SECTION 4

PREVENTIVE MAINTENANCE AND CHECKOUT

4.1 EIGHTH-HOUR CLEANING

4.2 HEADS

4.3 Clean heads, and all other components in the tape threading path, after each eight hours of operation, or oftener if visual inspection indicates the need. This is to remove the oxide (deposited from the magnetic tape) which will degrade equipment performance as it accumulates. Remove the head shield and clean each head thoroughly with a cotton-tipped applicator dampened with Ampex Head Cleaner (4010823 or 087-007). Leave head shield off until heads are demagnetized (paragraph 4.6).

CAUTION

WHEN CLEANING THE HEADS, USE ONLY THE RECOMMENDED SOLVENT, TO AVOID DAMAGING THE HEADS. KEEP SOLVENT OFF PLASTIC FINISHES AND THE CAPSTAN IDLER TIRE. DO NOT USE METAL TOOLS WHICH MIGHT SCRATCH THE HEADS.

4.4 TAPE GUIDE ELEMENTS

4.5 Use isopropyl alcohol to clean all tape-guiding elements, the capstan, and the capstan idler.

CAUTION

DO NOT USE HEAD-CLEANING SOLUTION ON IDLER RUBBER TIRE, OR CAPSTAN; IT WILL CAUSE TIRE DAMAGE AND TAPE SLIPPAGE IF APPLIED.

4.6 EIGHTH-HOUR DEMAGNETIZING

4.7 Head and other components in the tape threading path can acquire permanent magnetization that increases signal noise and distortion, and partially erases high frequencies on recorded tapes. Demagnetize components after each eight hours of operation, or oftener if required, using an Ampex Head Demagnetizer (4010820), or equivalent, as follows:

Step 1: Turn equipment power off, and remove any recorded tape near the transport (tape could be partially erased by the demagnetizer).

Step 2: Cover the demagnetizer tips with pressure-sensitive tape (to prevent scratching the heads) and connect the demagnetizer to a 110-120 volt ac-power source.

Step 3: Simultaneously and lightly touch the two demagnetizer tips to the two faces of one head.

Step 4: With a slow, even motion, move the tips up and down the stack several times. Slowly withdraw the demagnetizer (slow withdrawal is required for effective demagnetization).

Step 5: Repeat steps 3 and 4 at each head stack and tape guide (on the reel idler and takeup tension arm).

Step 6: Move the demagnetizer at least three feet from the recorder, then de-energize it.

Step 7: Re-install the head shield.

4.8 MONTHLY CLEANING

4.9 Once a month, or as required, use a vacuum cleaner or a brush to remove all contamination from the tape transport interior. If necessary, moisten the brush with isopropyl alcohol to clean parts. Do not use pressurized air for cleaning, because dirt can be forced between bearing surfaces.

4.10 LUBRICATING

4.11 GENERAL

4.12 The only components requiring lubrication are bearings in the capstan and capstan idler. Ampex Lubricating Oil (4010825 or 087-579) should be used. (Equivalent oils are Esso Standard Oil Co., Teresso No. 47; and Socony Mobil Oil Co., Mobiloil DTE, Medium.)

4.13 CAPSTAN AND CAPSTAN IDLER SIXTH-MONTH LUBRICATION (See Figure 4-1)

4.14 Every six months, or after each 1,000 hours of operation (whichever occurs first), lubricate the capstan and capstan idler as follows:

Step 1: Pry off rubber cap in capstan idler center.

Step 2: Remove the clip that secures the idler on its shaft. Use care to retain all washers or shims (which must be re-installed in the same positions), then lift the idler from its shaft.

Step 3: Pry off the plug button from around the capstan and remove the felt washer beneath it (do not put lubricant on the washer).

Step 4: Apply as much oil as the bearing will accept, then carefully wipe off excess oil. Re-install the felt washer and the plug button around the capstan.

Step 5: Install all washers and shims in original positions, and slide the capstan idler on the shaft. Place two drops of oil around the inner bearing surface, then rotate the idler to work the oil in. Wipe off excess oil. Replace the idler clip and the rubber cap.

Step 6: Carefully clean the capstan idler tire with isopropyl alcohol to remove any oil or other contamination including fingerprints.

Step 7: Lubricate the capstan lower bearing through the oil hole (see Figure 4-1) with exactly four drops of oil.

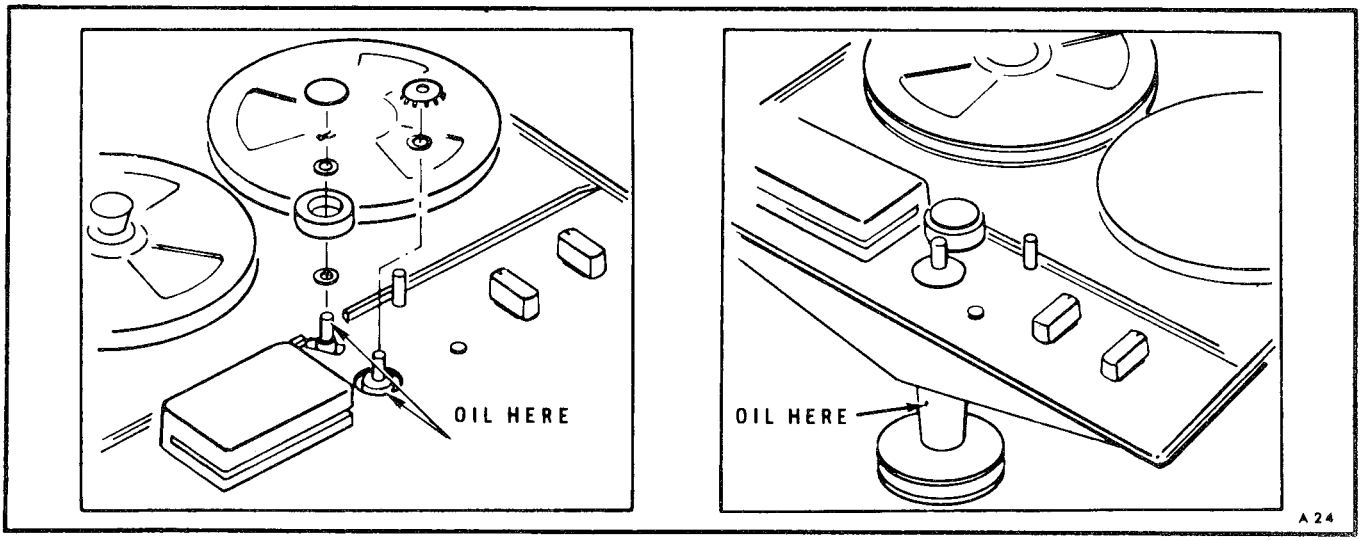

Figure 4-1. Capstan and Idler Bearing Lubrication

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4.18 PERFORMANCE CHECKOUTS

4.19 These checkouts should be regularly scheduled to determine when tape transport adjustment/alignment is required. Adjustment/alignment procedures are given in paragraph 5.41. Erased tape or blank tape can be used for the performance checks, or recorded tape can be erased during the recording portion of the procedure. Always bulk-erase any tape that was recorded on equipment with a different head configuration, to make sure that it is completely erased.

4.20 TRANSPORT CHECKOUT

4.21 TEST EQUIPMENT

4.22 Obtain the following test equipment, or equivalent:

1. Feeler Gauge, 0.015 inch
2. Spring Scale, 0-to-16 ounce
3. Spring Scale, 0-to-6 pound
4. Reel, EIA 2-1/4-inch diameter hub
5. Cord or string, about 30 inches long, with small loop tied in one end
6. Ampex Standard Flutter Tape:

   7-1/2 ips, Catalog No. 01-31326-01

   3-3/4 ips, Catalog No. 01-31336-01
7. Flutter Bridge, Micom Model 8155-01 or 8100-W; or Gotham Audio Model ME102B.
8. Technician hand tools

4.23 TAPE TENSION CHECK (See Table 4-1 and Figure 4-2)

4.24 Introduction

4.25 Tape tension is measured by determining the drive and holdback brake torque at each reel. Torque of the turntable pulling the tape is measured by holding the spring scale stationary against the motor drive force; torque of the turntable supplying tape is measured by the force required to rotate the reel in the normal direction (see Figure 4-2).

4.26 Torques are given in ounce-inches and in ounces. If an EIA reel, with a 2-1/4-inch diameter hub is used, the ounce indication on the spring scale applies. For any other hub size, multiply the spring scale indication by the hub radius for the ounce-inch figure.

4.27 Supply Turntable Tension

Step 1: Install empty reel on supply turntable and turn power ON.

Step 2: Wrap cord counterclockwise around reel hub with cord loop at free end.

Step 3: Insert spring scale hook in cord loop and set SPEED/EQUALIZATION switch for desired speed.

Step 4: Hold the scale stationary and set switch to REWIND. Tap reel lightly (to ensure a true reading) and compare scale indication to Table 4-1 requirements for rewind takeup tension.

Table 4-1. Tape Tension Requirements

TURNTABLE	MODE	TORQUE		TENSION DESIGNATION
		Ounce-inches*	Ounces (EIA Reel)	
Supply	Play (3-3/4 ips)	4.6-5.8	4.5	Holdback
	Fast Fwd. (7-1/2 ips)	0.75-1.25	0.67-1.1	Holdback
	Rewind	5.6-6.8	5-6	Takeup
Takeup	Play (3-3/4 ips)	2-3.5	1.75-3.1	Takeup
	Fast Fwd. (7-1/2 ips)	5.6-6.8	5-6	Takeup
	Rewind	0.75-1.25	0.67-1.1	Holdback

*For other than EIA reels, multiply scale indication by the reel hub radius to obtain ounce-inches.

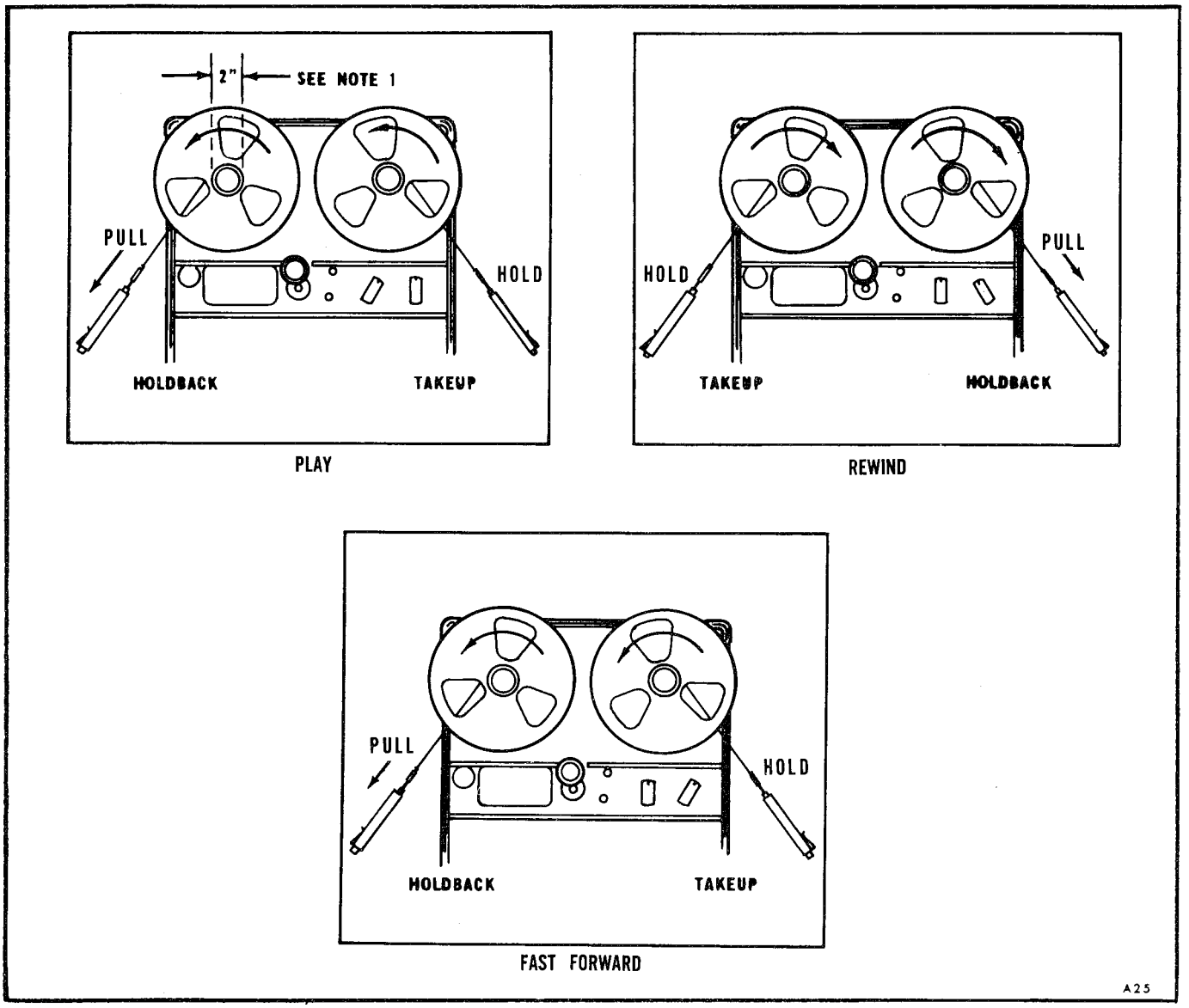

Figure 4-2. Tape Tension Measurement

Step 5: With spring scale still attached to cord, set switch to FAST FWD.

Step 6: Pull the scale slowly and steadily, then check scale indication to Table 4-1 requirements for fast-forward holdback tension.

Step 7: Set REWIND/FAST-FWD switch to neutral (dot).

Step 8: Set PLAY/REC to PLAY and pull the scale in a slow but steady motion. Check scale indication to Table 4-1 requirements for play holdback tension.

Step 9: Set PLAY/REC to neutral (dot).

Step 10: If necessary, adjust tension per paragraph 5.8.

Step 11: Repeat this procedure after any tension adjustment, and for the other tape speed.

4.28 Takeup Turntable Tensions

Step 1: Install empty reel on takeup turntable and turn power ON.

Step 2: Wrap cord clockwise around reel hub with cord loop at free end.

Step 3: Insert spring scale in cord loop and set SPEED/EQUALIZATION switch for desired speed.

Step 4: Hold the scale stationary and set PLAY/REC to PLAY. Tap reel lightly (to ensure a true reading) and compare scale indication to Table 4-1 requirements for play takeup tension.

Step 5: Return PLAY/REC to neutral (dot) position.

Step 6: Set REWIND/FAST-FWD to REWIND. Pull scale slowly and steadily (reel turns clockwise), then check scale indication to Table 4-1 requirements for rewind holdback tension.

Step 7: Set REWIND/FAST-FWD to neutral (dot).

Step 8: If necessary, adjust tension per paragraph 5.9.

Step 9: Repeat this procedure after any tension adjustment and for the other tape speed.

4.29 IDLER PRESSURE CHECK (See Figure 4-3)

4.30 To check the capstan idler pressure against the capstan, tie the cord or twine ends together to form a continuous loop. Place the loop around the capstan idler shaft between the idler and the arm.

4.31 Turn power ON. Insert the hook on the 0-to-6 pound spring scale in the loop, and pull the loop taut in the direction of normal capstan idler movement 90° to the arm (the scale will then be about over the tape-position indicator counter).

4.32 Initiate play mode. Pull on the scale, in the direction of normal capstan idler movement, until the idler doesn't contact the capstan. Read the scale indication just as the idler leaves the capstan (idler rotation stops). The scale should indicate 5, ±0.5, pounds.

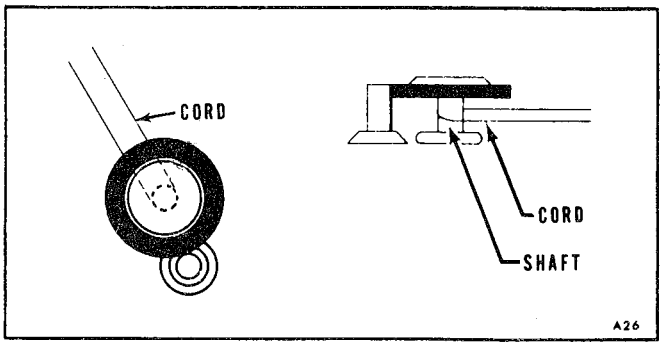

Figure 4-3. Idler Pressure Measurement

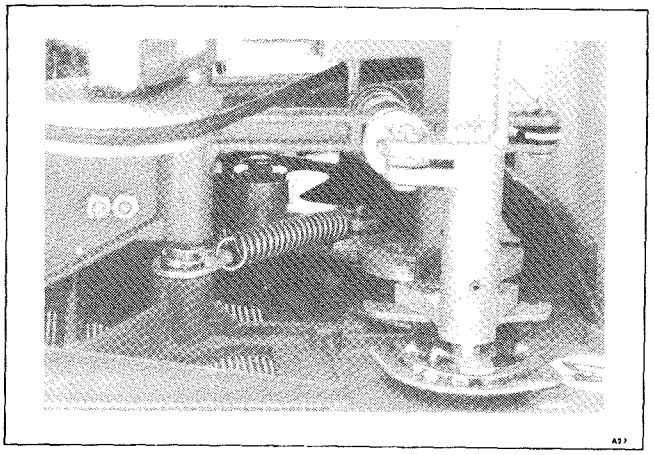

Figure 4-4. Capstan Idler Pressure Spring

4.33 Since there is no adjustment for idler pressure, the pressure spring (see Figure 4-4) must be replaced to correct the pressure.

4.34 FLUTTER AND WOW CHECK

4.35 Test Tape Requirements

4.36 This check must be made with Ampex Standard Alignment Test Tapes. These tapes, recorded on very precise equipment, have an inherent flutter below 0.03% rms (which can be ignored). Alignment test tapes must be used only at the speed they are made for. The tapes must be correctly handled and stored to retain their accuracy. The following requirements should especially be followed:

a. Clean and demagnetize equipment heads and other tape-handling components before installing the test tape (refer to paragraph 4.2).

b. Never store test tapes in areas where there are temperature or humidity extremes, or magnetic field sources such as magnets, motors, transformers, generators, loudspeakers, etc.

c. Remove test tapes from equipment only after a normal play run (never after a fast-winding mode).

4.37 Tape Degradation

4.38 After extensive use, flutter indications may increase even though actual flutter remains unchanged. Flutter increase is caused by: demagnetization of the recorded signal from repeated runs; tape deformation due to tape tension; changes in temperature and humidity; poor head-to-tape contact; and increased dropouts resulting from tape wear.

4.39 Test Procedures

4.40 This procedure applies to the use of the Micom 8100-W flutter bridge. If a different flutter bridge is used, the manufacturer's instructions should be followed. Check tape flutter as follows, on correctly-aligned equipment:

Step 1: Disconnect all equipment interconnections except that for the power.

Step 2: Thread the flutter-test tape on the equipment with the tape on the takeup turntable. Rewind the tape to reel on the supply turntable (this allows the flutter tape to be stored without rewinding).

CAUTION

WHEN THE FLUTTER-TEST TAPE IS ON THE EQUIPMENT, DO NOT INITIATE THE RECORD MODE, OR THE TAPE WILL BE ERASED.

Step 3: Connect the flutter bridge SIGNAL INPUT connector to the electroni OUTPUT connector.

Step 4: Set PLAY/REC to PLAY.

Step 5: Set the flutter meter FLUTTER WEIGHTING control to NAB UNWTD; the DEMOD INPUT SELECT to 100 MV - 5V EXT SIGNAL; the METER SELECT to DEMOD; and FLUTTER % FULL SCALE to 0.3%.

Step 6: Read indication on the FLUTTER meter and if necessary, reposition the FLUTTER % FULL SCALE control. Flutter indication should meet specifications (Table 1-1, Section I).

Step 7: When the tape is completely wound on the takeup reel, stop the recorder, remove the reel, label or mark the reel "Rewind Before Using", and store it in a safe place.

Step 8: To correct excessive flutter, refer to paragraph 4.41 and then 5.72.

4.41 Flutter Analysis Aids

4.42 As an aid in determining flutter causes, a sound-and-vibration analyzer (such as General Radio Type 1564-A) can be used to isolate flutter to certain frequencies, by connecting the analyzer to the flutter bridge output. Compare the results with the rotational rates in Table 4-2 for a possible indication of the source of flutter problems.

4.43 If flutter is caused by the supply turntable assembly, the frequency will be low when the tape quantity on the supply reel is large, and will gradually increase as the tape quantity gets smaller. The takeup turntable assembly seldom causes appreciable flutter, because it is isolated from the heads by the capstan. If it causes flutter, the frequency change would vary inversely to that of the supply turntable (high with a small tape quantity on the takeup reel, and decreasing as the quantity increases).

4.44 ELECTRONIC CHECKOUTS

4.45 TEST EQUIPMENT

4.46 Obtain the following test equipment, or equivalent:

1. Signal Generator, Hewlett-Packard Model 200C
2. Vacuum Tube Voltmeter, AC, Hewlett-Packard Model 400D
3. Wave analyzer (if available)
4. Bias Filter (see Figure 4-5)
5. Bandpass Filter (see Figure 4-6)

4.47 TEST CONDITIONS

4.48 Check that the following test conditions are met:

1. Line Output terminated in 600 ohms

Table 4-2. Component Rotational Rates

COMPONENT	TAPE SPEED	
	7-1/2 ips	3-3/4 ips
	ROTATIONAL RATE (rps)	
Capstan	9.5	4.8
Capstan Idler	1.6	0.8
Motor Pulley	30	30
Drive Belt	5.6	2.8
Motor	30	30
Rotary Guide	3.8	1.9

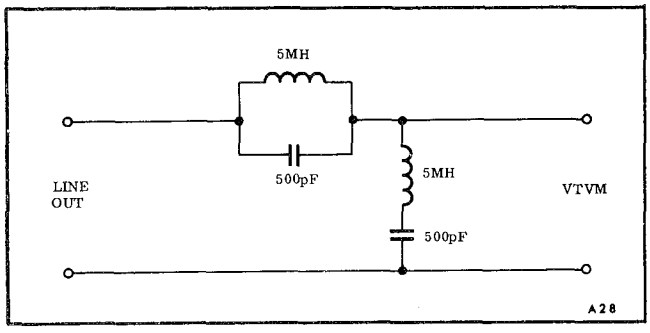

Figure 4-5. Bias Filter Schematic

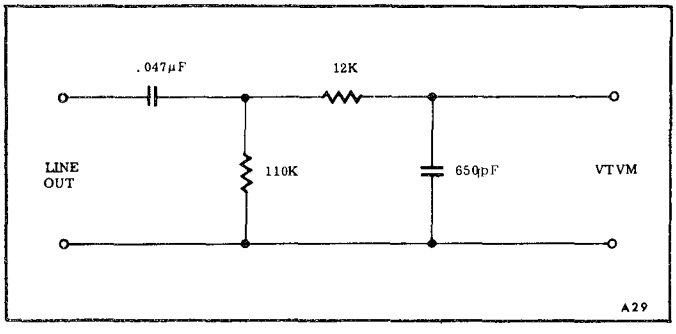

Figure 4-6. Bandpass Filter Schematic

2. Dummy plug installed (instead of accessory)

3. Heads cleaned and demagnetized

4. Covers installed on electronic assemblies

5. Magnetic tape, Ampex 631, or equivalent, installed

4.49 POWER SUPPLY CHECK

4.50 The power supply operation can be easily checked at an input-accessory socket on the electronic assembly. The power supply cannot be adjusted.

Step 1: Remove one of the dummy plugs from INPUT ACCESSORY (J5 or J7).

Step 2: Turn power ON.

Step 3: Initiate the record mode (tape is not required on the transport).

Step 4: Connect a dc voltmeter between accessory socket pin 5 (counted counterclockwise from the socket key) to chassis ground. Voltage should be 22 to 24.5 volts.

4.51 FREQUENCY RESPONSE CHECK

4.52 This check can be made while simultaneously recording and reproducing using a bias filter (see Figure 4-5).

Step 1: Connect the signal generator to pins 1 and 3 of either INPUT connector (A or B). Set the generator to 500 Hz, at a nominal 1-volt level.

Step 2: Connect the bias filter to the OUTPUT connector, and the vtvm to the filter output.

Step 3: Set OUTPUT SELECTOR to INPUT. Adjust applicable RECORD LEVEL to indicate a -10 dBm output on the vtvm. Set OUTPUT SELECTOR to REPRODUCE.

Step 4: Set SPEED/EQUALIZATION switch for desired tape speed.

Step 5: Install blank tape on transport and initiate the record mode.

Step 6: During this simultaneous recording and reproducing, change the signal generator frequency in even steps through the response spectrum of the tape speed (refer to Section 1). Response indicated on the vtvm should remain within specifications.

Step 7: To check at the second tape speed, repeat Steps 4, 5, and 6.

Step 8: On two-channel equipment, repeat the procedure for the second channel.

Step 9: Perform corrective action per paragraph 5.65.

4.53 SIGNAL-TO-NOISE CHECK (See Table 4-2)

4.54 This check requires the use of an output bandpass filter (Figure 4-6).

Step 1: Connect the signal generator to either INPUT connector (A or B). Set the generator to 500 Hz, at a nominal 1-volt level.

Step 2: Connect the bandpass filter to the OUTPUT connector, and the vtvm to the filter output.

Step 3: Set OUTPUT SELECTOR to INPUT, and adjust applicable RECORD LEVEL to indicate a +10 dBm output on the vtvm.

Step 4: Set SPEED/EQUALIZATION switch for desired tape speed.

Step 5: Install blank tape on transport, and initiate the record mode to record a tape section with the 500-Hz signal.

Step 6: Stop transport and rewind tape to the beginning of the recording just made.

Step 7: Remove the signal generator from the input, then set OUTPUT SELECTOR to REPRODUCE.

Step 8: Initiate the record mode, with no input signal. While thus erasing the 500-Hz signal, check noise level indicated on vtvm and add 10 dB. The result should be within the specifications given in Section 1.

NOTE

Signal-to-noise ratio is computed from peak record level (6 dB higher than normal); therefore the signal-to-noise ratio is 10 dB above the vtvm indication, and the vtvm indication must be increased by 10 dB.

Step 9: Check at the other tape speed by repeating steps 4 through 8.

Step 10: On two-channel equipment, repeat the procedure for the second channel.

Table 4-3. Reproduce Signal/Noise from Peak Record Level

TAPE SPEED	HEAD TRACK TYPE	Signal/Noise Reproduce (from 3% level)
7-1/2 ips (NAB)	Full	62 dB
	Half, Double, Quarter	60 dB
7-1/2 ips (CCIR)	Full	62 dB
	Half, Double, Quarter	57 dB
3-3/4 ips (120 USEC)	Full	62 dB
	Half, Double, Quarter	60 dB

Step 11: To check reproduce noise, remove the tape and connect the vtvm through the bandpass filter to the OUTPUT receptacle. Initiate the play mode. The signal-to-noise ratio should be as shown in Table 4-3 (the figures are also computed from peak level, as explained in the above note).

Step 12: Correct the signal-to-noise ratio per paragraph 5.70.

4.55 DISTORTION CHECK

4.56 For accurately checking distortion, use a wave analyzer which measures individual distortion products (instruments that measure total harmonic distortion are affected by tape noise and modulation noise). Also, to avoid error, use a signal generator with less than 0.1% distortion.

4.57 To check distortion, record a 500-Hz signal on blank tape, at normal operating level, then reproduce the signal. The second harmonic content should not exceed 0.4%, and the third should be 0.6 to 1.1%.

4.58 Check reproduce distortion on a unit that is correctly adjusted, and has a head track configuration identical to the recorder head that recorded the tape. For possible distortion corrections, refer to paragraph 5.67.