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EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

GUIDELINES ON ADDITIONAL PARAMETERS RECOMMENDED FOR PROCUREMENT SPECIFICATIONS FOR 12,7 mm MAGNETIC TAPES

ECMA TR/36

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TABLE OF CONTENTS

1. SCOPE AND INTRODUCTION

This Technical Report gives guidance on magnetic tape parameters that are considered important to ensure continued good performance of tape systems. When preparing purchasing specifications, these parameters should be considered in addition to parameters included in the Interchange Standard ECMA-62 as they constitute an important part in the description of the product. Whereas this report does not develop a model for a purchasing specification, it does provide a technical presentation of several parameters which should be included.

In performing the procedures outlined in this Technical Report, the Care and Handling Requirements of ECMA Technical Report TR/11 and the test conditions of Section II of ECMA-62 should be strictly observed to give validity to any results obtained and to give a sound basis for any correlation of results between purchaser and supplier. When considering correlation, test conditions should always be accurately reported as even small variations may critically affect the results obtained, e.g. Abrasivity is highly dependent on Relative Humidity.

2. REFERENCES

ECMA-62 : Data Interchange on 12,7 mm 9-Track Magnetic Tapes.

ECMA TR/11 : Guidelines for the Handling and Storage of Magnetic Tapes.

NASA RP-1075 : Magnetic Tape Recording for the Eighties

A. Boese van Groenou and M.I.L. Uijerschout : A quick test on wear of head materials by recording tapes (wear scar) in EIII Transactions on Magnetics, Vol. Mag-19 No 5, Sept. 1983

A. Begelinger and A.W.J. De Gee : Wear measurements using Knoop diamond indentations, in wear, 43 (1977) p. 259-261 Elsevier Sequoia SA, Lausanne

3. DEFINITIONS

3.1 Error

An error is due to the presence of an extra pulse or to the occurrence of a missing pulse.

3.2 Extra Pulse

An extra pulse is a pulse detected on a totally DC erased tape with a base-to-peak amplitude higher than an agreed level (See ECMA-62 Paragraph 5.16.2).

3.3 Missing Pulse

A missing pulse is a pulse detected on a tape written with flux transitions of constant frequency and amplitude with a base-to-peak amplitude lower than an agreed level (See ECMA-62 Paragraph 5.16.1).

3.4 Permanent Error

An error, whether due to a missing pulse or to an extra pulse, which recurs after an agreed number of attempts is made to read the same area of tape.

3.5 Transient Error

An error, whether due to a missing pulse or to an extra pulse, which does not recur after an agreed number of attempts is made to read the same area of tape.

3.6 Physical Recording Density

The number of flux transitions per unit length of track (ftpmm).

3.7 Data Density

The number of data characters stored per unit length of the tape (cpmm).

4. FLEXURAL RIGIDITY (STIFFNESS)

4.1 Definition

The ability of the tape to resist bending.

4.2 Recommendation

The flexural rigidity (EI) of the tape shall be between 0,63 $N.mm^2$ and 0,32 $N.mm^2$.

4.3 Procedure

Clamp a 180 mm sample of tape in a universal testing machine, allowing a 100 mm separation between the machine jaws. Set the jaw separation speed at 5 mm per minute. Plot force against distance. Calculate the flexural rigidity using the slope of the curve between 2,2 N and 6,7 N. The calculation is :

$$E = \frac{\delta F/WT}{\delta L/L}$$

$$I = WT^3 /12$$

$$\text{Flexural rigidity} = \frac{\delta F T^2}{12 \delta L/L}$$

Where :

δF = change in force in N

T = measured thickness in mm

W = measured width in mm

$\delta L/L$ = change in sample length between the jaws divided by original length between the jaws.

5. COATING ADHESION

5.1 Definition

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

5.2 Procedure

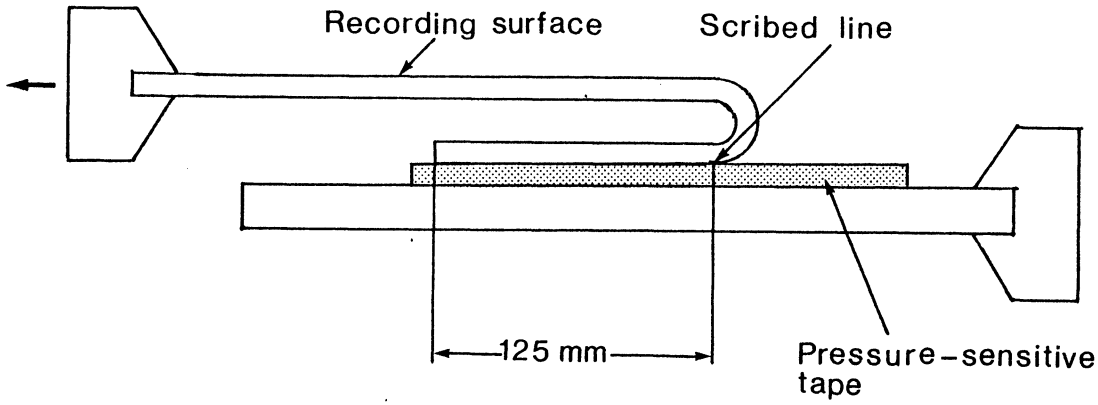
i) Take a sample of the tape approximately 300 mm long and scribe a line through the recording coating across the wrath of the tape 125 mm from one end.

ii) Using a double-sided pressure-sensitive tape, attach the sample to a smooth metal plate, with the recording surface facing the plate.

iii) Fold the sample over 180°, attach the metal plate and the free end of the sample to the jaws of a universal testing machine and set the speed of the jaw separation to 254 mm per min.

iv) Note the force at which any part of the coating first separates from the base material. If this is less than 1,5 N, the test has failed. If the sample peels away from the double-sided pressure sensitive tape before the force exceeds 1,5 N, an alternative type of double-sided pressure sensitive tape shall be used.

v) If the back surface of the tape is coated, repeat i) to iv) for the back coating.



6. INHIBITOR TAPE

6.1 Definition

A tape that reducers affects the performance of the tape drive or other tapes, is called an inhibitor tape.

Certain tape characteristics can contribute to degraded tape drive performance in respect of data performance or in extreme cases, tape drive malfunction (e.g. column vacuum collapse). These characteristics include poor edge conditions such as edge lip (rippled edge), tape creases, excessive tape wear products, interlayer slippage, the tendency of the oxide coating to transfer to the back of the reel's next layer, as well as the tendency for the tape constituents to separate and cause deposits that could give tape stiction or prevent normal

performance of other tapes. Tapes which have any of the above characteristics may not give satisfactory performance and may result in excessive errors. These tapes are known as inhibitor tapes.

The following tests although not exhaustive are designed to test tapes for inhibitor characteristics :

6.2 Abrasivity

6.2.1 Definition

The tendency of the tape to wear the tape drive.

There are several methods of measuring comparative abrasivity involving the following :

i) Brass shim (NASA/1075)
ii) Radio-active trace (NASA/1075)
iii) Thin films (NASA/1075)
iv) Knoop diamond indentation
v) Wear Scar

Whereas the above methods can be reasonably quick and possibly low cost, they only give an indication of potentially abrasive magnetic tapes. Measurements may also be be made using the tape drive and its recording head. The values given in 6.2.2 apply for non-ceramic heads. The procedure in 6.2.3 may be used for any recording heads.

6.2.2 Recommendation

Following the first 1000 full length passes of 732 m of tape, the recording head wear shall not exceed 2,17 um, with a pass being defined as either BOT to EOT or EOT to BOT. This recording head wear shall not exceed 0,64 um for any subsequent 1000, passes and over a total of 30000 passes the recording head wear shall not exceed 19,69 um.

6.2.3 Procedure

Using talysurf equipment or equivalent, perform a profile trace of a new recording head across both the read and write heads at their respective gaps. Mount the recording head assembly onto the tape drive and perform routine maintenance and cleaning to ensure correct tape tensions and to minimise the influence of contaminants. Cycle the tape under test for 200 full length passes, using stop-start times of 5 ms while cleaning at the end of each 50 full length passes. At the end of 200 passes, perform a second profile trace to obtain an early indication of the abrasivity but noting that the head wear is usually greatest during the first few passes. Using the same recording head, perform the same procedure for a further 800 passes using four additional tapes of the same tape formulation to obtain a profile trace at 1000 passes. If the average wear is in excess of the requirement at 1000 passes the test should be continued to a total of 30000 passes. For this continued test, profile traces need only be taken at each 1000 pass point or until it is established that the tape formulation under test has excessive abrasivity.

6.3 Stick/Slip

6.3.1 Definition

This property of the tape is assessed by observing the velocity profile of the tape after the initiation of a GO signal. Variations in the velocity profile may lead to data errors due to stick or slip conditions between the tape and the recording head, capstan or any other contacting surface.

6.3.2 Recommendation

At the end of the first pass in the test described below, the velocity profile of the reverse start at the end of tape shall be free of inflection points (i.e. no erratic motion and/or glitches) between 10 % and 90 % of nominal velocity during reverse acceleration. In determining inflection points, comparison should be made to the velocity profile of the forward start. The time taken to reach 90 % of nominal velocity from initiation of a GO signal shall not be greater than 125 % a reverse start performed in the region of BOT.

The above recommendation shall hold for the Testing Environment of ECMA-62 and when the tape is stress conditioned as follows :

i) Write the tape continuously at 356 ftpmm to the EOT marker.

ii) Stress-condition the tape at 48°C and 80 % Relative Humidity for 48 hours in a suitable environmental chamber.

iii) Acclimatise in the Testing Environment for 24 hours.

6.3.3 Procedure

Clean the tape drive in accordance with its maintenance manual. Write the tape continuously at 356 ftpmm for 10 metres and measure the time taken to reach 90 % of the nominal velocity from the initiation of a GO signal for a reverse start. Write the tape continuously at 356 ftpmm to the EOT marker and leave the tape loaded and stationary for 5 minutes, then again measure the time taken to reach 90 % of nominal velocity from initiation of a GO signal for reverse start.

6.4 Contamination

6.4.1 Definition

A tape which causes variation in signal amplitudes due to tape material which separates the tape from the head.

6.4.2 Recommendation

The average signal amplitude from the second pass shall be at least 90 % of that measured at corresponding points during the first pass.

6.4.3 Procedure

Clean the tape transport in accordance with its maintenance manual. No further cleaning should be performed during this

test. On the first pass, measure the read-while-write amplitude at 126 ftpmm on two tracks adjacent to the centre track (e.g. tracks 4 and 6) at the beginning of the tape and at the end of the tape.

Unload the tape and stress-condition the tape for 24 hours at 52 °C and 15 % Relative Humidity before acclimatising for 24 hours at the test environment. Repeat measurements for read-while-write amplitudes at the beginning of the tape and the end of tape on the same two tracks.

7. DURABILITY

7.1 Short-Length

7.1.1 Definition

The ability of the tape to withstand the wearing action encountered during repeated reading of a short file of data.

7.1.2 Recommendation

Under the conditions of the following test procedure, the tape should average at least 40000 read passes before a permanent error is encountered.

7.1.3 Procedure

Write a length of tape from BOT with 10 records of 2000 characters each, phase-encoded recording. No write errors are allowed during the write pass. Then read the 10 records (read forward/rewind) repeatedly until a permanent read error occurs. The test is to be performed with sufficient stop time (e.g. 20,0 milliseconds) to ensure that the tape comes to a complete stop for each record.

7.2 Long-Length

7.2.1 Definition

The ability of the tape to resist the wearing action encountered while cycling full length on a tape drive.

7.2.2 Recommendation

At least 90 % of the tapes tested should meet the following criterion :

Tapes tested for use at 126 ftpmm should not average more than three write errors per pass, or exceed ten write errors on any single pass for a minimum of 200 forward passes on tape drives that operate at 126 ftpmm.

7.2.3 Procedure

Write a 732 m length of tape in start/stop mode with 2000-character records using phase-encoded recording on each pass. Record the number of write errors and repeat until 200 passes have been completed. In order to determine the effect of wear particles generated during the test do not clean the tape drive between passes.

8. TAPE PERFORMANCE

8.1 Definition

Tape performance is a quality criterion of the tape over its life-time. It is derived from the error behaviour of the tape.

ECMA-62, clause 5.16 defines the parameters missing and extra pulses while identifying reasons why acceptable numbers are not specified. These reasons should be carefully noted when checking tape quality.

Data corruption due to missing and extra pulses will cause loss of time when writing data, due to write-error recovery procedures and will also cause a related loss of time when reading data. Generally a moderate number of such errors is acceptable to the user and later in this paragraph guidelines to acceptable numbers are quoted. There are conditions, however, e.g. when the tape may be repeatedly accessed in the same area, when any errors would, or could, result in unacceptable loss in performance. Where a large number of errors are noted, this is often indicative of poor surface quality and there is a strong likelihood of early deterioration in use.

Errors fall into two categories, known as transient or permanent errors. There is commercially available equipment for measuring permanent and transient errors known as tape certifiers and evaluators although variation in numbers of the above errors reported may vary from one device to another. It is important therefore that in discussing numbers of errors a careful correlation exercise takes place and that such equipment is fully maintained to ensure its on-going quality of operation.

It is worth noting that many tape systems provide Volume Error Statistics that give information on tape errors. While they are extremely useful for tapes in system usage and give an alternative method of assessing tape performance, for testing new tapes this may be wasteful on system time and potentially a risk to the system if the tapes have any inhibiting characteristics.

8.2 Recommendation

Guidelines for numbers of transient and permanent errors allowable one new tapes are as follows :

8.2.1 At 126 ftpmm Physical Recording Density

8.2.1.1 Permanent Missing Pulses

A tape of 732 m length shall not have more than 7 permanent missing pulses.

A tape of 366 m length shall not have more than 4 permanent missing pulses.

8.2.1.2 Transient Missing Pulse

A tape of 732 m length shall not have more than 30 transient missing pulses.

A tape of 366 m length shall not have more than 15 transient missing pulses.

8.2.1.3 Permanent Extra Pulses

A tape of 732 m length shall not have more than 7 permanent extra pulses.

A tape of 366 m length shall not have more than 4 permanent extra pulses.

8.2.1.4 Transient Extra Pulses

Tape irregularities which cause transient extra pulses are not known. Transient extra pulses are usually generated by electronic noise.

8.2.2 At 356 ftpmm Physical Recording Density

8.2.2.1 Permanent Missing Pulses

The number of permanent missing pulses shall not exceed those in the following Table.

Tape Length	Errors on		
	One Track	Two Tracks	Three Tracks
732 m	50	5	5
366 m	30	3	3

8.2.2.2 Transient Missing Pulses

Tapes of 732 m length shall not have more than 100 transient missing pulses on one track.

Tapes of 366 m length shall not have more than 60 transient missing pulses on one track.

8.2.2.3 Using Volume Error Statistics (For Library Tapes only)

732 m length tapes with more than 20 erase gaps are not recommended.

366 m length tapes with more than 10 erase gaps are not recommended.

8.3 Procedures

8.3.1 Using a Tape Certifier

For each tape to be tested clean the test equipment and perform a full length retension cycle of the tape. If the test equipment checks for errors in the reverse direction, the pass from BOT to EOT is considered adequate retensioning. Otherwise a two pass cycle is required.

Following retensioning, perform full length passes to obtain the number of transient and permanent errors while writing an all ONEs pattern at both 126 ftpmm and 356 ftpmm. Compare the results with the requirements of 8.2.

8.3.2 Using Volume Error Statistics

Use an appropriate tape drive and associated tape control. Clean the tape drive and write the tape full length in start/stop with an average block length of 38,1 mm. By use of Volume Error Statistics, compare the tape performance with the requirements of 8.2.2.3.