IBM

TAPE REQUIREMENTS FOR IBM ONE-HALF INCH TAPE UNITS AT: 556, 800, 1600 AND 6250 BPI

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Introduction

This manual is in two parts; the General Information is presented in Part 1. Part 2 contains recommendations for enhanced performance of tape, and requirements of minimum tape properties for use on IBM tape units.

In the text, the term 24XX is used to mean all models of the IBM 2401, 2402, 2403, 2404, 2415, and 2420 Tape Units. The term 34XX is used to mean all models of the IBM 3420, 3410 and 3411 Tape Units. The term 8809 is used to mean all models of the 8809 Tape Unit.

Part 1. General Information

This part contains information regarding compatibility, testing environment, and recording densities.

A. Compatibility Test

A tape tested for use at 9042 fci must also operate at 3200 fci and at 800 fci on seven-track or nine-track tape units. A tape tested at 3200 fci must also operate at 800 fci on seven-track or nine-track tape units and at 556 fci on seven-track tape units. A tape tested for 800 fci for seven-track or nine-track tape units must also operate at 556 fci on seven-track tape units.

B. Conditioning Prior to Testing or Use

Before testing or use, condition tapes by exposure to the testing environment for 24 hours.

C. Testing Environment

Unless otherwise specified, perform all tests in a room held at 70° + 10°, −5°F (21° + 4°, −2°C), and 50% ± 10% relative humidity.

D. Recording Density

When testing, hold all recording densities, 556 (21.9), 800 (31.5), 3014 (118.7), 3200 (126.0), and 9042 (356.0) flux changes per inch (flux changes per millimeter), to a tolerance of ± 5% when measured with continuous tape motion.

Part 2. Tape Properties Essential for IBM Tape Unit Use

This part lists as requirements those properties deemed essential for a tape to operate satisfactorily on IBM Tape Units. These properties have been established in the testing of magnetic tape and experience has demonstrated that tape which meets these test requirements will normally perform satisfactorily with a two meter-hour cleaning cycle on IBM Tape Units.

Further testing experience may indicate that changes are advisable. These requirements may be revised by IBM from time to time without notice.

The following recommendations are provided as suggestions for achieving optimum performance.

A. Physical Properties

1. Tape Assembly

Description—The tape assembly consists of a reel, tape, tape end retainer, write-enable ring, and appropriately located reflective markers.

Requirement—The reel dimension must fall within the envelope defined by Table 1 and Figure 2. The write-enable ring should conform to the dimensions specified in Table 2 and Figure 3. The size and location of the reflective markers received from the manufacturer should be those in Figure 1. When fabricated, the tape reel specified by Table 1 and Figure 2 must be an integral unit.

2. Discontinuity

Definition—Any interruption in the tape such as that produced by splicing or perforations.

Requirement—There will be no discontinuities.

3. Width

Definition—The width of the tape measured at right angles to the edges.

Requirement—The width of the tape will be 0.498 ± 0.002 inch (12.65 ± 0.05 mm).

4. Thickness

Definition—The thickness of the different layers comprising the tape.

Requirement—The total thickness of the tape will be between 1.6 and 2.2 mils (0.0406 and 0.0559 mm). Nominal base thickness will be 1.42 mils (0.0361 mm) ± 10%.

5. E Value

Definition—The radial distance by which the reel flanges extend beyond the outermost layer of tape.

Requirement—The E value will be greater than 1/8 inch (3.18 mm). For tape units which use automatic loading cartridges, the E value must be greater than 1/4 inch (6.35 mm), but no greater than 5/8 inch (15.88 mm).

6. **Magnetic Surface Resistance**

Definition—The electrical resistance of the magnetic coating.

Requirement—The magnetic surface resistance shall be greater than 5×10^5 but shall not exceed 5×10^8 ohms per square area.

Procedure—After 12 hours' exposure to the test environment (see Part 1, section C), place the sample tape between gold-plated electrodes such that the magnetic coating is in contact with all of the electrodes. In mounting the specimen for measurement, make sure that no conducting paths exist between the electrodes except those through the magnetic coating. Place the samples under 160 ± 16 grams tension. Be careful not to contaminate the specimen or insulating surface (such as by handling with bare fingers); it is recommended that clean, lint-free gloves be used during all measurements. Determine the surface resistance from the current flow resulting from a 500-volt potential. See also, ASTM D257 (*American Society for Testing and Materials Manual*).

7. **Magnetic Coating Roughness**

Definition—The average peak-to-peak surface irregularity.

Requirement—The roughness of the oxide surface shall not exceed six microinches (0.152 micrometers), but must be a minimum of 1.75 microinches (0.045 micrometers) CLA (Center Line Average) in both the longitudinal and transverse directions, using a cut-off wavelength of 0.030 inch (0.76 mm).

8. **Frictional Drag–Magnetic Coating to Brass or Chromium**

Definition—The resistance of the tape to motion on brass or chromium.

Requirement—The dynamic frictional drag shall be a maximum of 130 grams.

Procedure—At 2 inches (50 mm) per minute, pull the sample up over a one-inch (25 mm) diameter brass cylinder (90° wrap), with a 65-gram weight suspended on the other end of the tape. Plot force versus time (or force versus distance) on a recorder. Repeat using a chromium-plated cylinder. Give particular attention to keeping the samples clean (do not handle with bare fingers), and to maintaining the cylinder finishes (5–10 microinches or 0.127–0.254 micrometers peak-to-peak).

9. **Frictional Drag–Magnetic Coating to Back Surface**

Definition—The resistance of the tape coating to motion on the back surface of tape.

Requirement—The dynamic friction drag shall be a minimum of 80 grams.

Procedure—Secure a sample of tape to a 1-inch (25 mm) diameter cylinder so that the back surface of tape is exposed. At 2 inches (50 mm) per minute, pull the coating surface of another piece of sample tape up over the tape-covered cylinder (90° wrap) with a 65-gram weight suspended on the free end of the tape. Plot force versus time (or force versus distance) on a recorder.

10. Back Surface and Marker Reflectivity

Definition—The percent reflectivity possessed by the back surface of the tape and the photo reflective marker compared to a reference standard at an incident light angle of 60°.

Requirement—The reflectivity of the back surface of the magnetic tape shall not exceed 30% of the reflectivity of the standard. The reflectivity of the marker shall be greater than 90% of the reflectivity of the standard.

Procedure—Provide a reflectivity standard of 6061T6 (Al–Mg1SiCu) aluminum (see ISO/R 209—1971, *International Standards Organization/Recommendation*) with a flat face dimension of 1.2 by 0.20 inch (30 by 5 mm) with a surface finish of between 0.3 and 0.6 microinch (0.008 and 0.015 micrometer) CLA. (See ISO/R 460—1966.) Resurface the standard periodically to prevent a reflectivity shift due to oxidation.

Provide a fixture which seats the reflectivity standard and the tape under test in the same plane. Take care to ensure that ambient light does not enter the measuring photocell.

The light source shall be an incandescent lamp with a color temperature of 2600° Kelvin.

Measure and note the reflectivity of the standard.

Measure the reflectivity of the back surface and marker of the tape being tested.

Compare the tape back surface and marker reflectivity (expressed in percent) to the reflectivity of the standard.

11. Opacity

Definition—A characteristic which limits the transmission of light through the tape.

Requirement—The opacity of the tape shall not be less than 95% over the range of wavelengths given below.

Procedure—Measure the tape with a light source and detection system capable of working the complete range from 0.4 micrometers to 1.5 micrometers. The effective opacity of a tape sample may be measured by obtaining the ratio of the detector resistance with and without a single layer of tape inserted in the measuring device.

12. Coating Integrity Failure

Definition—The adhesive or cohesive failure of the oxide coating and/or back surface.

Requirement—There shall be no coating integrity failures.

Procedure—Record the tape sample (2400 feet, 732m) with continuous ones on all tracks at 3200 fci on a 3420 Model 7 tape unit. Rewind and read back, noting all bits (if any) which do not reproduce at an output level of at least 35% of the IBM Standard Signal Level Tape, part 461108A. Wind the tape on a reel which conforms to Figure 2. Store at 120°F(49°C)/40% relative humidity for 40 hours. Recondition by storing at operating environment for 24 hours. Read back the tape and note whether any additional defects have occurred. If so, examine the defective areas to determine if an integrity failure has occurred.

13. Curvature

Definition—A departure from a straight line of the longitudinal dimension of the tape in the plane of the surface of the tape.

Requirement—Any deviation from a straight line shall be gradual and shall not exceed 1/8 inch per 36-inch, or 3.2 mm per 1-meter, length of tape.

Procedure—Allow a 36-inch or 1-meter length of tape to assume its natural shape on a flat smooth surface. Measure the deviation of either edge of the tape from a straight line.

14. Cupping

Definition—The departure across the width of tape from a flat surface.

Requirement—The maximum cupping of a 1/4-inch (6.35 mm) long sample shall not exceed .010 inch (0.25 mm) when placed with concave side down on a smooth flat surface.

Procedure—Measure in a free state one hour or longer after sample has been cut.

15. Secant Modulus (Elasticity)

Definition—The ratio of stress to strain at a specified point on the stress-strain curve.

Requirement—The secant modulus will be greater than 3.25×10^5 psi (228,5 kgf/mm^2) based on a 10-inch (254.0 mm) sample length, a 2–10 inch (50.8–254.0 mm) per minute crosshead speed, and the slope of the curve between 2.5 and 7.5 pounds (11,12 and 33,36N) load. Also, see ASTM D882 and ASTM D638.

16. Yield Strength

Definition—The first stress level on the stress/strain curve at which the slope of the curve becomes zero when the test is conducted on a machine having a constant rate of cross-head movement. A marked increase in strain occurs at this level without a stress increase.

Requirement—The yield strength shall be a minimum of 10,000 psi (7 kgf/mm^2) when tested to ASTM D638.

17. Stress Relaxation

Definition—The time-dependent change in stress resulting from the application of constant strain.

Requirement—Using a 5-pound (22N) initial load and a 10-inch (254 mm) sample length, the stress relaxation will be less than one pound (4.4N) after 15 minutes.

Procedure—At 0.5 inch (12.7 mm) per minute cross-head speed, apply sufficient strain to a 10-inch (254 mm) long sample to result in a 5-pound (22N) load. Maintain this strain for 15 minutes. Stress relaxation is the difference between the initial load and the load after 15 minutes. See also ASTM D674.

18. Flexural Rigidity

Definition—Ability of the tape to resist bending.

Requirement—Flexural rigidity (EI) of the tape shall not exceed 2.2×10^{-4} psi (6.4×10^{-4} kgf/cm^2), must be a minimum of 1.1×10^{-4} lbs-force-in^2 (3.2×10^{-4} kgf/cm^2).

Procedure—Pull a 0.125 inch (3.175 mm) longitudinal dogbone sample (ASTM D412, Type D) using a cross-head speed of 0.2 inches/minute (5.1 mm/minute). Calculate the flexural rigidity using the slope of the curve between 1/8 pound (57 grams) and 3/8 pound (170 grams).

19. Reel Moment of Inertia

Requirement—The moment of inertia of the tape reel, complete with tape and write-enable ring, should not exceed 0.091 inch-pounds sec^2 (0.105 cm-kg sec^2). For use on 8809, 10.5 inch reels must meet the following moment of inertia requirements:

1. For a full reel (with outermost layer at a radius of 4.82 $\pm$ 0.02 inches (12.24 $\pm$ 0.05 cm), the moment of inertia shall be 0.0768 $\pm$ 0.0037 in-lbs-sec^2 (0.0885 $\pm$ 0.0043 cm-kg-sec^2).
2. For an empty reel, the moment of inertia shall be 0.0221 $\pm$ 0.0020 in-lbs-sec^2 (0.0255 $\pm$ 0.002 cm-kg-sec^2).

B. Tape Unit Performance

Section B relates to testing and measurements performed on appropriate models of IBM 24XX and/or 34XX series tape units.

1. Standardization

Individual units should be adjusted to their engineering specification. Signal level should be adjusted using the IBM Standard Signal Level Tape, part 461108A.

2. Signal Level

Definition—The average of all peak pulse amplitudes (without regard for polarity) over any 1.0 inch (25.4 mm) of tape throughout the length of the tape.

Requirement—Tape tested for use at 556 bpi must have an average signal level within ± 10% of that of the IBM Standard Signal Level Tape, part 461108A, when compared at 556 fci.

Tape tested for use at 800 bpi must have an average signal level within ± 10% of that of the IBM Standard Signal Level Tape, part 461108A, when compared at 556 fci and 800 fci respectively.

Tape tested for use at 1600 bpi must have an average signal level within +25%, −10% of that of the IBM Standard Signal Level Tape, part 461108A, when compared at 3200 fci. This tape also must have an average signal level within ± 10% of the IBM Standard Signal Level Tape, part 461108A, when compared at 556 fci or 800 fci.

For 6250 bpi operation, it has been shown that most tapes which meet the 1600 bpi requirements will perform satisfactorily at 6250 bpi.

For 1600 bpi operation, an interchange tape should have an average signal level of +50%, −20% of that of the IBM Standard Signal Level Tape, part 461108A, when compared at 3200 fci on the unit receiving the interchange tape.

Due to the equipment differences (such as in the write systems, components, tape speeds, and forward-backward ratios), interchange tapes exceeding the tolerance specified in the preceding paragraphs may not perform reliably.

3. Signal Quality

Definition—The consistency of the peak amplitudes of individual read pulses.

Requirement—Signal quality at any density shall be such that the tape experiences fewer than twenty write skips during a full-file pass.

Recommendation for new tape:

a. For tape tested for use at 556 bpi—the tape should not have more than two defects that cause peak amplitudes less than 50% of IBM Standard Signal Level Tape, part 461108A, when compared at 556 fci on a 2400-III or equivalent transport.

b. For tape tested for use at 800 bpi—the tape should not have more than two defects that cause peak amplitudes less than 50% of IBM Standard Signal Level Tape, part 461108A, when compared at 800 fci, on a 2400-III or equivalent transport.

c. For tape tested for use at 1600 bpi—the tape should not have more than two defects that cause peak amplitudes less than 35% of IBM Standard Signal Level Tape, part 461108A, when compared at 3200 fci on a 2420-7 or equivalent transport.

d. For tape tested for use at 6250 bpi—in addition to c. above, the tape should not have more than 10 two-track defects (individual defects separated by less than 0.3 lineal inches [7.62 lineal millimeters]). One or more read pulses measuring less than 25% of nominal amplitude at 9042 fci on a 3420-8 or equivalent transport defines an individual defect.

4. Noise

Definition—The spurious signals in a tape written at 800 fci after erasure with a magnetic field of a uniform intensity of 1000 oersteds.

Requirements—The average peak pulse output (without respect to polarity) will be less than 4% of the signal level at 3200 fci of the IBM Standard Signal Level Tape, part 461108A, and no individual noise pulse will have a peak amplitude that exceeds 10% of this signal level.

5. Phase Shift

Definition—A pulse time displacement that occurs at the transition from a low density recorded signal to a higher density, or from a high density signal to a lower density.

Requirement:

a. 1600 bpi—The phase shift will not exceed 225 nanoseconds of a 1.6 microsecond flux change period at 3200 fci.

b. 6250 bpi—The phase shift will not exceed 155 nanoseconds of a 554 nanosecond flux change period at 9042 fci.

Procedure:

a. 1600 bpi—Using an IBM 3420 Model 7, write a repetitive phase-encoded pattern 0, 0, 0, 1 at 3200 fci. Measure pulse time displacement at the frequency transition region. Test is to be performed in a read-while-write mode with continuous tape motion.

b. 6250 bpi—Using an IBM 3420 Model 8, write a repetitive 1, 1, 1, 0 pattern at 9042 fci. Measure pulse time displacement at the frequency transition region. Test is to be performed in a read-while-write mode with continuous tape motion.

6. Baseline Recovery Margin (For 6250 bpi Operation Only)

Definition—The degree of waveform sag between flux transitions toward the baseline reference of the pulse is called baseline recovery. The margin between the maximum point of waveform sag and the baseline reference is called the baseline recovery margin.

Requirement—The baseline recovery margin will not be less than 50% of that measured with IBM Standard Signal Level Tape, part 461108A.

Procedure—Using an IBM 3420 Model 4, write at 3014 fci. Measure baseline recovery margin differentially at the analog test points (all nine tracks) on the read card in a 6250 bpi read-while-write mode with continuous tape motion.

7. Dynamic Skew

Definition—Using the standard recording procedure, the time variation between the two outside track read signals during the write process.

Requirement—The time variation between the two outside track read signals will not exceed 1.1 microseconds. This test is referenced to the nine-track 3420 tape unit at a density of 3200 fci and a tape speed of 200 ips (5.08 mps).

8. Inhibitor Tape

Definition—A tape which degrades the performance of the tape unit or other tapes.

Certain tape characteristics can contribute to poor drive performance. These properties include poor edge conditions, excessive tape wear products, interlayer slippage, tendency for oxide coating to transfer to the back of the reel's next layer, as well as any tendency for tape constituents to separate and cause deposits leading to tape stick or to inhibiting proper performance of other tapes. Tapes which exhibit these characteristics may not give satisfactory performance and may result in excessive errors.

The following tests although not inclusive, are designed to check if a tape is an inhibitor.

a. **Wear of Transport**

Definition—The tendency of the tape to wear the tape transport, as measured by head wear.

Requirement—At the end of the first 1000 full-reel passes of tape, head wear shall not exceed 50 microinches (1.27 micrometers). The rate of wear shall not exceed 25 microinches (0.64 micrometers) per 1000 passes after the first 1000 passes, nor 775 microinches (19.69 micrometers) in 30,000 passes.

Procedure—Using a Taylor Hobson Model 3 Talysurf or equivalent, take a profile trace of a new head assembly, for a 9-track 3420 Model 7. Take the profile at both the read and write gaps. Mount the head assembly on an IBM 3420 Model 7 and cycle the tape under test for 200 full reel (2400 ft, 732m) passes, using go-up and go-down times of five milliseconds and cleaning the unit after each 50 full-reel passes. At the completion of the 200 passes, take another profile trace and determine the greatest depth of wear in the contact area of each gap. The deeper of the two measurements is the criterion measurement. Using the same head, repeat this procedure with four additional tapes, giving a total of 1000 passes. If the slope is in excess of the requirement, continue the test until it is proved that the extended curve meets the 775-microinch (19.69-micrometer) criterion at 30,000 passes.

b. **Start Test**

Definition—The consistency of the velocity during acceleration of a tape after initiation of a "GO" Command.

Recommendation—The tape must be tested on a 3420-7 tape unit. At the end of the first pass, the velocity profile of the backward start at end-of-tape must be free of inflection points (that is, no eratic motion and/or "glitches") between 10% and 90% of nominal velocity during both the forward hitch and backward acceleration. The time to reach 90% of nominal velocity from initiation of "GO" must be less than 4 milliseconds.

Procedure—Write the test tape continuously at 3200 fci (126.0 fcmm) past tape indicate. Then stress condition the tape at 125°F(51.7°C)/15% relative humidity for 48 hours. Recondition the tapes and tape unit at the test environment for 24 hours. Clean the tape unit and move the test tape to the end-of-tape marker. Leave the tape loaded for five minutes then photograph the velocity versus time profile associated with a rewind command.

c. **Contamination Test**

Definition—A tape which causes variation in signals due to tape material which separates the media from the head.

Recommendation—The average signal output from the second pass must be at least 90% of that measured at corresponding points during the first pass.

Procedure—Run the tape on a clean 3420 Model 7 in a read-while-write mode at 3200 fci with continuous tape motion. Do not clean the tape unit after starting the test. Measure the linear output of the tape at beginning of tape and end of tape on the two tracks adjacent to the center track for the first pass. Then expose the tape to 125°F(51.7°C)/15% relative humidity for 24 hours. Recondition the tape for 24 hours at the test environment and again measure in a read-while-write mode the outputs at beginning of tape and end of tape for second pass.

C. Quality

These paragraphs have been added to provide IBM's recommendations as to what quality a tape should contain when new (paragraphs 1 and 2) and as it exists in the library (paragraph 3).

1. Short-Length Reliability

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

Recommendation—Under the conditions of the following test procedure, the tape should average at least 40,000 read passes before a permanent error is encountered.

Procedure—Write a length of tape from load point with ten, 2000-character records (PE recording). No write skips shall be allowed during the write pass. Then read the 10 records (read forward/rewind) repeatedly until a permanent read error occurs. Perform this test with sufficient go-down time (20.0 milliseconds) to ensure that the tape comes to a complete stop for each record.

2. Long-Length Durability

Definition—The ability of the tape to resist the wearing action encountered while cycling full length on a tape unit. This is not a test for end of life.

Recommendation—At least 90% of the tapes tested should meet the following criteria:

> Tapes tested for use at 3200 fci 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 any IBM tape unit that operates at 3200 fci.

Procedure—Use the appropriate tape unit and associated tape control for this test. Write a 2400-foot (732-m) length of tape in start/stop mode with 2000-character records (PE recording) on each pass. In order to determine the effect of wear particles generated during the test do not clean the tape unit between passes.

3. Library Quality

Definition—A measurement of the quality of tape is its write capability.

Recommendation—Tapes with more than twenty write skips are not recommended. If tapes of this type are used, more frequent cleaning is recommended.

Procedure—Use the appropriate tape unit and associated tape control for this test. Write a 2400-foot (732-m) length of tape in a start/stop mode with an average block length of 1.5 inches (38.1 mm). By use of Volume Error Statistics, a measure of the quality of the tapes and library can be determined. Volume Error Statistics are available in the IBM Operating Systems, OS, DOS, and VS.

D. Safety and Environmental Requirements

1. Toxicity

Definition—The ability of any tape component to cause bodily harm by contact, inhalation, or ingestion during the normal use of the tape.

Requirement—There will be no toxic hazard.

2. Flammability

Definition—The behavior of the tape and reel after exposure to flame.

Requirement—The tape and reel must be self-extinguishing in a still, carbon-dioxide atmosphere.

3. Operating Environment

The operating environment for tape shall be 60° to 90°F (16° to 32°C) and 20% to 80% relative humidity, with a maximum wet bulb temperature of 78°F (26°C).

4. Storage Requirements

Storage conditions of 40° to 90°F (4° to 32°C) and 20% to 80% relative humidity, with a maximum wet bulb temperature of 80°F (27°C), shall not cause tape to go out of specification or deteriorate tape unit performance when reconditioned per Part 1, section B.

5. Extended Environments

Due to the unique design and tape handling characteristics of the 8809 Tape Unit, IBM Multi-System Tape may be utilized only with this unit at the following extended environments:

8809—Operating:

60° to 100°F (16° to 38°C), 8% to 80% relative humidity with a maximum wet bulb of 78°F (26°C).

8809—Storage:

40° to 100°F (5° to 38°C), 8% to 80% relative humidity with a maximum wet bulb of 80°F (27°C) provided the tape is reconditioned according to Part 1, section B before use.

The customer is cautioned that, the use of extended environments still requires the considerations outlined in paragraph 7 of this section.

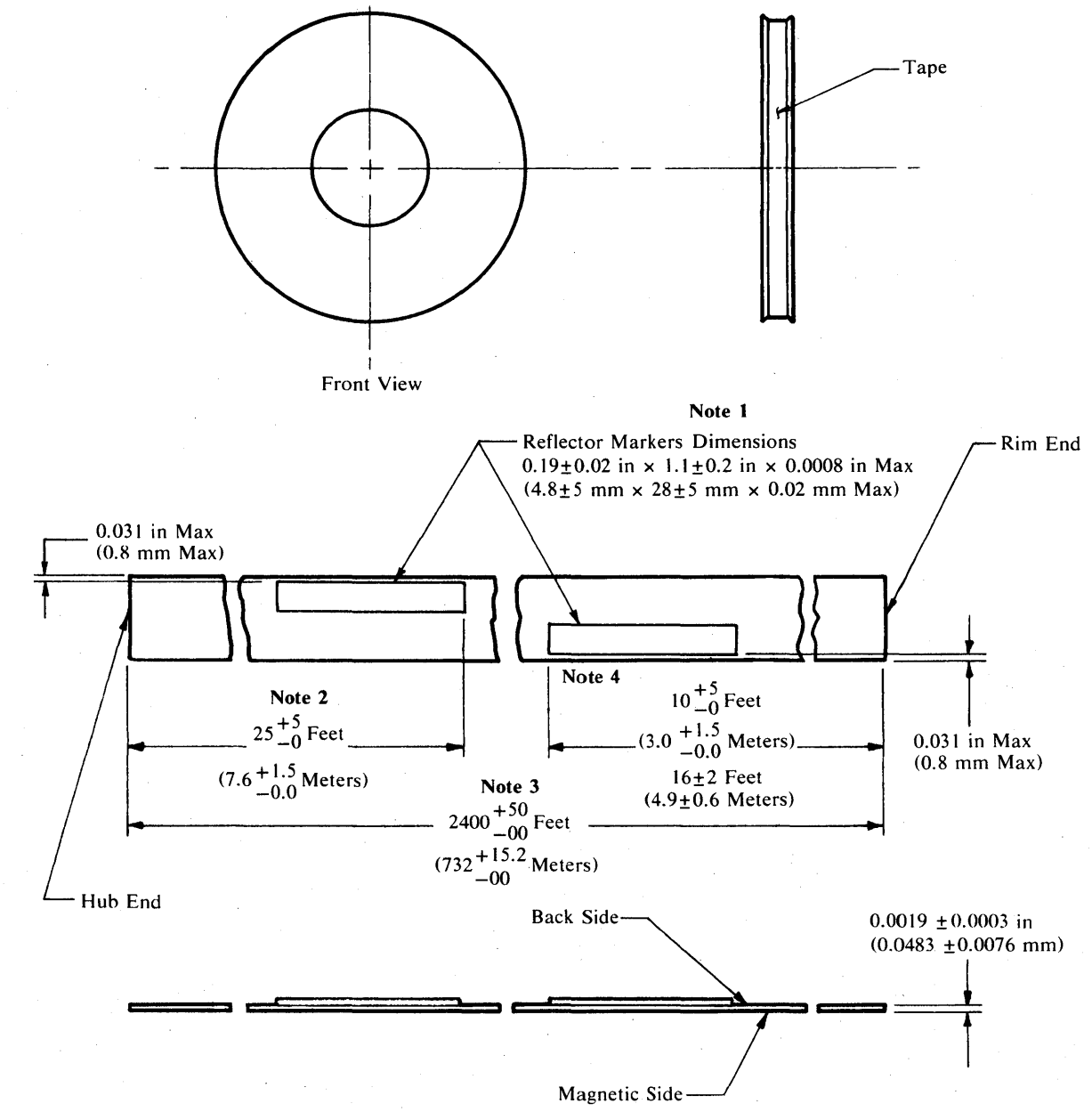
6. Shipping Requirements

During shipping, the tape may be exposed to conditions outside the operating environment. These conditions must not damage or destroy the tape properties and performance previously specified.

7. User Recommendations

The operating temperature of all subsystems types to which a tape may be exposed should be within the recommended operating environment. Varations of more than ± 5°F (3°C) between subsystems in the operating environment may cause degraded tape performance, temporary and permanent errors.

Tape without recorded information can usually be stored in environments with temperatures as high as 120°F (49°C) with a maximum wet bulb of 80°F (27°C). When tapes have been subjected to storage outside of the operating temperature, degraded performance may occur if the tapes are not reconditioned per Part 1, section B. High temperature and high humidity stress the tape and therefore should be avoided when possible.



Notes

1. Reflector shall be attached firmly to tape with its own adhesive back not to protrude beyond edge of tape and shall be free of wrinkles.
2. May be 100^{+5}_{-0} feet ($30^{+1.5}_{-0.0}$ meters) as applicable.
3. Length of tape 2400^{+50}_{-00} or 1200^{+20}_{-00} feet (732^{+15}_{-00} or 366^{+6}_{-0} meters) as applicable.
4. Two values are given, both of which will function on IBM tape units. The 16±2 feet (4.9±0.6 meters) is the new ANSI and ISO value.

Figure 1. Tape/Reel Assembly (Revised MAR75)

Table 1

Dimensions	Inches		Millimeters	
	Nominal (in inches except where otherwise noted)	**Tolerances** (in inches except where otherwise noted)	**Nominal** (in millimeters except where otherwise noted)	**Tolerances** (in millimeters except where otherwise noted)
A	3.688	+ 0.005 − 0.003	93.68	+ 0.13 − 0.08
B Note 1	10.500	± 0.020	266.70	± 0.51
C Note 2	5.125	± 0.005	130.18	± 0.13
D	3.875	± 0.005	98.42	± 0.13
E	4.388	± 0.005	111.46	± 0.13
F	0.250	+ 0.010 0.000	6.35	+ 0.25 0.00
H	0.750	± 0.015	19.05	± 0.38
Jf Note 3	0.622	+ 0.025 − 0.005	15.80	+ 0.64 − 0.13
Jr Note 3	0.097	+ 0.005 − 0.025	2.46	+ 0.13 − 0.64
Kf	0.848	maximum	21.53	maximum
Kr	0.080	maximum	2.03	maximum
L	4.125	minimum	104.78	minimum
M	0.718	± 0.005	18.24	± 0.13
R	1.677	± 0.010	42.60	± 0.25
Sf	0.753	maximum	19.12	maximum
Sr	0.030	maximum	0.76	maximum
T	0.030	minimum	0.76	minimum
P	4 degrees	± 15 minutes	4 degrees	± 15 minutes

Notes:

1. For use with Easy Load cartridges, Diameter B = 10.500+0.010,−0.030 inches (B = 266.70+0.25,−0.76 mm).
2. The outside cylindrical surface of the hub shall be concentric with the bore (dimensions C and A, respectively of Figure 2) within 0.020 inch (0.50 mm) Total Indicator Reading (TIR).
3. There will be a minimum radius of 0.035 inches (0.89 mm) on the inside edge and .015 inches (0.38 mm) on the outside edge of the outer extremity of the flanges.

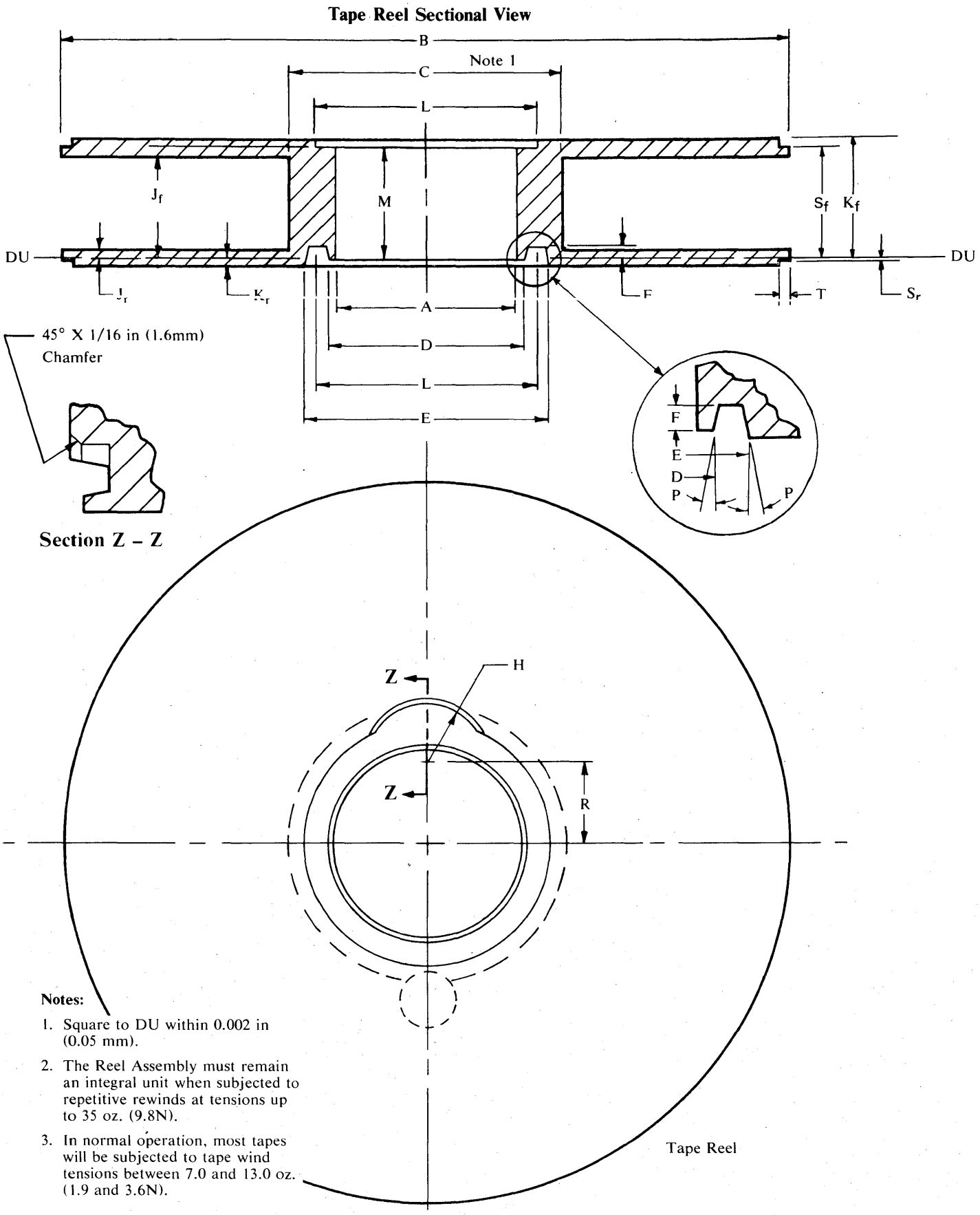


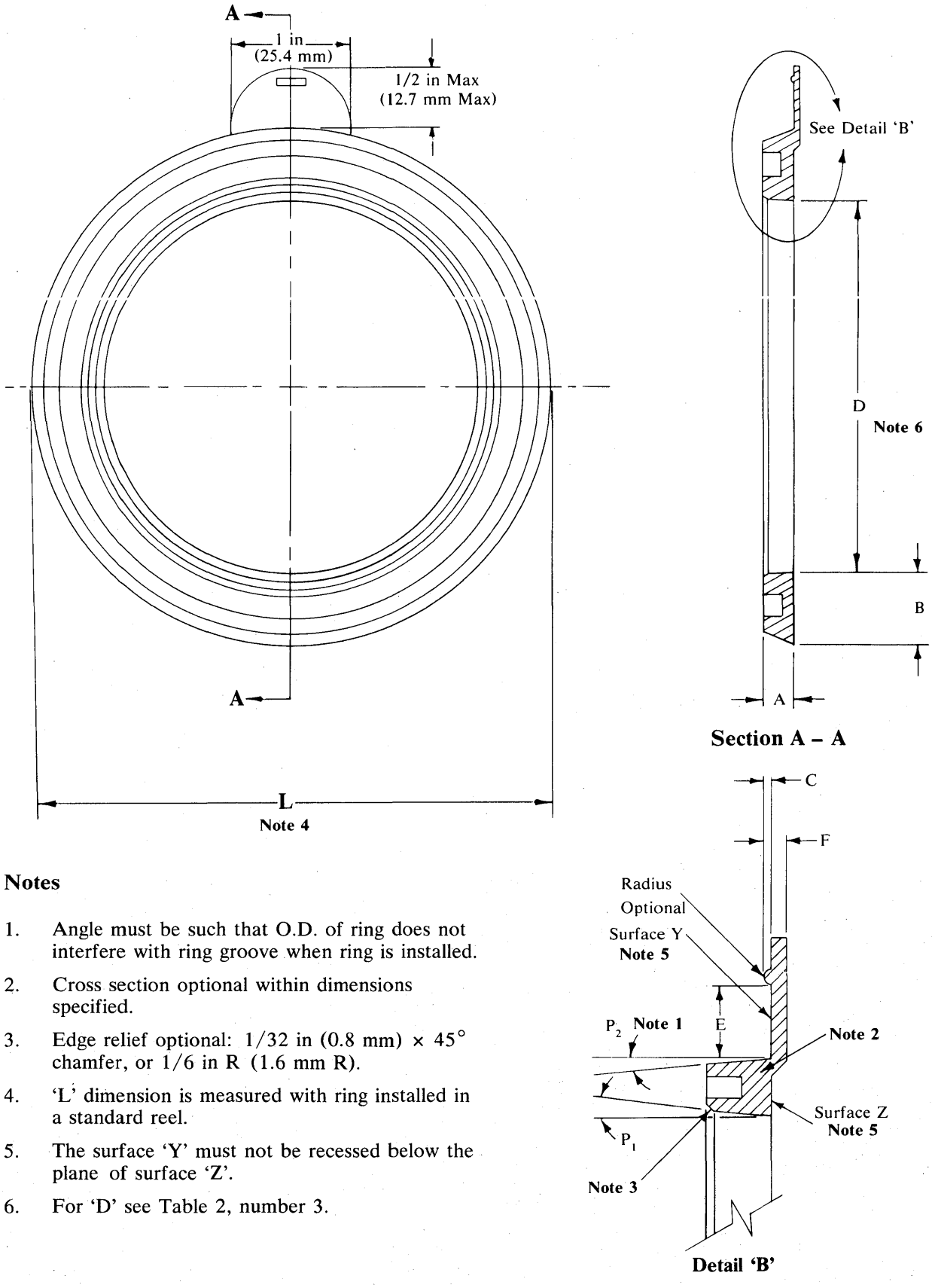
Figure 2. Sectional View

Table 2

Dimension	Inches (except where otherwise noted)	Millimeters (except where otherwise noted)
A	0.235 + 0.000 − 0.020	5.97 + 0.00 − 0.51
B	0.230 ± 0.010	5.84 ± 0.25
C	0.040 maximum	1.02 maximum
E	0.300 minimum	7.62 minimum
F	0.060 maximum	1.52 maximum
L	4.360 maximum	110.7 maximum
P_1	4 ± 1 degree	4 ± 1 degree
P_2	3 degrees minimum	3 degrees minimum

Write-Enable Ring

1. When installed on a standard reel, the top surface of the write-enable ring must be such that it does not protrude above the lateral mounting surface as defined by dimension L in Figure 2.
2. All rings must have a tab to facilitate removal from the groove. The shape and size of the tab are optional within the limits specified.
3. The D dimension, cross-section and material used must be such that the ring may be installed and removed with reasonable effort and remain seated during normal use.



Notes

1. Angle must be such that O.D. of ring does not interfere with ring groove when ring is installed.
2. Cross section optional within dimensions specified.
3. Edge relief optional: 1/32 in (0.8 mm) × 45° chamfer, or 1/6 in R (1.6 mm R).
4. 'L' dimension is measured with ring installed in a standard reel.
5. The surface 'Y' must not be recessed below the plane of surface 'Z'.
6. For 'D' see Table 2, number 3.

Figure 3. Write-Enable Ring

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Tape Specifications for IBM One-Half Inch Tape Units at: 556, 800, 1600 and 6250 BPI

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