separator Burst</b>	<b>42</b>
<b>13.3</b>	<b>Interblock Gaps</b>	<b>42</b>
<b>13.4</b>	<b>Erase Gaps</b>	<b>43</b>
<b>13.4.1</b>	<b>Normal Erase Gaps</b>	<b>43</b>
<b>13.4.2</b>	<b>Elongated Erase Gaps</b>	<b>43</b>
<b>13.5</b>	<b>Tape Marks</b>	<b>43</b>
<b>13.6</b>	<b>Relationship between Interblock Gaps, Erase Gaps and Tape Marks</b>	<b>44</b>
<b>13.6.1</b>	<b>Interblock Gap followed by a Tape Mark</b>	<b>44</b>
<b>13.6.2</b>	<b>Tape Mark followed by an Interblock Gap</b>	<b>44</b>
<b>13.6.3</b>	<b>Interblock Gap followed by an Erase Gap</b>	<b>44</b>
<b>13.6.4</b>	<b>Erase Gap followed by an Interblock Gap</b>	<b>44</b>
<b>13.6.5</b>	<b>Summary of the relationship between Interblock Gaps, Erase Gaps and Tape Marks</b>	<b>45</b>
<b>13.7</b>	<b>First and last recording on the tape</b>	<b>45</b>
<b>13.8</b>	<b>Summary of the tape format</b>	<b>46</b>
<b>13.9</b>	<b>Transform Change Records (TCRs)</b>	<b>47</b>
<b>Annexes</b>	<b></b>	<b></b>
<b>A</b>	<b>Recommendations for transportation</b>	<b>49</b>
<b>B</b>	<b>Inhibitor tape</b>	<b>50</b>
<b>C</b>	<b>Tape abrasivity measurement procedure</b>	<b>51</b>
<b>D</b>	<b>Recommendations on tape durability</b>	<b>53</b>
<b>E</b>	<b>Pre-recording condition</b>	<b>54</b>
<b>F</b>	<b>Representation of 8-bit bytes by 9-bit patterns</b>	<b>55</b>
<b>G</b>	<b>Measurement of bit shift</b>	<b>58</b>
<b>H</b>	<b>Summary of data flow</b>	<b>60</b>
<b>J</b>	<b>Implementation of a CRC</b>	<b>61</b>
<b>K</b>	<b>Calculation of a Physical Position Indicator</b>	<b>62</b>

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 ISO/IEC 11559:1993

## 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 11559 was prepared by European Computer Manufacturers Associations (as ECMA-152) 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 C, E, F, G and K form an integral part of this International Standard. Annexes A, B, D, H and J are for information only.

## Introduction

ISO/IEC 11559 incorporates all the specifications of ISO 9661, together with extensions and modifications which specify the additional features of an extended format that also allows higher capacities to be achieved. The specifications of the tape, cartridge, recorded signal, recording method and most of the recorded format are identical with those in ISO 9661.

It is not intended that this International Standard replaces ISO 9661. Existing drives and cartridges which conform to ISO 9661 will continue to do so and will not conform to all requirements of this International Standard. Drives conforming to this International Standard will be able to write on, and read from, cartridges conforming to ISO 9661.

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# Information technology — Data interchange on 12,7 mm wide 18-track magnetic tape cartridges — Extended format

## Section 1 - General

### 1 Scope

This International Standard specifies the physical and magnetic characteristics of a 12,7 mm wide, 18-track magnetic tape cartridge, to enable interchangeability of such cartridges. It also specifies the quality of the recorded signals, the format and the recording method, thus allowing, together with ISO 1001, full data interchange by means of such magnetic tape cartridges.

The cartridge and recording method are identical with those described in ISO 9661. This International Standard specifies extensions to the transformation of data before it is formatted as in ISO 9661.

These extensions

- specify a method for increasing the utilization of the tape by combining smaller blocks of data into extended blocks;
- specify a method for identifying whether the recorded data has been processed and, if it has been processed, the algorithm used for processing;
- specify a method for including recorded data blocks conforming to this International Standard and recorded data blocks conforming to ISO 9661 on the same tape.

The permissible routes for the flow of data are shown in annex H.

### 2 Conformance

#### 2.1 Magnetic tape cartridge

A magnetic tape cartridge shall be in conformance with this International Standard if

- the cartridge meets all the requirements of clauses 4 and 6 to 8;
- the recording on the tape meets the requirements of clauses 9 to 13;
- for each recorded packet the algorithm used for processing the data therein, if processed data has been recorded, has (have) been registered and the registered identification is included in Byte 13 of the Packet ID Block of this packet (see 11.2).
- Note 1 - If the algorithm has not been registered Byte 13 shall be set to (FF).

#### 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 a tape meet the mandatory requirements of this International Standard. A claim of conformance shall state whether or not one, or more, registered algorithms are implemented and, if so, the registered number(s) of all implemented algorithm(s).

#### 2.3 Receiving system

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

- be able to recognize the occurrence of extended blocks and to identify and retrieve data from individual packets within the extended blocks;
- be able to recognize that the data has been processed, to identify the algorithm(s) used, and to indicate to the host if it cannot restore the data to its original form;

- be capable of restoring to its original form data which has been processed according to zero or more registered algorithms.

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 implemented algorithms.

### 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 edition of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

- ISO 683-13:1986, *Heat-treatable steels, alloy steels and free-cutting steels - Part 13: Wrought stainless steels.*
- ISO 1001:1986, *Information processing - File structure and labelling of magnetic tapes for information interchange.*
- ISO 1302:1992, *Technical drawings - Method of indicating surface texture on drawings.*
- ISO 9661:1986, *Information processing - Data interchange on 12,7 mm (0.5 in) wide magnetic tape cartridges - 18-tracks, 1 491 data bytes per millimetre (37 871 data bytes per inch).*
- ISO/IEC 11576:1993, *Information technology - Procedure for the registration of algorithms for the lossless compression of data.*

### 4 Definitions

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

- 4.1 algorithm:** A set of rules for transforming the logical representation of data.
- 4.2 Average Signal Amplitude:** The average peak-to-peak value of the signal output of the read head measured over a minimum length of track of 25,4 mm exclusive of missing pulses.
- 4.3 back surface:** The surface of the tape opposite the magnetic coating used to record data.
- 4.4 Beginning of Tape (BOT):** The point along the length of the magnetic tape indicated by the start of the Density Identification Burst.
- 4.5 byte:** An ordered set of eight bits acted upon as a unit.
- 4.6 cartridge:** A container holding a supply reel of magnetic tape with an attached leader block.
- 4.7 Cyclic Redundancy Check Character:** A character represented by two bytes, placed at the end of a byte string and used for error detection.
- 4.8 Data Block:** The data entity resulting from concatenating one or more Packets, and appending control information.
- 4.9 Data Records**
- 4.9.1 Processed Data Record (PDR):** The data entity resulting from the application of an algorithm to a Logical Data Record.
- 4.9.2 Host Data Record:** The data entity originally compiled by the host.

**4.9.3 Logical Data Record (LDR):** The data entity received by the system from the host. It may consist of one or several Host Data Record(s) depending upon action taken by the host to use extended blocks.

**4.9.4 User Data Record (UDR):** The data entity available to the Packet former.

When the data has been processed it shall be a PDR.

When the data has not been processed it shall be an LDR.

**4.10 Error Correcting Code:** A mathematical procedure yielding bits used for the detection and correction of errors.

**4.11 flux transition position:** That point which exhibits maximum free-space flux density normal to the surface of the tape.

**4.12 flux transition spacing:** The distance along a track between successive flux transitions.

**4.13 magnetic tape:** A tape which will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.

**4.14 Master Standard Reference Tape:** A tape selected as the standard for Reference Field, Signal Amplitude, Resolution and Overwrite.

Note 2 - A Master Standard Reference Tape has been established at the National Institute for Standards and Technology (NIST).

**4.15 Packet:** A UDR with a Packet Identifier and Packet Trailer added.

**4.16 Packet Identifier:** The group of 32 bytes added to the beginning of a UDR when forming a Packet.

**4.17 Packet Trailer:** The group of bytes of variable size appended to a UDR when forming a Packet.

**4.18 pad byte:** A byte having a bit pattern consisting of eight ZEROs.

**4.19 physical recording density:** The number of recorded flux transitions per unit length of track, expressed in flux transitions per millimetre (ftpm).

**4.20 Postamble:** A repeated 9-bit pattern at the end of a Recorded Data Block providing electronic synchronization when reading in the reverse direction.

**4.21 Preamble:** A repeated 9-bit pattern at the beginning of a Recorded Data Block providing electronic synchronization when reading in the forward direction.

**4.22 Processed Data:** Data which has been processed by an algorithm.

**4.23 processing:** The use of an algorithm.

**4.24 Reference Field:** The Typical Field of the Master Standard Reference Tape.

**4.25 Secondary Standard Reference Tape:** A tape the performance of which is known and stated in relation to that of the Master Standard Reference Tape.

Note 3 - Secondary Standard Reference Tapes have been developed at the National Institute for Standards and Technology (NIST) and will be available from the NIST Office of Standard Reference Materials, Room 205, Building 202, National Institute of Standards and Technology, Gaithersburg, MA 20899, USA, under reference number SRM 3202, until January 2004.

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

**4.26 Standard Reference Amplitude (SRA):** The Average Signal Amplitude from the Master Standard Reference Tape when it is recorded with the Test Recording Current on the NIST measurement system at 972 ftpmm.

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

**4.27 Standard Reference Current:** The current that produces the Reference Field.

**4.28 Test Recording Current:** The current that is 1,5 times the Standard Reference Current.

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

**4.30 Typical Field:** In the plot of the Average Signal Amplitude against the Recording Field at the physical recording density of 972 ftpmm, the minimum field that causes an Average Signal Amplitude equal to 85% of the maximum Average Signal Amplitude.

**4.31 transformation:** The manipulation of Host Data Records before formatting. It includes the operations of Processing, the formation of Packets and the concatenation of Packets.

## 5 Conventions and notations

### 5.1 Representation of numbers

The following conventions and notations apply in this International Standard, unless otherwise stated:

- In each field the bytes shall be arranged with Byte 1, the most significant, first. Within each byte the bits shall be arranged with Bit 1, the most significant, first and Bit 8, the least significant bit, last. This order applies to the data, and to the input and output of the error correcting codes and the cyclic redundancy codes.
- Letters and digits in parentheses represent numbers in hexadecimal notation.
- 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 bit to the left.
- The setting of bits is denoted by ZERO or ONE.

### 5.2 Names

The names of entities are given with a capital initial letter.

### 5.3 Acronyms

BDM	Beginning of Data Mark
BOT	Beginning of Tape
CRC	Cyclic Redundancy Check
DRC	Diagonal Redundancy Check
ECC	Error Correcting Code
EDM	End of Data Mark
ID	Identifier
LDR	Logical Data Record
NB-SNR	Narrow band signal-to-noise ratio
PDR	Processed Data Record
RBW	Resolution BandWidth
SRA	Standard Reference Amplitude
STA	Short Term Average
TCR	Transform Change Record

UDR	User Data Record
VBW	Video BandWidth
VRC	Vertical Redundancy Code

## 6 Environment and safety

Unless otherwise stated, the conditions specified below refer to the ambient conditions in the test or computer room and not to those within the tape equipment.

### 6.1 Cartridge/Tape testing environment

Unless otherwise stated, tests and measurements made on the tape 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

### 6.2 Cartridge 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 40,5 °C.

Note 4 - Localized tape temperatures in excess of 49 °C may cause tape damage.

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.

### 6.3 Cartridge storage environment

Cartridges used for data interchange shall be stored under the following conditions.

temperature:	5 °C to 32 °C
relative humidity:	5 % to 80 %
wet bulb temperature:	26 °C max.

### 6.4 Safety requirements

#### 6.4.1 Safeness

The cartridge and its components shall not constitute any safety or health hazard when used in its intended manner or in any foreseeable misuse in an information processing system.

#### 6.4.2 Flammability

The cartridge and its components shall be made from materials which, if ignited from a match flame, do not continue to burn in a still carbon dioxide atmosphere.

### 6.5 Transportation

This International Standard does not specify parameters for the environment in which cartridges should be transported. Annex A gives some recommendations for transportation.

## Section 2 - Characteristics of the tape

### 7 Characteristics of the tape

#### 7.1 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 ferromagnetic material dispersed in a suitable binder. The back surface of the tape may also be coated with a ferromagnetic or non-ferromagnetic material.

#### 7.2 Tape length

The length of the tape shall not be less than 165 m.

#### 7.3 Tape width

The width of the tape shall be  $12,650 \text{ mm} \pm 0,025 \text{ mm}$ . The width shall be measured across the tape from edge-to-edge when the tape is under a tension of less than 0,28 N.

#### 7.4 Tape discontinuity

There shall be no discontinuities in the tape such as those produced by tape splicing or perforations.

#### 7.5 Total thickness of tape

The total thickness of the tape at any point shall be between 0,025 9 mm and 0,033 7 mm.

#### 7.6 Base material thickness

The thickness of the base material shall be 0,023 4 mm nominal.

#### 7.7 Longitudinal curvature

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

#### Procedure

Allow a 1 m length of tape to unroll and assume its natural curvature on a flat smooth surface. Measure the deviation from a 1 m chord. The deviation shall not be greater than 3,8 mm. This deviation corresponds to the minimum radius of curvature of 33 m if measured over an arc of circle.

#### 7.8 Out-of-plane distortions

All visual evidence of out-of-plane distortion shall be removed when the tape is subjected to a uniform tension of 0,6 N. Out-of-plane distortions are local deformations which cause portions of the tape to deviate from the plane of the surface of the tape. Out-of-plane distortions are most readily observed when the tape is lying on a flat surface under no tension.

#### 7.9 Cupping

The departure across the width of tape from a flat surface shall not exceed 0,3 mm.

#### Procedure:

Cut a  $1,0 \text{ m} \pm 0,1 \text{ m}$  length of tape. Condition it for a minimum of 3 h in the test environment by hanging it so that the coated surface is freely exposed to the test environment. From the centre portion of the conditioned tape cut a test piece of length 25 mm. Stand the test piece on its end in a cylinder which is at least 25 mm high with an inside diameter of  $13,0 \text{ mm} \pm 0,2 \text{ mm}$ . With the cylinder standing on an optical comparator measure the cupping by aligning the edges of the test piece to the reticle and determining the distance from the aligned edges to the corresponding surface of the test piece at its centre.



## 7.10 Dynamic frictional characteristics

In the tests of 7.10.1 and 7.10.2 the specified forces of 1,0 N and 1,50 N, respectively, comprise both the force component of the dynamic friction and the force of 0,64 N applied to the sample of tape.

Note 5 - Particular attention should be given to keeping the surfaces clean.

### 7.10.1 Frictional drag between the recording surface and the tape back surface

The force required to move the recording surface in relation to the back surface shall not be less than 1,0 N.

#### Procedure:

- Wrap a test piece of tape around a 25,4 mm diameter circular mandrel with the back surface of the test piece facing outwards.
- Place a second test piece of tape, with the recording surface facing inwards, around the first test piece for a total wrap angle of 90°.
- Apply a force of 0,64 N to one end of the outer test piece of tape. Secure its other end to a force gauge which is mounted on a motorized linear slide.
- Drive the slide at a speed of 1 mm/s.

### 7.10.2 Frictional drag between the tape recording surface and ferrite after environmental cycling

The force required to move the tape at a point 1,34 m from the leader block of the cartridge shall not be greater than 1,50 N. The force required at a point 4,3 m from the junction of the tape with the cartridge hub shall not exceed the first force by more than a factor of 4.

#### Procedure:

- Wind tape on to a spool hub of diameter 50 mm to an outside diameter of 97 mm with a winding tension of  $2,2 \text{ N} \pm 0,2 \text{ N}$ .
- Repeat the following two steps five times:
  - Store for 48 h at a temperature of 50 °C and a relative humidity of 10% to 20%.
  - Condition in the testing environment for 2 h and rewind with a tension of  $2,2 \text{ N} \pm 0,2 \text{ N}$ .
- Condition the tape for 48 h at a temperature of 30,5 °C and a relative humidity of 85%. The tape shall remain in this environment for steps d) and e).
- Apply a force of 0,64 N to one end of a test piece of not more than 1 m, taken 1,34 m from the leader block. Pass the test piece over a ferrite rod of diameter 25,4 mm with the recording surface in contact with the rod for a total wrap angle of 90°.
 

The rod shall be made from the ferrite specified in annex C. It shall be polished to a roughness value  $R_a$  of 0,05 µm (roughness grade N2, ISO 1302). Pull the other end of the test piece horizontally at 1 mm/s.
- Repeat step d) for a similar test piece taken 4,3 m from the junction of the tape with the cartridge hub.

## 7.11 Coating adhesion

See figure 1.

The force required to peel any part of the coating from the tape base material shall not be less than 1,5 N.

#### Procedure:

- Take a test piece of the tape approximately 380 mm long and scribe a line through the recording coating across the width of the tape 125 mm from one end.