

MAGNETIC TAPE MANAGEMENT

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1. GENERAL

1.01 This section covers management of digital magnetic tape used for stored program control (SPC) and automatic message accounting (AMA) associated with Bell System central offices (COs) where a wide range of environments are expected. Magnetic tapes used in typical computer centers are not subject to such environments.

1.02 This section is reissued for the following reasons:

- (1) To include Addendums
- (2) To revise 1.03 and 3.01
- (3) To add a new shipping container, Fig. 8
- (4) To make minor changes as required.

The Equipment Test List is not affected.

1.03 This section replaces and expands information in the notification to data processing center

and tape damage prevention part(s) in all sections covering magnetic tape handling and threading (034-311-301) for the numerous magnetic tape recorders.

2. TAPE HANDLING

2.01 *Tape Damage Prevention Measures:*

Since tape damage of any degree may result in mutilated data recording, the following preventative measures should be observed.

- (a) Magnetic tape shall not be spliced (2.03).
- (b) No external labels of any type shall be placed on the surface of magnetic tape. Labels or notes shall not be stored inside the tape reel canister (3.01).
- (c) To avoid tape edge damage, tape reels shall be handled by the reel hub and reel flange edges only. When mounting a reel of tape, force shall be applied only at the reel hub. When removing a reel of tape, the tape reel shall be pulled off only by the edges of the outside flange (flange closest to operator). No force shall be applied to the flanges perpendicular to the tape pack area.
- (d) Smoking and eating shall not be permitted in the tape recorder area or in the tape storage area. Cigarette ashes can contaminate the tape oxide surface.
- (e) Never allow magnetic tape surfaces or tape edges to contact clothing or floor.
- (f) Care must be exercised to prevent cleaning fluid that is specified for recorder cleaning only from contacting magnetic tape surfaces.
- (g) Since body oils and other foreign matter can contaminate the tape so as to result in mutilated data, care should be exercised during the tape-threading operation to avoid handling

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Bell System except under written agreement

that part of the tape on which data is recorded or to be recorded.

(h) When starting tape onto a take-up reel, **do not** insert the tape end into the reel hub slot (where provided) to hold the tape to the reel hub (Fig. 1).

(i) Avoid using the tape in the immediate vicinity of the beginning-of-tape (BOT) and end-of-tape (EOT) markers where marker adhesive may be found (Fig. 1).

(j) Magnetic tape with unprocessed data shall not be exposed to strong magnetic fields resulting from ac or dc currents in relays, motors, generators, magnetic detection devices, or any other magnetic apparatus (4.03 and 5.03).

(k) Control tape pack temperatures as near as possible to +70°F (Fig. 9).

(l) Magnetic tape and tape reels that have been dropped should not be reused until both have been inspected, tested, and proven serviceable; otherwise, retire the tape and reel from service (6.01).

(m) Ends of a reel of tape that are frayed, wrinkled, or otherwise damaged should be cut off before threading the tape in the recorder. If more than a few inches of tape leader are removed, a new BOT (or EOT) photoreflexive marker should be affixed to the tape in accordance with Fig. 1 or 2 as appropriate. Use replacement markers such as Scotch* Brand Sensing Markers, No. 650, 3M Company (Fig. 1).

*Registered trademark of the 3M Company.

(n) Each tape reel should be visually checked at least once weekly for warpage and alignment to make sure that the reel does not wobble when seated on the reel turntable and secured by the reel hold-down knob. Gauge by using such as a pencil held next to the flange edge and rotate the reel. Note any wobble by the change of flange distance up and/or down the gauge.

(o) The inside surfaces of the take-up reel flanges should be checked visually for burrs or other surface defects which may interfere with smooth winding of tape (Fig. 3).

(p) Maintain the tape transport; keep tape and magnetic heads clean. The heads should be inspected after each period of tape running time and cleaned during the tape change procedure (6).

(q) The tape shall be placed in the tape canister immediately after removal from the recorder. Always position the foam rubber pad (provided with each new reel) between the flanges over the tape end (5.03).

(r) Spare reels of tape shall always be stored in the tape reel canister (or equivalent). The canister shall always be stored vertically minimizing damage to the edge of the tape and with the foam rubber pad positioned between the flanges over the tape end (5.03).

2.02 Rewind of Tape: A reel of magnetic tape should be rewound before use when the tape packing shows severe unevenness as shown in Fig. 3. This condition is generally caused by extreme temperature excursions, subsequent handling (see 8.04), machine tape path misalignments, or air turbulence especially associated with high-speed machines. Similar but not as severe unevenness in tape pack is a common result of tape operation on many machines. Generally this condition does not affect tape performance. It is a matter of judgment by the user to evaluate the severity of the tape pack misalignment and estimate the conditions causing that misalignment (such as known extreme temperature exposure or mechanical shock) as to whether the tape should be used directly, rewound first, or retired. Tape rewind can be accomplished by performing a complete forward and reverse tape wind at a continuous speed (8.01). See electronic data processing (EDP) center for rewind procedures.

2.03 Broken Tape: Do not splice magnetic tape. Forward both sections of the tape to the EDP center with the transmittal form (E-5233) and adhesive labels (Form 6050) placed on both reels to identify each section of the tape. Retire the two sections from service after data retrieval. The tape parts should not be used in critical applications, particularly a minimum distance of 3 feet on each side of the tape break for any application.

2.04 Write-Enable Ring: Some tape reels are equipped with write-enable rings. While

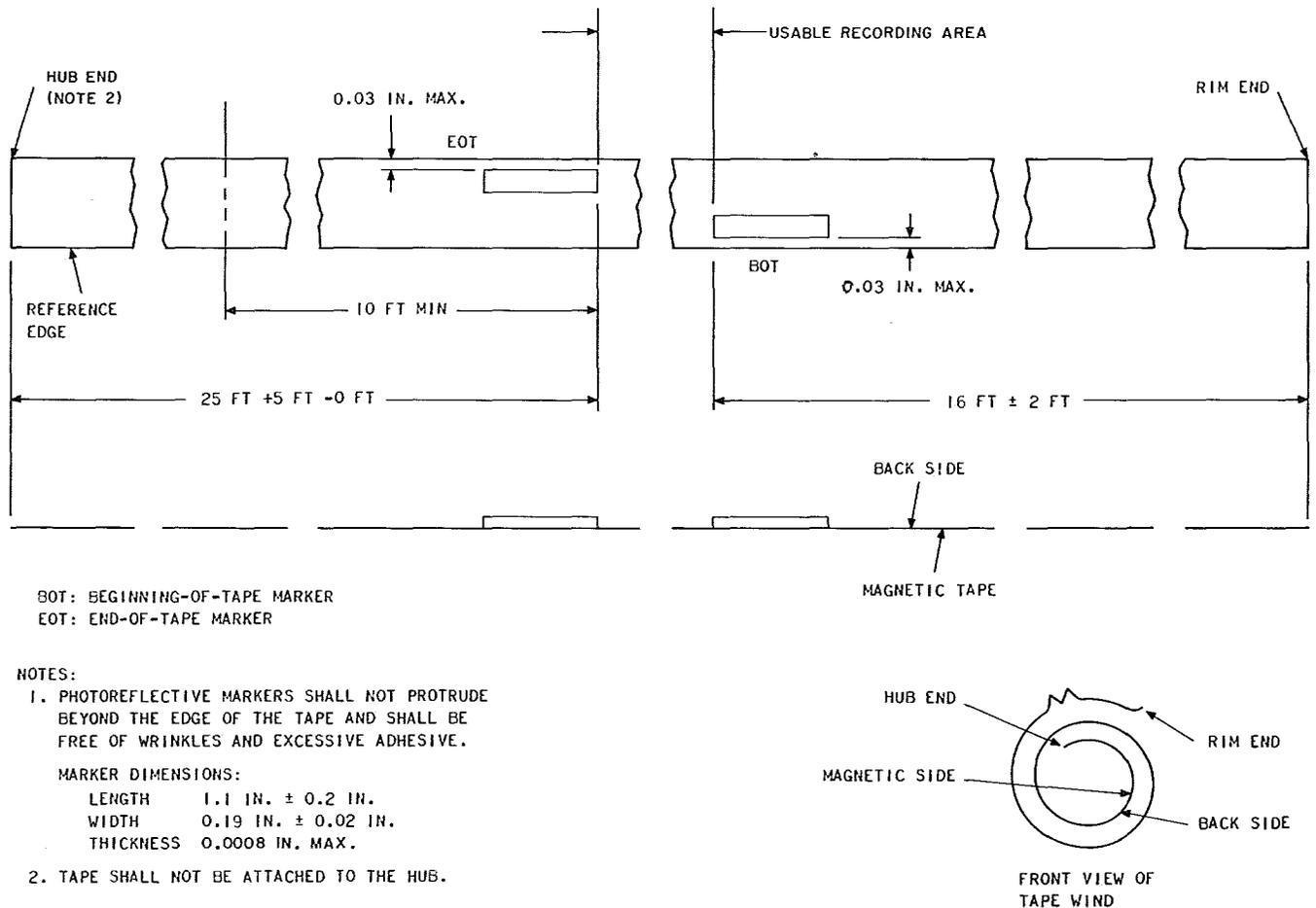


Fig. 1—Photorefective Tape Marker Placement on 1/2-Inch Magnetic Tape

most magnetic tape recorders do not deposit data on the tape when a ring is not located in the reel hub, there are magnetic tape recorders that function with or without the ring in position. Therefore, the write-enable ring requirement for any specific magnetic tape recorder must be defined and the ring used accordingly.

2.05 Loading Recorder: When loading a reel of magnetic tape at the end of a recording period, do not position the tape end into the take-up reel hub slot if the hub slot is provided. Wind the tape around the hub without securing or sticking the tape end to the hub. Locate the BOT marker approximately 3 inches on the take-up reel side of the write head (or write-read head) for proper tape loading. EDP center computers may treat tapes

containing unprocessed data as blank tapes when data blocks are not encountered within specified time (or distance) from the BOT marker.

2.06 Tape Erasure: Where all data on a reel of magnetic tape requires erasing, bulk erasers are commercially available for this purpose and should be used. Bulk erasure use is the preferred method in view of both magnetic tape and recorder head(s) wear economics.

3. TAPE IDENTIFICATION

3.01 Automatic Message Accounting Application

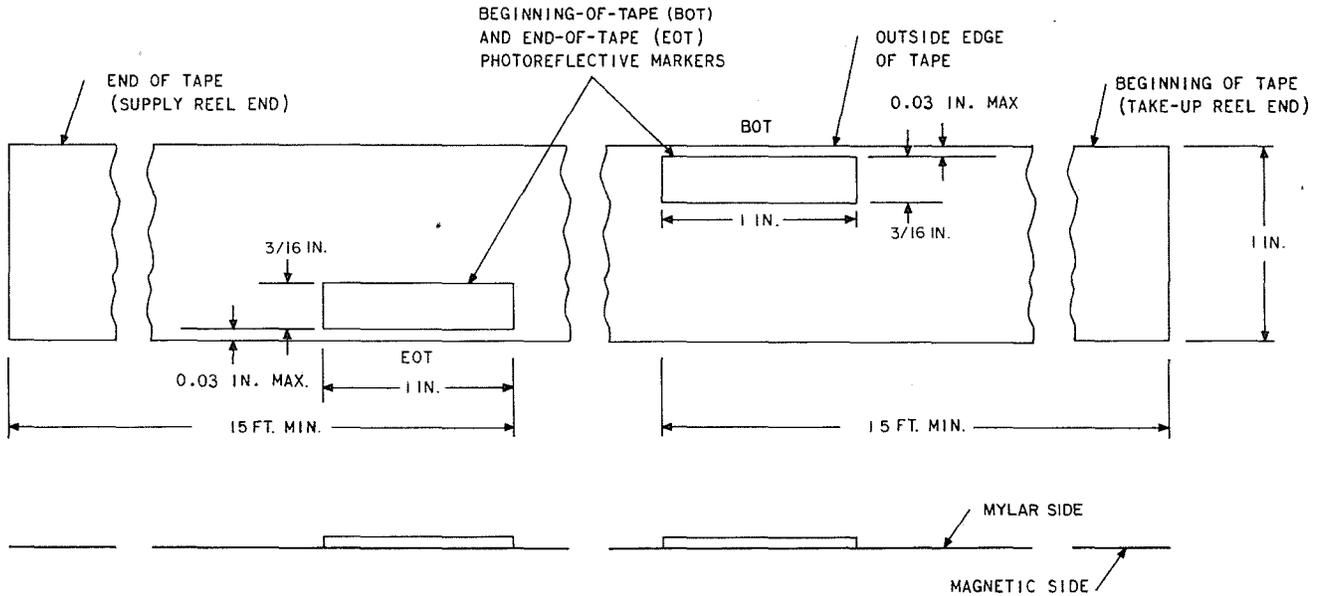


Fig. 2—Photorefective Tape Marker Placement on 1-Inch Magnetic Tape

(a) **External Label:** Tape reels shall have an external identification label affixed to the front reel flange. Information to be shown on the reel label shall be in accordance with local office requirements and procedures. The type and size of the label used shall be in accordance with local instructions. A similar label should be attached to the shipping container when the tape is to be shipped to an EDP center or on the tape reel canister when the tape is to be placed in extended storage.

(1) Form 6050 (Fig. 4), ESS/TSPS Magnetic Tape External Label, shall be attached to each tape reel to provide additional identification to the EDP center. Each label has sufficient space available for six uses of the tape and should be filled in before tape shipment to the EDP center.

(2) Form 6050 provides for the following information from the using facility.

(a) **IDENT. NO.**—The ESS office identification. Each ESS/TSPS office is assigned a distinctive 6-digit number as a means of identifying magnetic AMA tapes.

(b) **FILE NAME**—For the central office NXX code and town where located.

(c) **TRACK**—For the number of longitudinal tracks recorded on the magnetic tape.

(d) **REEL OF REELS**—For the number of reel and the total number of reels, such as REEL 1 of 3 REELS.

(e) **CREATED**—For the date that the magnetic tape was recorded.

Leave the remaining spaces blank as they are for EDP center use.

3.02 Stored Program Control Applications

(a) **Control Record**

(1) Form E-5854, SPC—Magnetic Tape Control Record (Fig. 5), shall be attached to the tape reel upon completion of recording

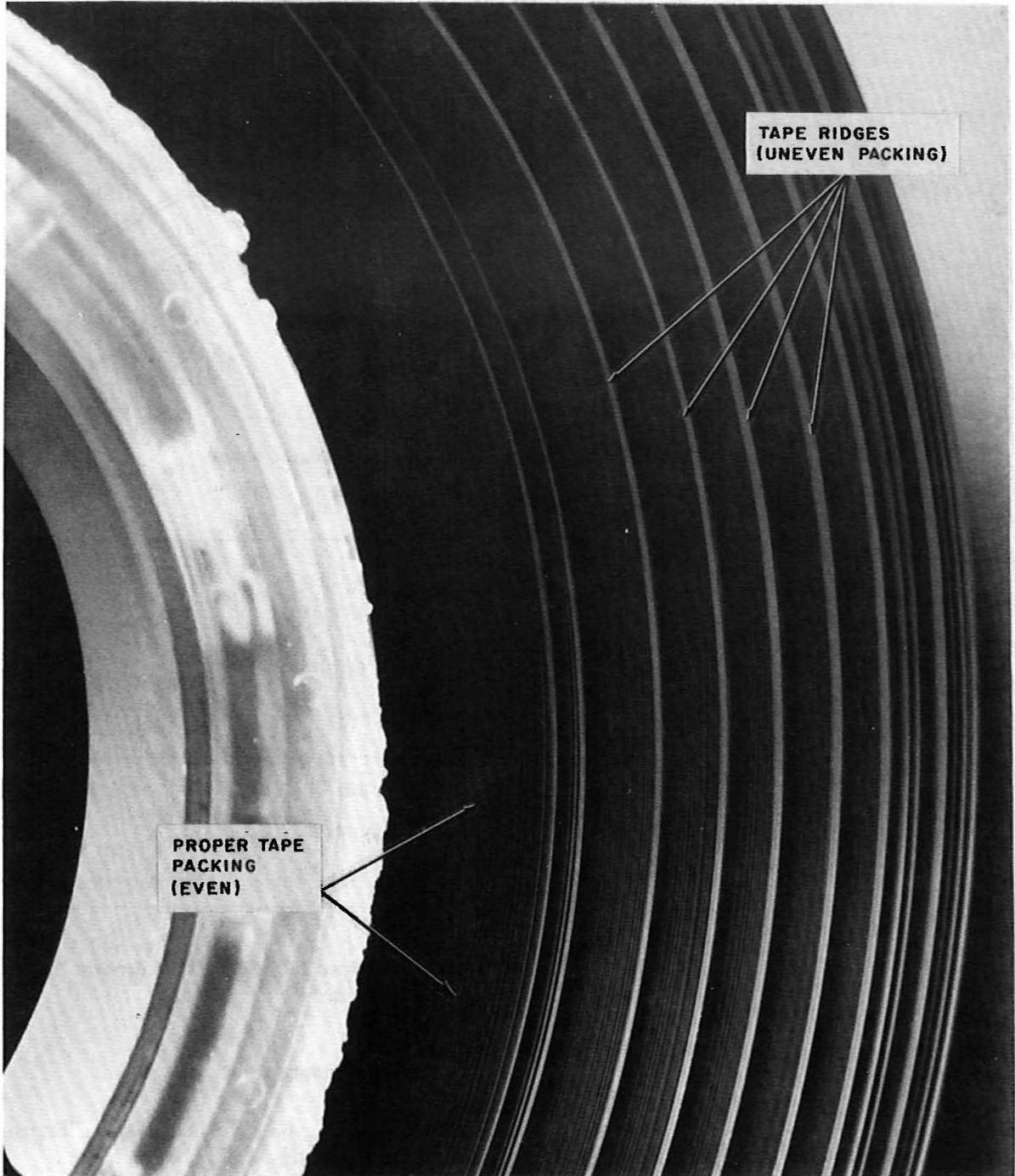


Fig. 3—Uneven Tape Packing on a Reel of Magnetic Tape

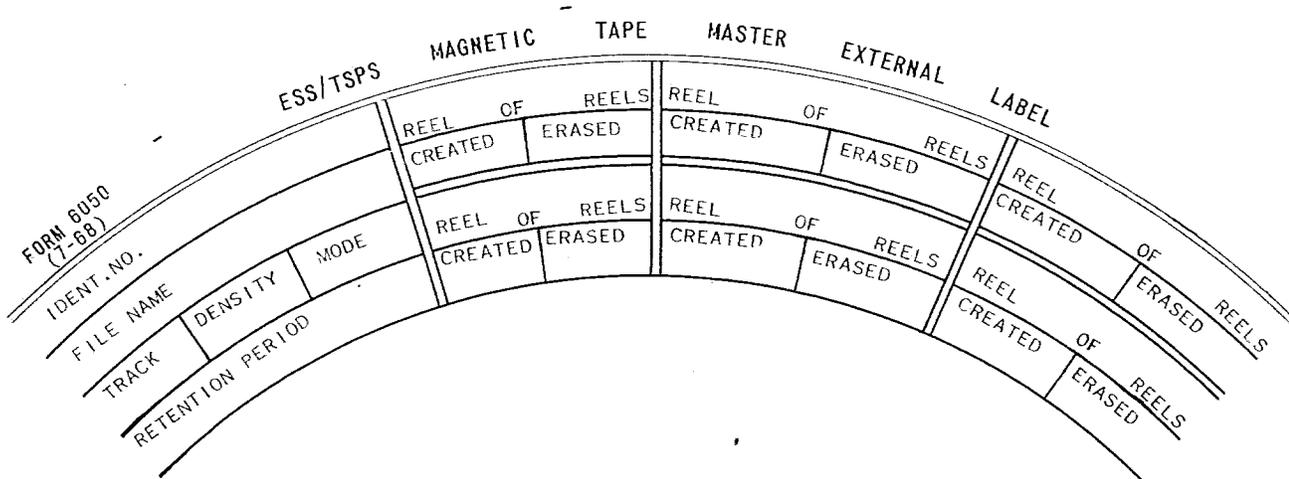


Fig. 4—ESS/TSPS Magnetic Tape Master External Label

information on the tape. The form is a 2-by 3-inch self-adhesive paper label and shall be completed as follows.

- (a) Enter the AMA identification of the office in the OFFICE IDENTIFICATION blank.
- (b) Enter the day that the tape was made in the DATE blank.
- (c) Enter the issue number of the generic program in the ISSUE blank.
- (d) If the tape contains office data, check the OFFICE DATA block.
- (e) If the tape contains a copy of the generic program, check the GENERIC PROGRAM block.
- (f) If the tape is used for special studies, indicate this in the OTHER blank.

(2) Form E-5854 is packaged in quantities of 25. Requisitions for these forms, in multiples of the standard package, should be worded as follows:

(Quantity) Form E-5854

E-5854
SPC-MAGNETIC TAPE CONTROL RECORD
OFFICE IDENTIFICATION _____
DATE _____
ISSUE _____
OFFICE DATA <input type="checkbox"/>
GENERIC PROGRAM <input type="checkbox"/>
OTHER _____

Fig. 5—Form E-5854-SPC Magnetic Tape Control Record

4. TAPE SHIPPING

4.01 AMA Magnetic Tape Transmittal (Form E-5233)

(a) Form E-5233 (Fig. 6) is a 4-copy, carbon-interfold assembly used to report central office trouble or routine activity related to the AMA magnetic tape. In order of assembly, the use of the copies is as follows:

- 1st copy—White-Originator
- 2nd copy—Pink-Tape Container

- 3rd copy—Yellow-Transportation
 - 4th copy—Green-Accounting
- (b) Form E-5233 shall be prepared at the beginning of each recording period. A recording period may be a single day, a number of days, or a weekend in accordance with local arrangement with the data processing center. All trouble incidents and irregular activity and the time of day they occurred are important entries to be made on the form. Reported incidents alert the data processing center that additional care must be exercised when processing specific tapes.
- (c) Each tape shipment should include all magnetic tape containing entries for the completed recording period. Situations may arise when an AMA recorder transfer occurs after the scheduled transfer. Where the central office is unattended during this time, the magnetic tape on the on-line (active) recorder contains entries for the current recording period and the completed recording period. For such a case and as soon as the trouble has been cleared, an AMA recorder transfer should be made. The magnetic tape on the standby recorder should then be changed and the tape reel included in the regular shipment to the data processing center. An entry should be made on Form E-5233 noting the existence of AMA data entries for both the completed and ensuing periods.
- (d) Trouble and activity reports shall include the time of the occurrence and a brief explanation, such as broken tape, AMA recorder transfer or testing. A separate line for time changes is provided.
- (e) Form E-5233 should be prepared for each recording period with distribution as follows.
- (1) Originator retains white copy in CO. This copy must also show transport pickup initials and time. Retain copy 190 days.
 - (2) Pink copy is placed inside the shipping container, NOT inside the tape reel canister. No routing initials necessary.
 - (3) Yellow and green copies are sent with the tape but under separate cover. Yellow copy is retained by transportation 30 days. Bottom routing data must show originator, pickup, delivery and received by, time and initials.
 - (4) Green copy is signed and retained by accounting. This copy must show all time and initials of "CO Pickup," "Transport," and "Received By."
 - (f) Form E-5233 is packaged in quantities of 100. Requisition for these forms, in multiples of the standard package, should be worded as follows:

(Quantity) Form E-5233

4.02 Hand-Carrying Magnetic Tape Through Airport Antihijacking Metal Screening Devices:

Metal screening devices do not provide a detrimental effect upon magnetic tape containing data so long as a typical 6-inch distance is maintained between the tape and the metal screening magnetic field generating device.

4.03 Magnetic Field, Crush, and Shock Protection of Tape in Transit:

As a general practice, magnetic tape with stored data on the tape is transported from local COs to EDP centers by intercity buses. Such transportation is the economical method for tape shipment, but magnetic field protection requires consideration since assorted freight is also transported in the same compartment with the tape. Where magnetic tape shipping containers are transported in freight compartments, adequate magnetic field protection is provided by a typical 6-inch distance from any ordinary magnetic field generating device (except a magnetron-type device). Crush and shock protection for the shipping container (and, in turn, tape reel canister, tape reel, and physical tape damage protection) remains a major consideration.

4.04 Return of CO AMA Tapes or Other Magnetic Tapes:

When CO magnetic tapes have been erased by the EDP center and are ready for release to the originating CO, the tapes should be packaged in a protective shipping container(s) for return shipment by the most economical means that provides for temperature and crush/shock protection. The magnetic field restrictions governing the CO shipment of tapes containing unprocessed

Note: This copy may be forwarded to EBAC or AMA analysis group if desired.

E-5233

AMA MAGNETIC TAPE TRANSMITTAL

Local Serial # _____ (If Required) PG. ____ OF ____

C.O. ENTITY _____ DATE(S) COVERED _____

NO. 1 ESS NO. 2 ESS NO. 4 ESS TSPS CAMA-C

NO. 5 MTR AMARC OTHER _____

ACCTG. R.G. ID# _____ TROUBLE? NO YES

EXPLAIN BELOW

TIME CHANGE? DATE _____ TIME _____

TROUBLE INFORMATION
DATE AND TIME OF TRANSFER TO:

TAPE SERIAL ID #

ACTIVE				
STANDBY				
OTHER				

REPORT ON TROUBLE(S) _____

CALL COUNT CONTROL
(IF REQUIRED)

--	--	--	--	--

ORIGINATOR _____ TEL. NO. _____

ROUTING INFORMATION

	CENTRAL OFFICE PREPARED FOR PICK-UP	TRANSPORT PICK-UP	DELIVER	RECEIVED BY ACCTG
TIME				
BY				

COPIES: (1) WHITE-ORIGINATOR (3) YELLOW-TRANSPORTATION
(2) PINK-TAPE CONTAINER (4) GREEN-ACCOUNTING

Fig. 6—Form E-5233—AMA Magnetic Tape Transmittal

data are relaxed when the erased tapes are for return shipment. However, protective shipping container shock and crush requirements must be maintained for tape reel canister, tape reel, and physical tape damage protection.

4.05 Protective Shipping Containers

(a) **Shock-Protecting Containers:** Many shipping containers do not provide adequate shock protection for the 10-1/2 inch tape reel or canister contents because the container is not equipped with internal insulation material. This type container does not guarantee magnetic tape survival in a modest shock environment. Permanent errors may be inflicted by shock that can render the tape useless for further service.

(b) **Tests:** Shock test conducted on selected commercially available 10-1/2 inch tape reel canister shipping containers indicated that a shock, such as a 6-foot drop, typically inflicts serious damage to the tape reels and/or tape reel canister. Other test drop distances, such as 4 and 2 feet, can subject the tape, reel, and canister to dangerous effects. Table A shows test results on three commercially available magnetic tape shipping containers using a 2-foot

drop as the shock environment. While the drop effects are indicated in Gs (acceleration due to gravity), the relative capability to damage the shipping container and contents by shock is represented by the G values. The lower G values of container C are explained by the particular container design using a limited amount of internal insulation material, such as shown in Fig. 7 and 8.

(c) **Shock-Protecting Shipping Container Design Specifications:** The test results lead to recommended specifications essential to shock-protect magnetic tape, tape reel, and canister during shipment in moderate shock environments (Fig. 7 and 8).

(1) The container specifications also apply to 10-1/2 inch tape reels arranged with less than 2400 feet of magnetic tape, such as 1200 feet, when used with 10-1/2 inch canisters.

(2) The container specification must be modified for use with mini-reels equipped with flange-edge bands (that serve as a canister) so that shifting of the reel inside the shipping container in any direction is prevented.

TABLE A

SHOCK ENVIRONMENT—2-FOOT DROP TEST
(G—Acceleration Due to Gravity)

CONTAINER	SIDE	FLAT SURFACE	CORNER
A	298.3G	129.0G	196.9G
B	187.5G	162.5G	137.5G
C	108.3G	93.8G	46.9G

All values are averages of three drops per side.

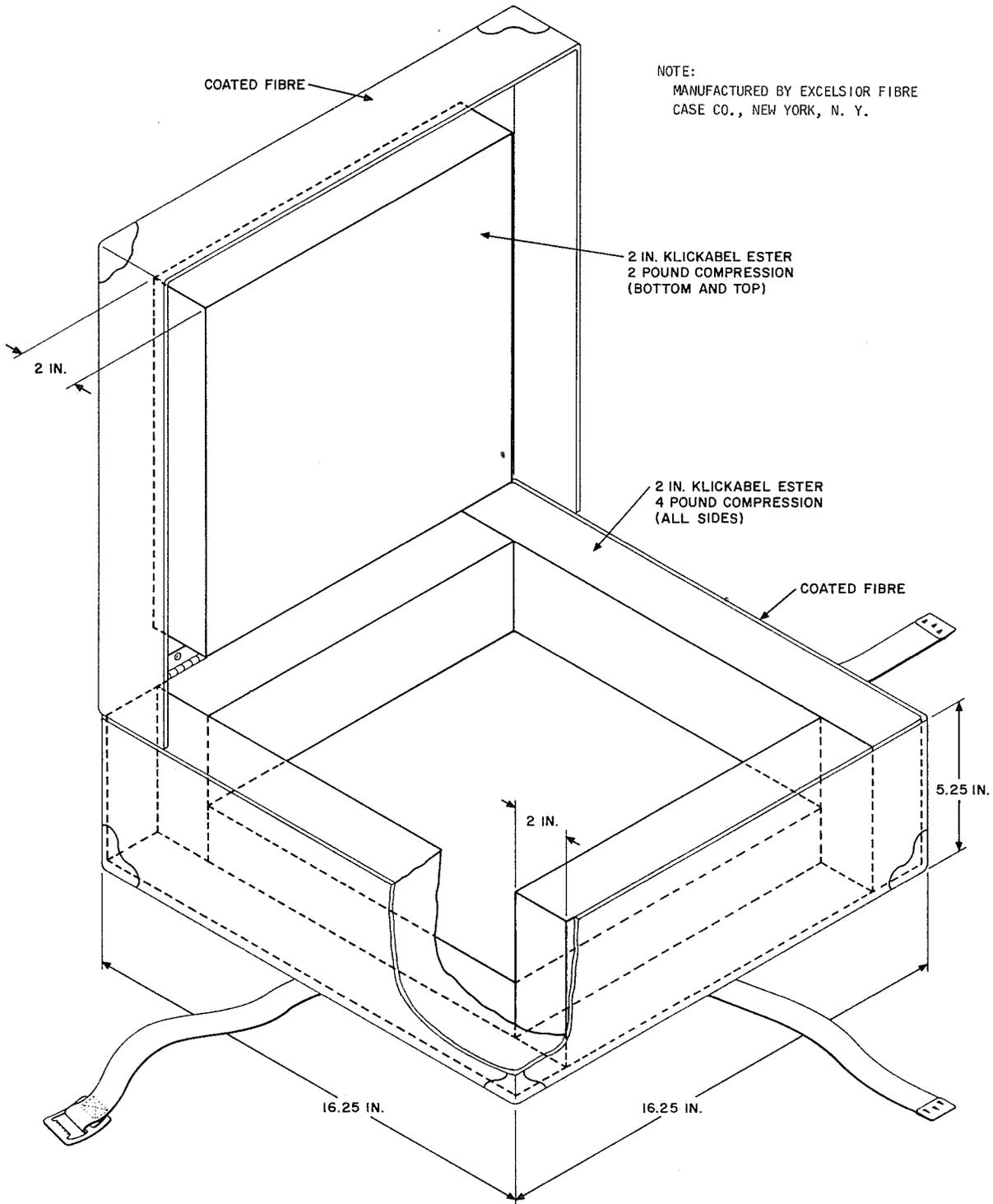


Fig. 7—Recommended Specifications for Shock Protected 10-1/2 Inch Magnetic Tape Reel Shipping Container

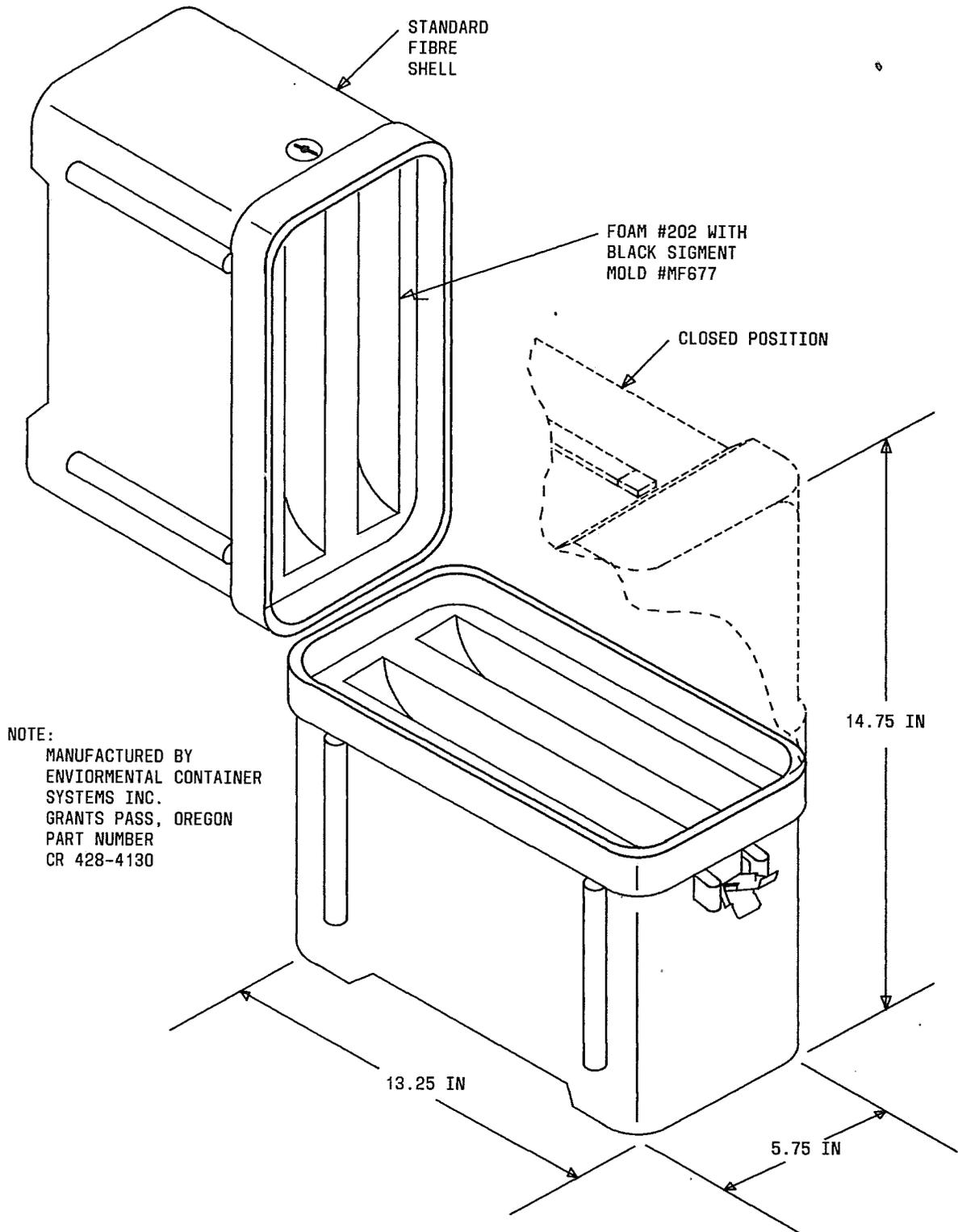


Fig. 8—Recommended Specifications for Shock Protected 10-1/2 Inch Magnetic Tape Reel Shipping Container

5. MAGNETIC TAPE STORAGE

5.01 Temperature and Humidity: Temperature and humidity extremes should be avoided in tape-storage areas. Recommended storage conditions for polyester-base magnetic tapes are as follows:

- Tape without recorded data: 40°F—120°F
20%—80% RH
- Tape with recorded data: 40°F—90°F
20%—80% RH

Wide ranges in temperature and humidity cause dimensional changes in tape base material. The result of tape distortion is that the tape may be rendered unserviceable, along with the danger of damaging the tape by mishandling, that in turn allows tape pack movement.

5.02 Tape Exposed to Low or High Temperature: Magnetic tapes exposed to low temperature extremes during storage or shipment should be allowed time to adjust itself to ambient conditions before removal from the protective shipping container. Tapes exposed to extreme high or low temperature that contain recorded data or not must be handled with great care during recorder loading because of loose tape packs. Tapes without recorded data should be exercised before use or reuse. Tape exercising can be accomplished by performing a complete forward and reverse tape wind at a continuous speed. For tapes with recorded data or not, special handling is required so as to preclude the slightest degree of shock and tape packing movement that causes physical damage to the tape. Also refer to Emergency Data Retrieval (Part 8).

5.03 Storage Area: Storage areas should be located away from magnetic fields caused by alternating or direct current. While very minor magnetic field levels do not provide a harmful effect upon tapes without stored data, very strong and multisourced magnetic fields must be avoided for tapes containing stored data. Tape reels should be stored in plastic (or metal) dustproof canisters or with flange-edge plastic belts that make the tape reel dustproof. Canisters and/or tape reels should be positioned vertically in a storage bin. Storage bins equipped with partitions are recommended. Unprotected tapes should never be left on shelves subjected to environmental dust and foreign matter.

5.04 Exercising of Tape After Storage:

Ideally, magnetic tape should be exercised every 6 weeks, and tape stored more than 6 weeks should be exercised before use or reuse. Tape exercising can be accomplished by performing a complete forward and reverse tape wind at a continuous speed. However, the rewind machine selected to exercise tape having stored data should not be equipped with an erase head or a machine that may be used without running the tape over any head so that data erasure is not possible.

6. MAINTENANCE

6.01 Tape Fundamentals and Irregularity Sources

(a) **Dropout:** The most common data error caused by magnetic tape is the dropout. A dropout is typically the result of a tape imperfection that prevents signal transfer of proper amplitude between magnetic tape and the read or write head. The lack of signal amplitude can cause two types of errors: (1) Data cannot be adequately erased, and (2) data can be misinterpreted, such as a 1 is read as a 0, or a 0 is read as a 1. Dropouts can occur while reading or writing a magnetic tape. The three main causes of dropouts are as follows.

(1) **Misalignment of Read or Write Head:** So that the reading head can pick up information from the tape, the head must be positioned exactly over the data track(s). A difference in the angular or dimensional tape-to-head relation of a few thousandths of an inch can cause an error.

(2) **Insufficient Magnetic Coating:** Thin or bare spots on the tape due to wear or manufacturing process produce dropouts.

(3) **Separation Between the Tape and Head:** Tape-to-head separation is the most common and most serious tape problem. So that a tape system may function properly, the magnetic tape and the recording head must be in positive contact. A gap need only be 150 millionths of an inch to result in signal loss. There are two main sources for signal loss:

(a) Distorted tape that does not lie flat against the head

(b) Some foreign object is intervening between the head and the tape.

(b) **Dirt:** The primary cause of magnetic tape failure is the loss of contact between recording surface (tape oxide layer) and the heads. The problem source is dirt on the tape magnetic oxide surface.

(1) **Foreign Dirt:** Many flaws on magnetic tape surfaces are due to foreign objects, such as dust, lint, and cigarette ashes. Imperfections can occur during tape manufacture or in equipment room environments. Equipment rooms of both central offices and EDP centers are especially vulnerable since friction between the magnetic tape and the magnetic tape guide surfaces creates an electrostatic charge which attracts airborne particles. Other dirt traps are oil film and grease due to careless tape handling.

(2) **Self-Dirt:** By far the largest source of tape imperfection is self-dirt, such as chips and pieces of magnetic oxide or plastic backing which have found their way onto the magnetic tape surface. Common types of self-dirt are as follows.

(a) **Slitting Debris:** During magnetic tape manufacture, the abrasive action of the tape-slitting knives leaves chips of the tape base material loosely attached to the edges. During tape use, some chips are dislodged and fall onto the magnetic oxide surface. Eventually the chips may be moved to a location between the head and the tape, and thus a dropout is caused.

(b) **Burred Edges:** Due to the shearing effect of the tape-slitting knives, magnetic tape edges may become burred. The wearing action of the rollers and tape guides used in the tape manufacturing process may eventually remove burrs and could deposit them on the magnetic oxide surface as error causing sources. Burred edges are also caused by tape transport misalignment.

(c) **Scratches:** Jagged particles of dirt may adhere to transport heads and tape guides causing scratches.

(3) **Temporary Flaws:** Dirt on the tape magnetic oxide surface creates a lump which separates the tape from the head and thereby causes signal amplitude loss. Initially, such lumps lie loose on the tape. The lumps are defined as temporary flaws (temporary errors) because they are not permanently attached or bonded to the tape. Some temporary flaws are removed by the recorder tape cleaner or corresponding recorder device.

(4) **Permanent Flaws:** As magnetic tape is used and reused, or as the result of forces applied by the tape pack pressure, temporary flaws may be bonded to the magnetic oxide surface. Such flaws may become permanent and cause an error (permanent error) each time that the tape is passed over a recording head. A magnetic tape that contains **one permanent error producing flaw** must be considered for retirement from service or eliminate the flaw by special cleaning processes.

(c) **Distortion**

(1) **Skewed Tape:** Next in importance to dirt as a source of tape error is skewed tape. Skew may result from poorly controlled processing during manufacture. Since magnetic tape is almost entirely plastic, it is subject to cold flow which is the tendency of the tape material to assume a semipermanent or permanent change in shape due to stress imposed upon the tape. Tape distortion can prevent the tape from flat contact against the reading or writing head and, in turn, cause a dropout. Some tape distortion considerations are as follows.

(2) **Cinched Tape:** Severe physical tape damage in the form of folds across the tape can be traced to improper recorder winding tension control. Tape looseness at any point in the tape pack may cause the tape to slip during handling or loading, thereby creating error-producing folds.

(3) **Creased Tape:** Creased magnetic tape is a serious type of flaw because the crease cannot be repaired. Horizontal creases result from improper tape handling and from cinching. Longitudinal creases are caused by extreme cases of misaligned tape guides or

rollers on a tape recorder or machine or loose tape packs that contact the flange surfaces. Both cinched tape and creased tape can be caused by temperature excursions outside of safe operating limits.

(4) **Edge Ripple:** Tape edge ripple is another important source of magnetic tape failure. The ripple appears as a tendency of one edge of the tape to become stretched or curled. Typically, the stretch or curled edge is accompanied by excessive head wear and migration of debris from the damaged edge. Magnetic tape that shows edge ripple damage must be removed from service. Edge ripple is caused by poorly aligned tape drives or, more commonly, magnetic tape reels that do not meet requirements for straightness.

(5) **Cupped Tape:** Cupped edges of magnetic tape appear as uneven edges that have had a semicircular pattern cut along the edge. Cupped edges are caused by intense heat, such as from a lighted lamp very close to the tape and/or uneven pressure distribution across the tape such as would be produced in the tape packing by temperature changes. Cupping can also occur in the middle of the tape instead of on the edges from the effects of sensor lamp heat. Cupped magnetic tape must be removed from service.

(d) **Performance and Maintenance:**

Recently procured or unused magnetic tape is more likely to become error free after approximately the first ten passes on a recorder (Fig. 9). The recorder head(s) and tape guides provide cleaning action. After the first few passes, the tape produces less wear on recorder heads because the iron oxide side is progressively polished and smoothed. In turn, less tape debris components become available for recorder tape path contaminants.

6.02 Cleaning and Rehabilitation

(a) Cleaning

(1) **Dirt:** Remove the tape contaminants that can interfere with maintaining intimate tape-to-head contact. The greatest portion of the contaminants encountered in magnetic tape are particles of dirt and most of these are self-debris composed of fragments

of tape material. Commercial tape equipment is available for tape surface cleaning but requires economic considerations for produced results as opposed to cost.

(2) **Self-Dirt:** The most significant source for self-dirt debris is the manufacturer slitting process. This process generates oxide particles and debris from tape-backing material that migrate onto tape surfaces as error-producing dirt.

(b) Rehabilitation and Recertification:

While commercial equipment and service are available for the rehabilitation and recertification processes, they are costly. Economic considerations are required. The magnetic tape rehabilitation and recertification processes do not guarantee an error-free tape.

6.03 Life Expectancy and Tape Retirement

(a) **Records:** The establishment and use of comprehensive records that show for each tape the following minimum information are an economic essential:

- Manufacturer
- Date acquired
- Bit density to which certified
- Number of times used (passes)
- Any difficulty encountered and date
- Any tape maintenance or rehabilitation performed and the date and nature of the processing

This information provides a basis for statistical data that lead to error-free use and extends life expectancy of the magnetic tape.

(b) **Tape Life:** Tape life is defined as the number of passes (cycles) a tape makes over a record head from the initial use to the end of life (Fig. 9). Tape life, therefore, includes operation not completely free of trouble.

(c) **End of Life:** End of life is defined as the time in tape usage when the tape

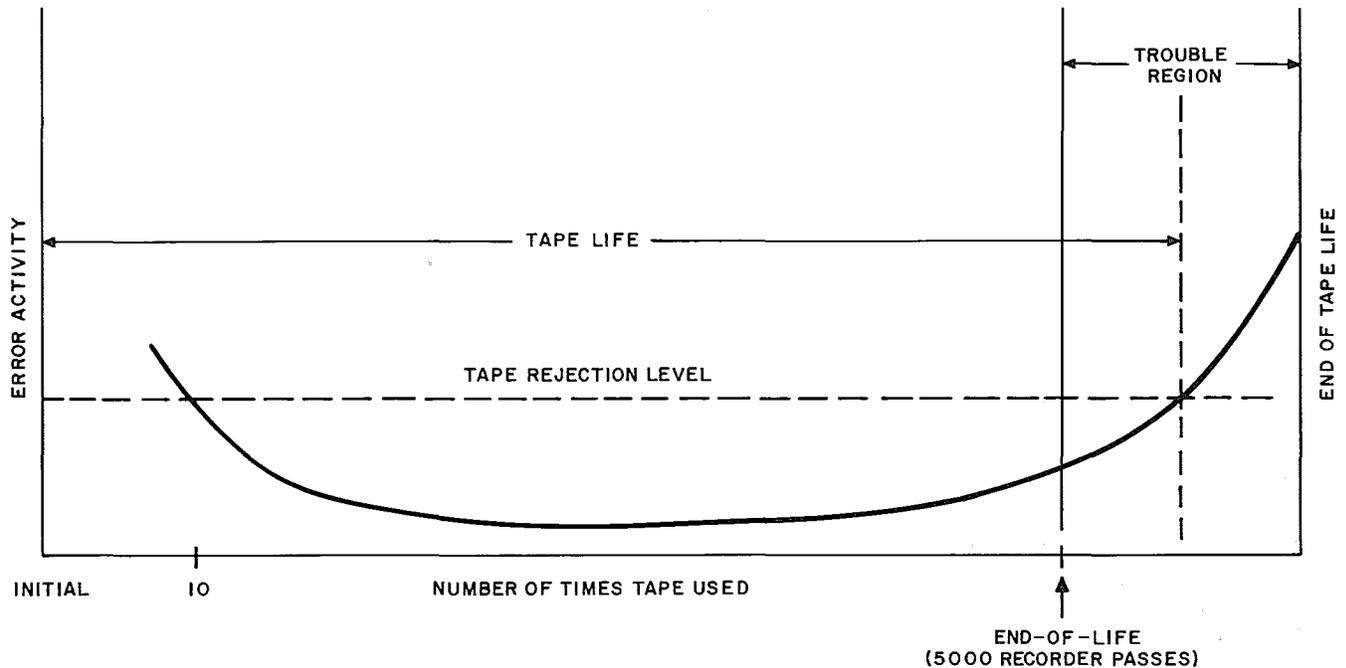


Fig. 9—Typical Error Activity Profile for a Reel of Magnetic Tape

develops a number of permanent flaws so as to render the tape useless.

(d) **Tape Retirement:** Magnetic tape is recommended for removal from service when the tape has made 5000 recorder head passes (where multihead arrangements are regarded as one pass) or has experienced 1000 hours tape running time whichever occurs first. This criterion provides a margin so as to enhance trouble-free use (Fig. 9).

7. VERIFICATION OF TAPE QUALITY

7.01 Quality Control: Tape quality verification is a function of the magnetic tape manufacturer for quality control of a particular tape grade specified by the purchaser. At the time of new tape procurement, the user should specify that

Each reel of tape be full width certified permanent error free at 3200 FCI (1600 BPI) with a minimum detection level of 35% at final inspection.*

*Flux changes per inch.

Also refer to 9.02.

8. EMERGENCY DATA RETRIEVAL

8.01 Tape Rewind: Magnetic tape exposed to high or low temperatures (5.01) beyond safe operating limits (Fig. 10) should be gently rewound at each 10-degree temperature decrease. Since magnetic tape expands as the tape pack temperature rises and contracts as the pack temperature decreases, the expansion (or slack) should be removed. Special handling is an essential for magnetic tape where temperatures have loosened the tape packing, and the tape packing moves so that the tape easily becomes damaged. Check EDP center for rewind procedures.

8.02 Rewind Machine Restrictions: The machine or recorder to be used to rewind high- or low-temperature exposed magnetic tape **must not provide high angular accelerations to the tape pack, such as during loading on a vacuum column or tension arm magnetic recorder.**

8.03 Unprocessed Data Erasure by Rewind Machine: Many magnetic tape recorders are designed so that tape rewind is not electronically

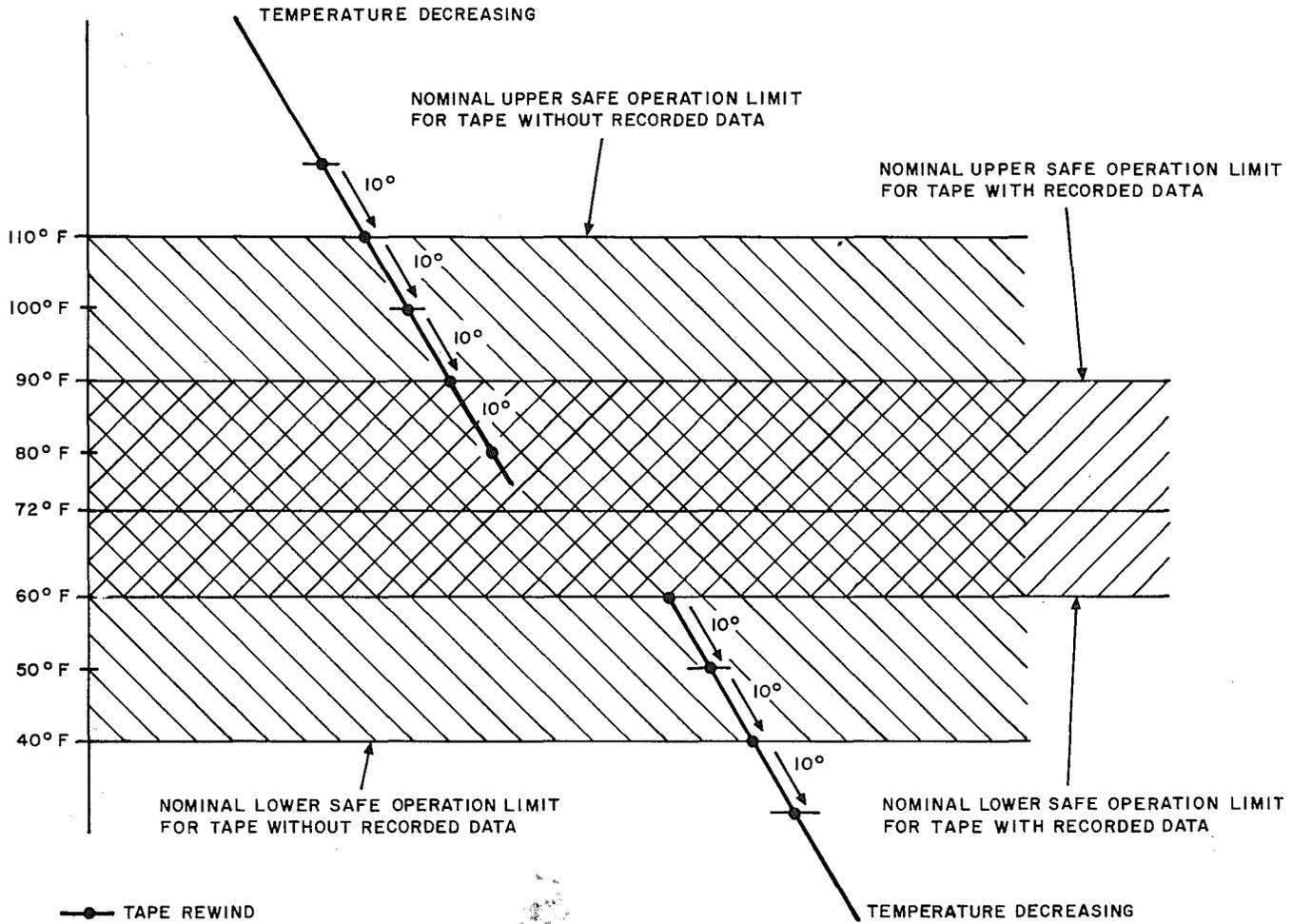


Fig. 10—Safe Operating Temperature Limits for Magnetic Tape

possible, thereby protecting stored data on magnetic tape from unintentional erasure. Others provide a tape reversal feature. Typically, magnetic tape recorders should not be used as tape wind and rewind machines since stored data may be accidentally erased. Tape rewind machines, without heads, that provide precision tape packing are commercially available.

8.04 Low-Temperature Exposed Tape (Less Than 32°F): While the tape pack temperature decreases, tape contraction occurs that affects pack-slip characteristics and, in turn, provides a source for error activity. Tape reels with severe uneven packing such as shown in Fig. 3 resulting from temperature fluctuations should be gently handled and rewound to establish a firm tape pack. Shock of any degree may damage the tape-by-tape

pack movement and render subsequent tape performance unacceptable. Typically, such exposure may take place while the tape is in transit; therefore, a low-temperature exposure is not identified nor can proper tape rewind be performed at the time when temperature is decreasing. For such cases, high error activity and without apparent cause is the only indication by the tape that exposure and damage have occurred. Then the tape must be considered for retirement from service.

(a) **Rewind:** The tape should be rewound for each 10-degree decrease in temperature (Fig. 10). While the tape pack temperature is increasing, tape pack rewind is not necessary unless large excursions, such as 50°F, are expected because tape contraction is removed by rising temperature. The number of rewinds should

continue decreasing at 10-degree changes until a minimum temperature is reached. Gentle handling of the tape and rewind machine restrictions (8.02) is necessary to continue tape life as well as to permit unprocessed data retrieval.

8.05 High-Temperature Exposed Tape (Greater Than 110°F):

Any magnetic tape exposed to extreme temperature in excess of 110°F for a significant period of time, such as one-half hour or more, must receive special handling. Tape rewinds during increasing temperature in this range are required to preclude high tape pack pressure and minimize pack looseness when the temperature is decreased. Tape rewind at 10-degree temperature changes is necessary to compensate for tape dimensional changes and prevent loose tape packs. As in low-temperature exposed tape, loose tape packs provide a source for error activity, and shock of any degree may damage the tape-by-tape pack movement. Pack movement may render subsequent tape performance unacceptable. Gentle handling of the tape reel and/or canister to prevent tape pack movement is necessary.

(a) **Rewind:** The tape should be rewound for each 10-degree temperature decrease until the pack temperature has returned to safe operation limits (Fig. 10). Rewind of the tape while temperature increases is not usually required unless excursions greater than 50°F are anticipated; then rewind near the tape-operating temperature. Tape pack firmness must be maintained to prevent tape-slip characteristics. Gentle handling of the tape, reel and/or canister, and tape rewind machine restrictions (8.02) is necessary to continue tape life as well as to permit unprocessed data retrieval.

(b) **135°F:** For Bell System purposes, no magnetic tape should be considered reliable

recording media after exposure to 135°F for enough time (approximately one-half hour) to bring the entire tape pack (2400 feet) to that temperature. If no check for tape errors has been made to determine further serviceability, such tapes should be retired from service.

9. TAPE PROCUREMENT REQUIREMENT

9.01 Certification: For magnetic tape applications in which minimal error activity is required from the first run of a new reel of tape, the user should specify that

Each reel of tape be full width certified permanent error free at 3200 FCI (1600 BPI) with a minimum detection level of 35% at final inspection.

9.02 Full Width Certified: For the purpose of this section, full width certified is defined as a function of the tape manufacturing process for a specified quality of magnetic tape where the manufacturer certifies the complete width and the complete length of the reel of tape to be free of "permanent error."

9.03 Definition of Permanent Error: A permanent error is defined as a magnetic flux transition on the tape which cannot be read within the detection level specified in 9.04 on any of three consecutive attempts.

9.04 Detection Level of 35%: Detection level of 35% is when the tape output level amplitude provides at least 35% of the standard output level when data is recorded at 1.5 times the saturation level of the tape.