SECTION V
MAINTENANCE

GENERAL

This section provides maintenance information for the AG-440C Recorder/Reproducer. Maintenance information, following this general discussion, is grouped under nine main headings: *Overall Test Equipment Requirements, Preventive Maintenance, Performance Tests, Tape Transport Adjustments, Electronic Alignment, Head Maintenance, Transport Maintenance, Removal of Electronic Assemblies and Components*, and *Troubleshooting*.

Under the heading *Overall Test Equipment Requirements*, Table 5-1 gives suitable test equipment (mechanical and electronic) for testing, adjustment, and maintenance of the AG-440C.

Preventive Maintenance includes procedures for cleaning, demagnetizing, and lubrication. Information under *Performance Tests* includes overall performance checkout for frequency response, signal-to-noise ratio, distortion, flutter, and speed accuracy. *Tape Transport Adjustments* provides procedures for adjusting tape tension, brakes, and the capstan idler. *Electronic Alignment* covers adjustment of power supply voltages, bias oscillator frequency, and calibration adjustments of record/reproduce electronic circuitry. *Head Maintenance* covers mechanical adjustments of the head assembly and provides head removal and installation procedures. *Transport Maintenance* provides servicing hints for the tape transport and provides detailed procedures for removal and replacement of tape transport components and assemblies. *Troubleshooting* discusses a number of the most common problems (electronic and mechanical) and provides suggestions for correcting these problems.

OVERALL TEST EQUIPMENT

All electronic and mechanical test equipment required during testing, alignment, adjustment, or maintenance of the recorder/reproducer is listed in Table 5-1. In Table 5-1 items 1 through 8 are used during Performance Tests, items 1 through 11 during Electronic Alignment, and items 12 through 15 are required for Tape Transport Adjustments. Equivalent equipment can be substituted for the equipment suggested in the table.

Table 5-1. Overall Test Equipment Requirements

ITEM NUMBER	EQUIPMENT TYPE	SUGGESTED MODEL	USED FOR
1	Audio Oscillator	Hewlett-Packard, Model 204C or 209D	Response and distortion tests
2	AC Vacuum Tube Voltmeter (VTVM)	Hewlett-Packard, Model 400D	Noise Test
3	Wave Analyzer	Hewlett-Packard, Model 302A	Distortion Test
4	Flutter Meter	Micom (Bahrs) Model B8100 or B100W	Flutter Test
5	Tape-Speed Strobe	Dubbings Electronics Model Deluxe AA for 7-1/2, 15, or 30 in/s	Speed Test

Table 5-1. Overall Test Equipment Requirements (Continued)

ITEM NUMBER	EQUIPMENT TYPE	SUGGESTED MODEL	USED FOR
6	Standard Alignment Tape	Refer to Table 5-2	Reproduce head azimuth, reproduce response, and operating level adjustment
7	Noise Filter 30 Hz to 18 kHz or ASA "A" weighted filter	See Figures 5-2 and 5-3	Noise Measurement
8	Flutter Test Tapes	Refer to Table 5-5	Flutter Test
9	DC Voltmeter (20,000-ohm/volt)	Any	Test and adjustment of power supply voltages
10	Frequency Counter or Oscilloscope	Hewlett-Packard 5221A or Tektronix 453	Bias Frequency Measurement
11	Flux Loop	Ampex 4050238-02	Reproduce Equalization
12	Spring Scales	Chatillon, 0-16 oz. and 0-10 lbs.	Tape Transport Adjustments
13	Cord or twine, about 30 in. long, with small loop at one end		
14	Empty reel, NAB hub		
15	Technician Tools		

PREVENTIVE MAINTENANCE

It is important that routine maintenance be performed at the recommended intervals. Cleaning and demagnetization procedures should be performed after each eight hours of operation.

The AC capstan drive motor requires lubrication initially (when the recorder/reproducer is installed), and at three month intervals thereafter. The capstan drive motor of tape transports equipped with the servo version drive motor, does not require initial or periodic lubrication.

Lubrication required at three month and annual intervals is discussed later in this section under the head *Lubrication.*

CLEANING

Oxide particles from the magnetic tape tend to collect on components in the tape path. These oxide accumulations degrade the performance of the recorder/reproducer. The heads and all other components in the tape path must be cleaned after each eight hours of operation, or more frequently if visual inspection indicates cleaning is needed.

Clean each head thoroughly with a cotton-tipped applicator dampened with Ampex Head Cleaner (Catalog No. 4010823 or 087-007).

CAUTION

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

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

CAUTION

DO NOT USE AMPEX HEAD CLEANER ON TAPE-GUIDING COMPONENTS, THE CAPSTAN, OR THE CAPSTAN IDLER.

Clean scrape-flutter idlers with a dry cotton-tipped applicator. Be sure to remove all oxide from the top and bottom of the roller holder assemblies.

DEMAGNETIZING

The head should be demagnetized after each eight hours of operation. Heads and other components in the tape path can acquire permanent magnetization that increases signal noise and distortion and partially erases high frequencies on recorded tapes. Use an Ampex Head Demagnetizer (Catalog No. 4010820) or equivalent to demagnetize components in the tape path.

NOTE

Remove recorded tape from the vicinity of the demagnetizer to prevent accidental tape erasure.

Proceed as follows:

1. Turn equipment power off and remove any recorded tape that is near the transport.

2. Cover the demagnetizer tips with an adhesive tape.

3. Connect the demagnetizer to a 110-120 Vac power source.

4. Lightly touch the demagnetizer tips simultaneously to the faces of one head stack.

5. Using a slow even motion, move the demagnetizer tips up and down the stack several times. Then, slowly withdraw the demagnetizer.

6. Repeat steps 4 and 5 at each head stack.

7. Move the demagnetizer at least two feet from the recorder/reproducer and then unplug the demagnetizer.

LUBRICATION

The only parts of the AG-440C Recorder/Reproducer that require lubrication are the bearings in the AC capstan drive motor (if applicable), the capstan idler, and the scrape-flutter idler. Ampex Lubricating Oil (Catalog No. 4010825 or 087-579) is recommended for the capstan motor and capstan idler. (Equivalent oils are Esso Standard Oil Co., Teresso No. 47 and Socony Mobil Oil Co., Mobiloil DTE, Medium.) Scrape-flutter idlers require the special equipment and oil described in the paragraph headed *Scrape-Flutter Idler Lubrication.*

AC Capstan Motor, Initial Lubrication

A procedure for the initial lubrication of an AC capstan motor is presented in the Installation section of this manual under the heading *Initial Lubrication*. (The servo-controlled DC capstan motor does not require lubrication.)

AC Capstan Motor and Capstan Idler, 3-Month Lubrication

The AC Capstan motor and the capstan idler should be lubricated every 3 months or after each 1,000 hours of operation.

AC Capstan Motor. Proceed as follows:

1. Use a knife blade or similar tool and gently pry up the metal dust cover from around the capstan shaft (Figure 5-1).

2. For motors that have an oil hole in the end bell, fill oil reservoir through the oil hole. For motors without an oil hole, lubricate motor bearings by applying ten drops of oil around the base of the capstan shaft while manually rotating the shaft.

CAUTION

BE CERTAIN TO CLEAN CAPSTAN SHAFT THOROUGHLY AS THE LUBRICATING OIL CAN RUIN THE CAPSTAN IDLER AND MAGNETIC TAPE. IF NECESSARY, CLEAN THE CAPSTAN IDLER WITH ISOPROPYL ALCOHOL.

3. Wipe oil off capstan shaft and surrounding parts. Then replace metal dust cap.

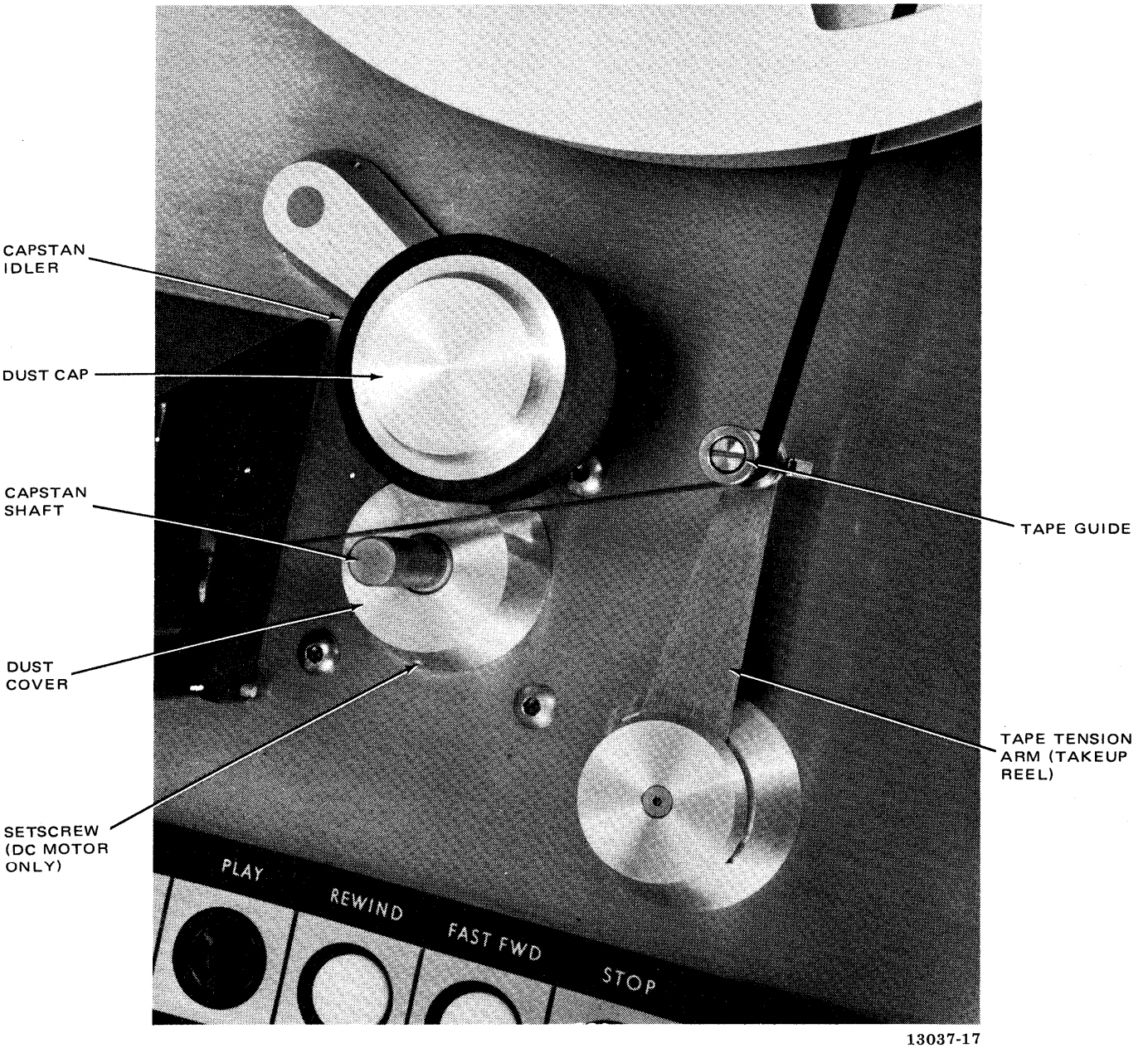


Figure 5-1. Tape Drive and Takeup Tensioning Components

Capstan Idler. Proceed as follows:

1. Use a knife blade or similar tool and gently pry up the dust cover from the hub of the capstan idler to expose the felt washer.

2. Apply sufficient oil to *just* saturate the felt washer.

3. Remove any excess oil from the hub of the capstan idler. Refer to the previous CAUTION.

4. Replace the dust cap.

Scrape-Flutter Idler Lubrication

Ultrasonically clean and then lubricate the scrape-flutter idlers once a year or after each 2,000 hours

of operation. This cleaning and lubrication can possibly be done by a local jeweler or watchmaker, who would usually have the ultrasonic cleaner and special jewel oil required. Otherwise, clean and lubricate the idler as follows:

1. Remove head assembly. (Refer to heading *Changing Heads*, in Section II.)

2. Remove idler assembly retaining screw and lockwasher. Then lift idler assembly off locating pin.

3. Ultrasonically clean the complete scrape-flutter idler assembly.

4. Lubricate each jewel bearing with one drop of jewel oil (or Ampex precision instrument oil No. 087-239). Use a No. 21 gauge hypodermic needle to apply oil to bearing.

5. Mount idler assembly on locating pin and secure, using screw and lockwasher.

PERFORMANCE TESTS

Performance tests should be performed at regularly scheduled intervals, to ensure that the recorder/reproducer is performing in accordance with the specifications given in Table 1-5. Performance tests should also be performed whenever the equipment appears to be malfunctioning and following repairs to the equipment that may affect performance.

TEST EQUIPMENT

The equipment listed in Table 5-1, items 1 through 8 (or equivalent) is required for completion of the performance tests. Included in the test equipment listed in Table 5-1 are: Alignment tapes (Table 5-2), flutter test tapes (Table 5-5), and filters used during noise measurement tests (Figures 5-2 and 5-3).

Standard test tapes (Table 5-2) are precisely recorded in an Ampex laboratory and must be correctly handled and stored to retain their accuracy. The following requirements should especially be followed.

1. Clean and demagnetize the heads and other tape-handling components before installing the test tape.

2. Never store test tapes in areas where there are temperature or humidity extremes.

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

After extensive use, high-frequency tones may drop as much as 2 dB, and flutter indications may rise even though actual flutter remains unchanged.

Table 5-2. Full Track Standard Alignment Tapes

SPEED	TYPE OF EQUALIZATION	TAPE WIDTH	
		1/4 INCH TAPE	1/2 INCH TAPE
3-3/4	NAB (90 μs and 3180 μs)	4690037-01	–
	EIA (120 μs and 3180 μs)	01-31331-01	–
7-1/2	NAB (50 μs and 3180 μs)	01-31321-01	01-31321-05
	IEC (CCIR) (70 ms and ∞)	4690014-01	4690015-01
15	NAB (50 μs and 3180 μs)	01-31311-01	01-31311-05
	IEC (CCIR) (35 μs and ∞)	01-31313-01	01-31313-05
30	AES (17.5 μs and ∞)	4690093-01	4690085-01

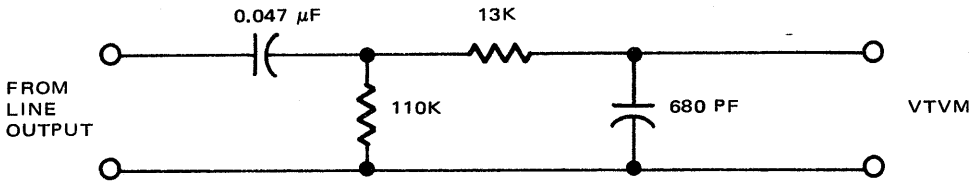


Figure 5-2. 30 Hz to 18 kHz Noise Filter

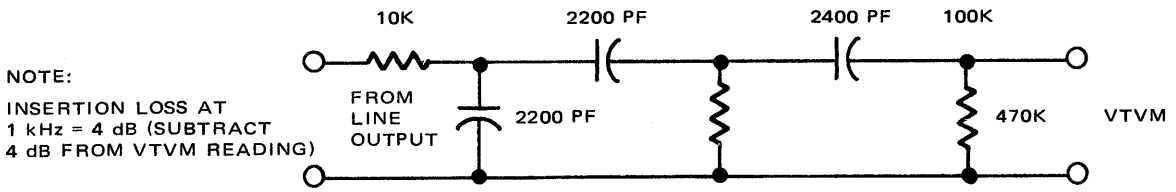


Figure 5-3. ASA "A" Weighted Filter

Flutter increase is caused by: demagnetization of the recorded signal from repeated runs; tape deformation due to tape tension, changes in temperature and humidity; and increased dropouts resulting from tape wear.

The test tape is threaded in the normal tape path (from the supply to takeup turntable). During the alignment procedures, the rewind and fast forward modes may be used as necessary. After alignment, wind the tape completely on the takeup reel, interchange reels, thread the tape, and place the equipment in the reproduce mode to wind the tape back on its original reel.

All tones on 15-in/s or 30-in/s standard alignment tapes are recorded at operating level. On slower speed tapes, all tones are recorded 10 dB below operating level, except for the last tone.

OPERATING-LEVEL CHECK

The specifications presented in Table 1-5 apply to an AG-440C Recorder/Reproducer using Ampex 406 high-output, low-noise tape (or equivalent) at a 260 nWb/m operating level. Some of these specifications may not be achievable using other tapes or operating levels. If in doubt about the existing level, proceed as follows:

1. Place a standard alignment tape (Table 5-2) on the supply reel. Thread tape according to Figure 3-1.

2. Set controls of the record/reproduce unit for each channel to be checked as follows:

   a. Set REPRODUCE LEVEL control to CAL.

   b. Press SAFE pushbutton.

3. Set SPEED switch to appropriate position.

4. Set REEL switches to appropriate positions.

5. Press PLAY pushbutton. The 185 nWb/m, 700-Hz operating level tone should produce a −3 VU indication on the VU meter if the recorder/reproducer is adjusted for a 260-nWb/m operating level. It will produce a 0 VU indication when adjusted for 185 nWb/m operating level.

TEST CONDITIONS

The test conditions specified in steps 1 through 8 below are to be set up prior to continuing with the performance test. After these test conditions are set up, continue with the procedures that follow for checking Overall Frequency Response, Overall Signal-To-Noise, and the Overall Distortion Check.

1. Externally terminate each line output and set LINE TERM switch(es) to off position(s) (down); or, if no external load(s) is (are) to be used (or impedance of external load is more than 2,000 ohms), set LINE TERM switch(es) to ON.

2. Install dummy plug(s) or appropriate input accessory unit(s) into INPUT ACCESS connector(s).

3. Clean and demagnetize heads and other tape-path components. (Refer to *Preventive Maintenance* portion of this section.)

4. Install a reel of blank tape on the recorder/reproducer and thread the tape according to Figure 3-1.

5. Set SPEED switch to appropriate position.

6. Set REEL switches to appropriate positions.

7. Set REPRODUCE LEVEL and RECORD LEVEL controls to CAL.

8. Switch recorder/reproducer POWER switch to ON.

OVERALL FREQUENCY RESPONSE

Either the VU meters of the recorder/reproducer or an external VTVM can be used to measure signal level during the overall frequency response test. The recommended signal level for checking frequency response is 14 dB below operating level for 3-3/4-in/s and 7-1/2-in/s tape speed. Proceed as follows:

1. Connect a signal generator to the INPUT connector of the record/reproduce unit of the channel to be tested.

2. Adjust the signal generator output frequency to 700 Hz.

3. If desired, connect a VTVM to the OUTPUT connector of the record/reproduce unit of the channel to be tested. Otherwise, use the front-panel VU meter.

4. Press the READY and INPUT pushbuttons and set RECORD LEVEL and REPRODUCE LEVEL controls to CAL.

5. If the VU meter is being used for response measurements, set the signal generator to the reading given in Table 5-3 (column 4) for the tape speed being used. When using an external VTVM, set the signal generator to the reading given in column 3 of Table 5-3 for the tape speed and line level being used.

6. Start the tape in the record mode of operation.

7. Depress the reproduce pushbutton. If a VTVM is being used, readjust the signal

Table 5-3. Recommended Signal Levels for Checking Frequency Response

METER SENSITIVITY (LINE LEVEL)	TAPE SPEED	VTVM READING MONITORING INPUT OR REPRO.	VU METER READING MONITORING INPUT
+8	3-3/4 or 7-1/2	−6 dBm	20% mark
+8	15 or 30	+8 dBm	0
+4	3-3/4 or 7-1/2	−10 dBm	20% mark
+4	15 or 30	+4 dBm	0

generator level if necessary to give the VTVM reading shown in column 3 of Table 5-3. If VU meters are being used, adjust the reproduce level control for a 0 meter reading.

8. While simultaneously recording and reproducing, vary the oscillator frequency and check the response on either the VU meter or VTVM.

9. Repeat this procedure on other channels or at the other tape speed.

OVERALL SIGNAL-TO-NOISE

The overall signal-to-noise test requires either a 30-Hz to 18-kHz noise filter (Figure 5-2) or an ASA "A" weighted filter (Figure 5-3) to attenuate noise outside of the audible-frequency band. However, since each of these filters attenuates frequencies above its bandpass at 6 dB per octave, neither filter completely removes inaudible high-frequency noise. Therefore, the overall signal-to-noise test should not be performed while simultaneously recording and reproducing a test signal because high-frequency bias-signal pickup may affect the test results.

The signal-to-noise ratio specified in the following test procedure is referenced to a peak record level that is 6 dB above operating level (520 nWb/m) when using Ampex 406 tape. If conventional tapes are used at a peak record level of 370 nWb/m, the signal-to-noise ratio will be degraded depending upon the actual tape used. To convert a VTVM measurement to peak signal-to-noise ratio, change the sign of the VTVM indication and add the number listed in Table 5-4. The result of the addition is a peak record-level signal-to-noise ratio expressed in dB. For example, if the recorder was adjusted with a +4 VU meter sensitivity and ASA, "A" weighted noise is being measured, a VTVM reading of −62.5 dBm indicates a peak signal-to-noise ratio of 62.5 +6, or 68.5 dB.

Perform signal-to-noise test on desired record/reproduce unit as follows:

1. Perform all steps of test setup procedure.

2. Connect either the 30-Hz to 18-kHz noise filter or an ASA "A" weighted filter to the OUTPUT connector.

3. Connect VTVM to filter output.

CAUTION

DO NOT CONNECT ANY OTHER LOADS TO THE INPUT OF THE VTVM BECAUSE THE ADDITIONAL LOADING MAY CHANGE THE CHARACTERISTICS OF THE FILTER.

4. Disconnect any cable that may be connected to the INPUT connector.

5. Set RECORD LEVEL control to the off position (slightly clockwise from CAL position).

6. Set REPRODUCE LEVEL control to CAL position.

7. Press READY and REPRO pushbuttons on all record/reproduce units.

8. Press PLAY and then RECORD pushbuttons.

NOTE

Steps 7 and 8 place all channels of the recorder/reproducer in the record mode.

Table 5-4. Signal-to-Noise Conversion Numbers

METER SENSITIVITY (LINE LEVEL)	30-Hz TO 18-kHz FILTER CONVERSION NUMBER	ASA "A" WEIGHTED FILTER CONVERSION NUMBER*
+8	14	10
+4	10	6

*This number applies to a filter with 4-dB attenuation at 1 kHz.

Placing all channels in the record mode prevents the possibility of a previous recording on an adjacent track cross-talking into the channel under test.

9. Press STOP and then REWIND pushbuttons, allow tape to rewind to beginning of recording made in step 8, then press STOP pushbutton.

10. Press PLAY pushbutton.

11. Note indication of VTVM. Calculate the signal-to-noise ratio using the technique described in the test associated with Table 5-4.

OVERALL DISTORTION CHECK

For accurately checking distortion use a wave analyzer which measures individual distortion products. Instruments that measure total harmonic distortion are inadequate because they will measure modulation noise and tape noise in addition to the distortion products. Also, to avoid error, use a signal generator with less than 0.2% distortion products.

To check distortion, record a 500-Hz signal at normal operating level. The second harmonic distortion should be below 0.4%. The third harmonic distortion will normally be between 0.6% and 1.1% and is dependent on the type of tape, bias adjustment and the accuracy of the "normal operating level" adjustment.

FLUTTER CHECK

It is recommended that these checks be made with Ampex standard flutter test tapes (see Table 5-5) which are recorded on precise equipment and have less than 0.03% rms flutter. If flutter tapes are not available, it is possible to record a 3000-Hz or 3150-Hz signal to be used for a flutter measurement. After recording a section of tape, rewind to the beginning and start the tape in the reproduce mode. Since it is possible for the record mode flutter to either add or subtract from the reproduce mode flutter depending upon the phase relationship, it is necessary to make several passes over the recorded section of tape and average the flutter meter readings.

Flutter meters are sensitive to amplitude modulation that results from poor head-to-tape contact or from signal dropouts. Therefore, clean the heads before making flutter tests. The following procedure applies to the use of a Micom (Bahrs) Model 8100 flutter meter. If a different flutter meter is used, the manufacturer's instructions should be followed.

Table 5-5. Flutter Test Tapes

TAPE WIDTH (INCHES)	SPEED (IN/S)	FREQUENCY (HZ)	AMPEX CATALOG NO.
1/4	3-3/4	3000	01-31336-01
1/4	3-3/4	3150	4690013-01
1/4	7-1/2	3000	01-31326-01
1/4	7-1/2	3150	4690012-01
1/4	15	3000	01-31316-01
1/4	15	3150	4690011-01
1/4	30	3000	4690099-01
1/2	7-1/2	3000	01-31326-05
1/2	7-1/2	3150	4690012-05
1/2	15	3000	01-31316-05
1/2	15	3150	4690011-05
1/2	30	3000	4690099-05

Perform the flutter check as follows:

1. Set pushbuttons at SAFE and REPRO, reproduce level control in CAL.

2. Connect the output receptacle to the flutter meter signal input connector.

3. Set the flutter meter controls as follows:

   a. Set the Demod. Input Select to line or 100 MV –5V.

   b. Set the Meter Select to Demod.

   c. Set the Weighting Control to DIN (unweighted or weighted, depending upon which flutter reading is desired).

   d. Set the % Full Scale Selector to 0.3 or 0.1 depending on the reading anticipated.

4. Apply power to the recorder and flutter meter.

5. Thread a flutter test tape on the transport with the tape reel on the takeup turntable. Rewind the tape to a reel on the supply turntable. Set the tape speed to conform to the test tape. Set reel switches to the reel hub sizes in use.

6. Start the test tape in motion in the reproduce mode. The Normal lamp on the flutter meter should light showing that the reproduce output is at the correct level for the flutter meter.

7. Read the indication on the flutter meter, repositioning the % Full Scale Selector on the flutter meter as required. The flutter should meet the specifications given in Section I.

8. Allow the flutter test tape to completely unwind from the supply reel.

MEASURING TAPE SPEED

The recommended method of measuring tape speed is to use an NAB speed measuring pulley similar to that manufactured by Dubbings Electronics. The speed measuring pulley incorporates a strobe disc so that the strobe bars will be stationary when illuminated from 60-Hz lamps (flashing at a 120-Hz rate). When held against a tape whose thickness is 0.0019 inch (1.5 mil tape), the strobe bars will remain stationary when the tape is traveling at nominal speed. The NAB speed measuring pulley is 1.4305/1.4307 diameter and contains 18 bars for 30 in/s, 36 bars for 15 in/s, etc. To calculate speed error; count the number of bars that drift past a fixed reference point in a measured period of time. The speed error in percent can be calculated by dividing the bars passing the point-per-minute by 72.

Measure tape speed as follows:

1. Apply power and thread a blank tape 0.0019 inch thick (1.5 mil tape) on the transport. Set tape speed and set reel switches for the reel hub size in use.

2. Start the tape and hold the speed measuring pulley lightly against the tape between the capstan and the head assembly.

NOTE

The speed of the tape at the capstan is not the same as at other places in the tape path. The elastic magnetic tape is subjected to different tensions in different portions of the tape path. Portions of the tape stretched by a high tension must travel faster than portions of the tape subjected to a lower tension.

3. Count the bars that move past a given point in a particular time. Be sure to count the bars in the pattern that agree with the tape speed selected. Calculate the speed error from the formula; bars per minute divided by 72 equals the speed error in percent.

TAPE TRANSPORT ADJUSTMENTS

When a failure is noted during the performance test given earlier in this section, adjustment, alignment, or troubleshooting is required.

TEST EQUIPMENT

Test equipment required for tape transport adjustments is given in Table 5-1 (items 12 through 15 or equivalent).

TAPE TENSION

The tape transport may be used under three conditions of tape width: 1/4 inch only, 1/2 inch only, or combined 1/4 inch and 1/2 inch. In Table 5-6 the tensions listed for 1/2 inch only are identical to those needed for combined 1/4 and 1/2-inch operation. Therefore, machines shipped from the factory with 1/2-inch head assemblies may be used with 1/4-inch tape without readjustment. Machines shipped with 1/4-inch head assemblies are adjusted with the 1/4 inch only tensions. If the 1/4-inch head is replaced with a head having a 1/2-inch tape width capability, the tape tension should be reset.

Tape tension is determined indirectly by measuring the torque of both tape reel motors. Required tension adjustments are made by positioning sliders on the resistors under the cover of the transport control box (Figure 5-4).

CAUTION

WHEN TRANSPORT POWER SWITCH IS ON, FULL LINE VOLTAGE IS PRESENT AT THE RESISTORS. TURN POWER OFF WHEN ADJUSTING THESE RESISTORS.

In the following steps, an empty NAB (4-1/2 inch hub) reel is used, and the cord (or twine) is wrapped on the reel being checked in the same direction as recording tape is pulled onto that reel. The spring scale is hooked onto a small loop formed in the free end of the cord and is held stationary, with little or no slack in the cord, so that it will indicate cord tension when PLAY or a FAST WIND button is pushed.

NOTE

An empty EIA (2-1/4 inch hub) reel may be used, but in this event, all of the scale readings of Table 5-6 must be doubled in value.

1. In adjusting resistors during the following steps, loosen contact screws just enough to slide the contacts, then tighten screws just enough to make good electrical contact.

Table 5-6. Tape Tension Adjustment

TAPE WIDTH	PLAY HOLDBACK TENSION		PLAY TAKEUP TENSION		FAST WIND HOLDBACK
	LARGE REEL	SMALL REEL	LARGE REEL	SMALL REEL	LARGE REEL
1/4 inch only	6 ± 1/2 oz. (155 to 185g)	3 ± 1/2 oz. (70 to 100g)	7 ± 1/2 oz. (185 to 215g)	4 ± 1/2 oz. (100 to 130g)	1 ± 1/4 oz.[2] (20 to 35g)
1/2 inch only or 1/4 inch and 1/2 inch	8 to 10 oz.[1] (225 to 285g)	3 ± 1/2 oz. (70 to 100g)	8 to 10 oz.[1] (225 to 285g)	4 ± 1/2 oz. (100 to 130g)	1 ± 1/4 oz.[2] (20 to 35g)

[1] Large reel sliders in extreme right position.

[2] Machines equipped with DC servo motors may be set for 1-1/2 to 2 ounce (40 to 55g) tension to minimize tape contact with capstan shaft during fast modes.

TAPE WIDTH	MAIN BRAKE FORCE[3]	
	SUPPLY REEL CCW MOTION	TAKEUP REEL CW MOTION
Any[4]	15 to 17 oz. (425 to 480g)	15 to 17 oz. (425 to 480g)

[3] Brake force is affected by humidity and temperature extremes.

[4] If only 1/2-inch tape is to be used, the main brake force can be increased up to 21 oz. (525g) to shorten fast wind stopping time.

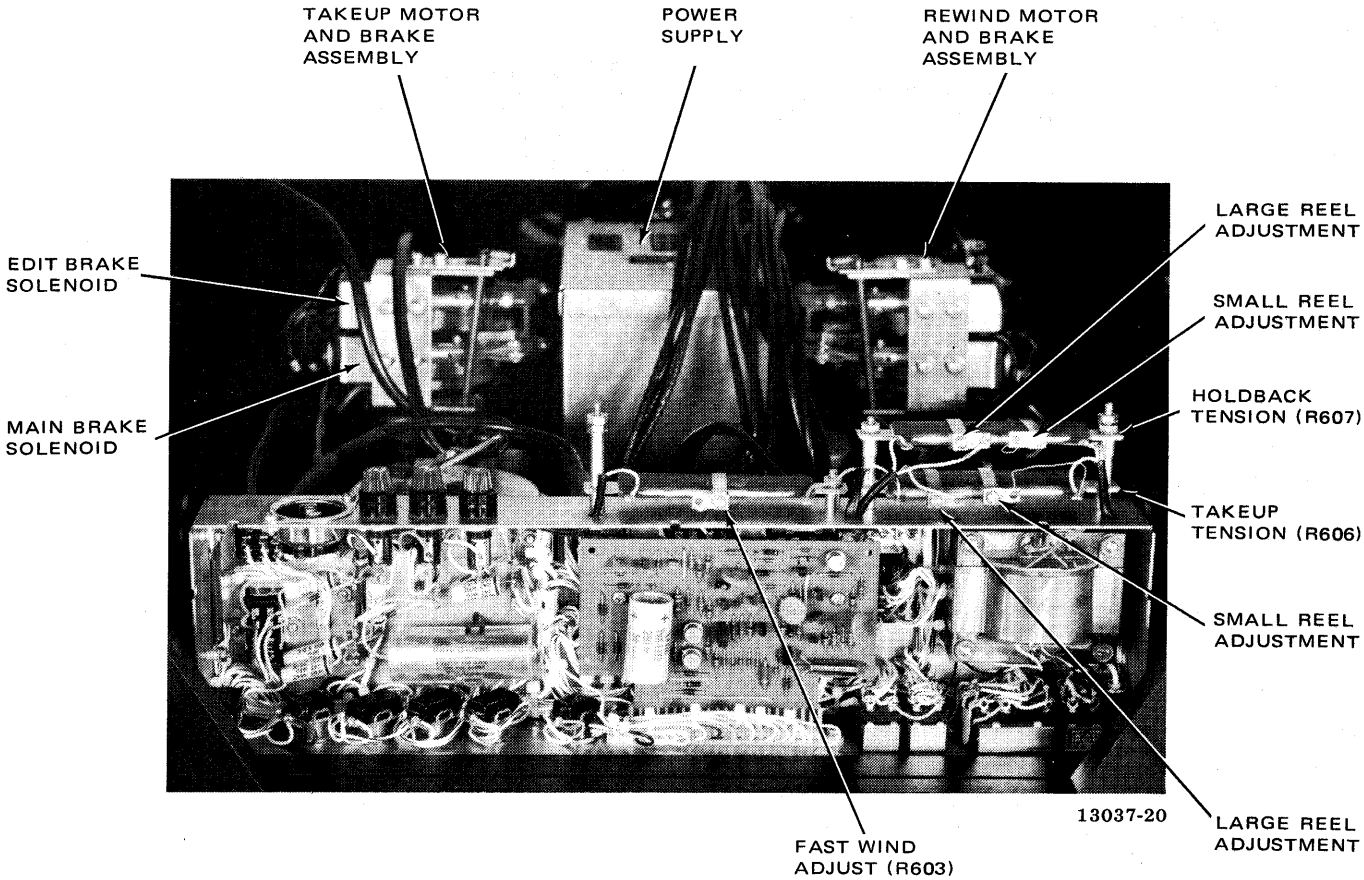


Figure 5-4. Tape Transport Control Box

2. Turn power ON and set SPEED to high or low.

3. Use tape, or a rubber band, to hold the takeup tension arm away from the safety switch.

4. Install the empty NAB reel on the takeup turntable and set the REEL hub switches in the large reel position. Press the PLAY button and adjust the inboard slider on R606 (resistor nearest chassis) for the large reel takeup tension in Table 5-6.

5. Change both REEL switches to the small reel position and adjust the outboard slider of R606 for the small reel takeup tension in Table 5-6.

6. Press STOP and change reel to the supply turntable. Place both REEL switches in the large reel position; press PLAY and adjust the inboard slider of R607 (farthest from chassis) for the large reel holdback tension in Table 5-6.

7. Change both REEL switches to small reel position and adjust the outboard slider of R607 for the small reel holdback tension in Table 5-6.

8. Press STOP and change REEL switches to the large reel position. Press FAST FWD and adjust the single slider on R603 for the tension in Table 5-6.

BRAKES

The main brake system on each reel stops reel rotation and maintains tape tension. An edit brake

note: mounting holes for the brake and edit solenoids enable adjustment; their positions relative to each other and the the strike plate interactively affect the operation of brake and edit modes

system partially releases the brake bands to reduce braking force when the stop/edit mode is selected.

Torrington clutches on both brake drums eliminate clockwise braking of the supply reel and counter-clockwise braking of the takeup reel. Braking is applied only to the reel supplying the tape at the time stop mode is initiated.

These clutches ensure proper stopping with mixtures of reel sizes. The disadvantage is that if the tape runs off the reel during a fast wind, the reel will spin for an appreciable length of time. If only one size reel will be used, the clutches may be defeated. (See heading *Rewind and Takeup Clutch Defeat*.) (page 5-34)

Required brake adjustments are made with the nuts shown in Figure 5-5. When adjusting the main braking force, the two nuts for the main brake adjustment must be turned equally. Proceed with the following steps:

1. Apply power to equipment. Place the NAB reel on the supply turntable.

2. Wrap the cord or twine on reel hub counterclockwise with the loop at the cord free end.

3. Insert the spring scale hook in cord loop. Pull the scale to rotate the reel and check the scale indication while the reel is moving slowly and steadily. Required braking force is given in Table 5-6. Adjust brake nuts as necessary (screw in to increase force, and out to decrease force).

NOTE

The force required to start reel rotation will be much higher than that required when the reel is rotating slowly and steadily.

4. Rewind the cord on the reel hub, counterclockwise. Press the EDIT pushbutton.

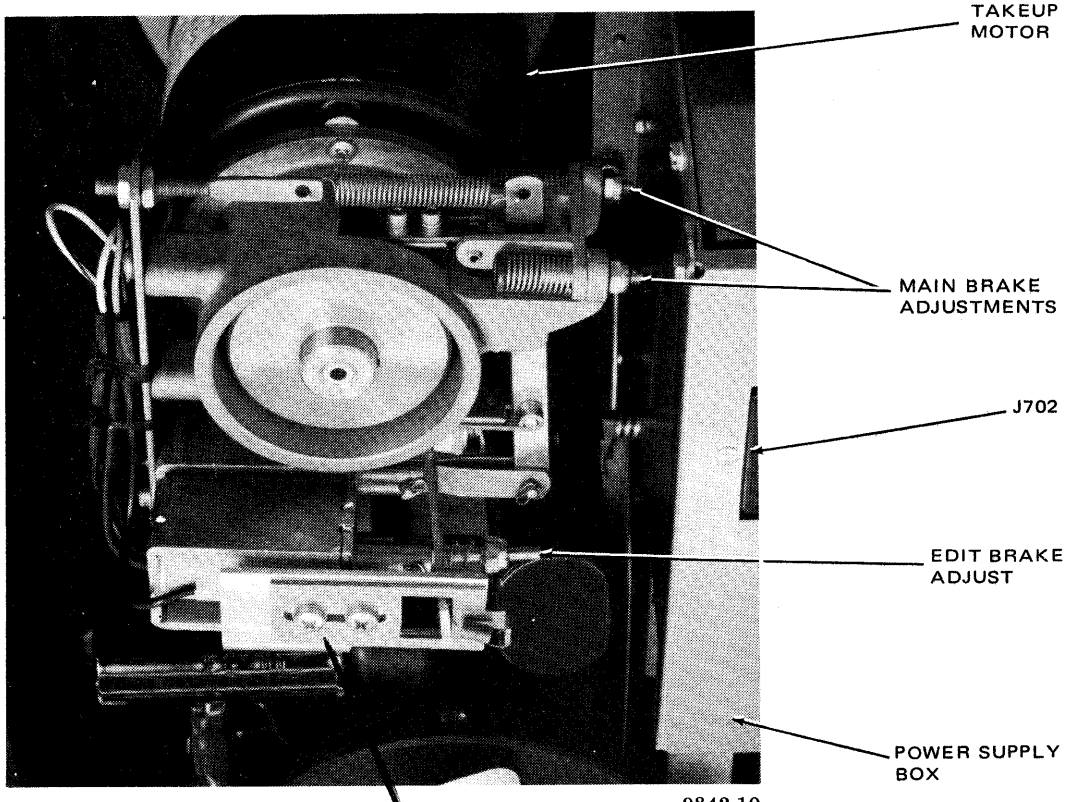


Figure 5-5. Brake Adjustments

limit-of-travel adjustment for soelnoids' strike plate: enables edit

NOTE

In the following steps, edit brake force can be set as preferred by each operator. The minimum tension specified ensures holding the takeup tension arm away from the safety switch.

5. Insert the spring scale hook in the cord loop. Pull the scale to rotate the reel and check the scale indication while the reel is moving slowly and steadily. The scale reading will vary as the reel is rotated. The minimum braking force should be between 1-1/2 and 2-1/2 oz. (40 to 70g).

NOTE

Adjust edit-brake nut as necessary (screw in to decrease force, and out to increase force).

6. Press the STOP pushbutton.

7. Move the empty reel to the takeup turntable. Wind the cord on the hub clockwise. Measure and adjust brake nuts per step 3.

8. Rewind the cord on the reel hub clockwise. Press EDIT pushbutton. Measure and adjust the edit braking force per step 5.

9. Press the STOP pushbutton.

CAPSTAN IDLER

The capstan idler force against the moving capstan is determined by the capstan idler solenoid spring. The force is adjusted by a lock nut on the capstan idler solenoid spade bolt shown in Figure 5-6.

As the solenoid temperature rises, its resistance also rises. When power line regulation is poor, allow 30 minutes or more for warmup (operating in the reproduce mode) before adjusting the capstan idler force. At the factory, the solenoid is checked to be sure it will bottom at line voltages of

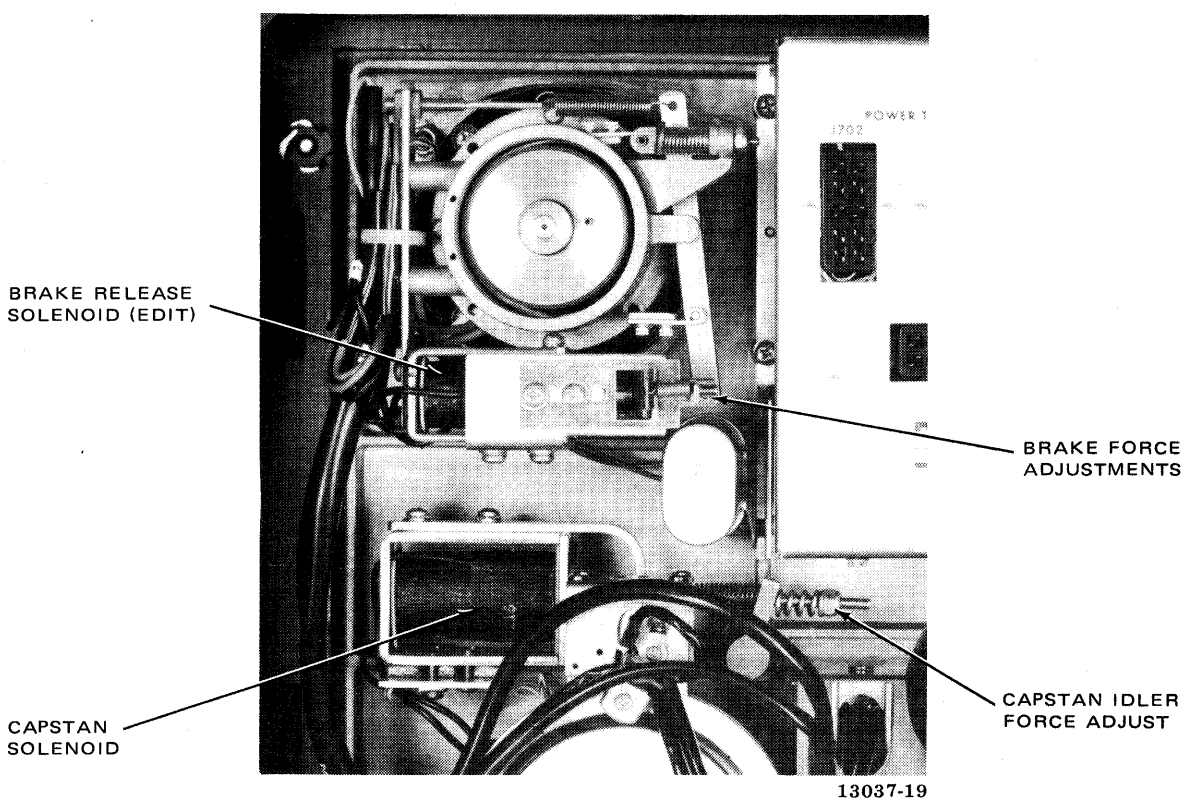


Figure 5-6. Capstan Idler Adjustment

95 volts (cold) and 105 volts (hot). Proceed with the following steps:

1. Apply power to equipment. Use pressure-sensitive tape or a rubber band to hold takeup tension arm (Figure 5-7) away from the safety switch.

2. Tie the cord together to form a continuous loop. Place the loop around the capstan idler shaft as shown in Figure 5-7.

3. Press PLAY pushbutton (the idler moves to contact the capstan, and then both rotate).

4. Insert the spring scale hook through the loop, then pull the cord taut at a 90° angle to the idler arm. Do not let the cord contact the rotating idler.

NOTE

It may be necessary to temporarily increase the clearance between the capstan idler and the capstan idler arm (to prevent the cord from touching the idler). If necessary, loosen the setscrew (that retains the idler shaft in the idler arm) and increase the clearance. After completing step 6 of this procedure, readjust clearance to normal.

5. Pull on the scale, and note the scale indication when the idler just loses contact with the capstan (the idler stops rotating).

6. Adjust the spring tension nut (Capstan Idler Force Adjust of Figure 5-6) for 9 lbs ±1/2 lb (3.9 to 4.3 kg).

ELECTRONIC ALIGNMENT

Complete electronic alignment consists of adjustment of power supply voltage, bias oscillator frequency, reproduce adjustments, and record adjustments. Procedures for complete electronic alignment of the AG-440C Recorder/Reproducer are provided below.

TEST EQUIPMENT

Test equipment required for electronic alignment is listed in Table 5-1 (items 1 through 11).

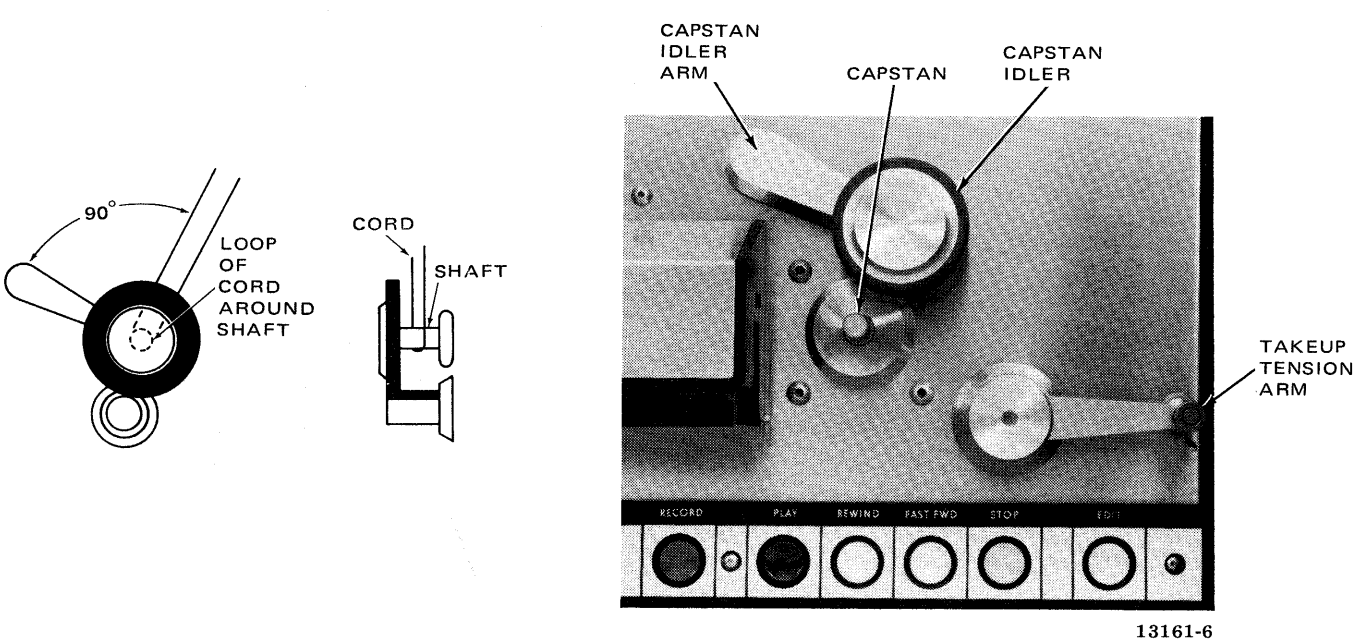


Figure 5-7. Capstan Idler Tension Measurement

PRELIMINARY PROCEDURES

Check that the output line is terminated either externally or with the line termination switch. Also clean and demagnetize the heads.

Power Supply

The power supply (with the bias and erase oscillator) is mounted on a plug-in printed circuit board in the transport power supply box. Operation can be checked by connecting the DC voltmeter across pin 9 (positive) and pin 5 of any of the four receptacles (J701 through J704) on the power supply box cover. The voltmeter should indicate 39 (±1) volts.

If adjustment is necessary, open the cover on the power supply box (see Figure 5-8).

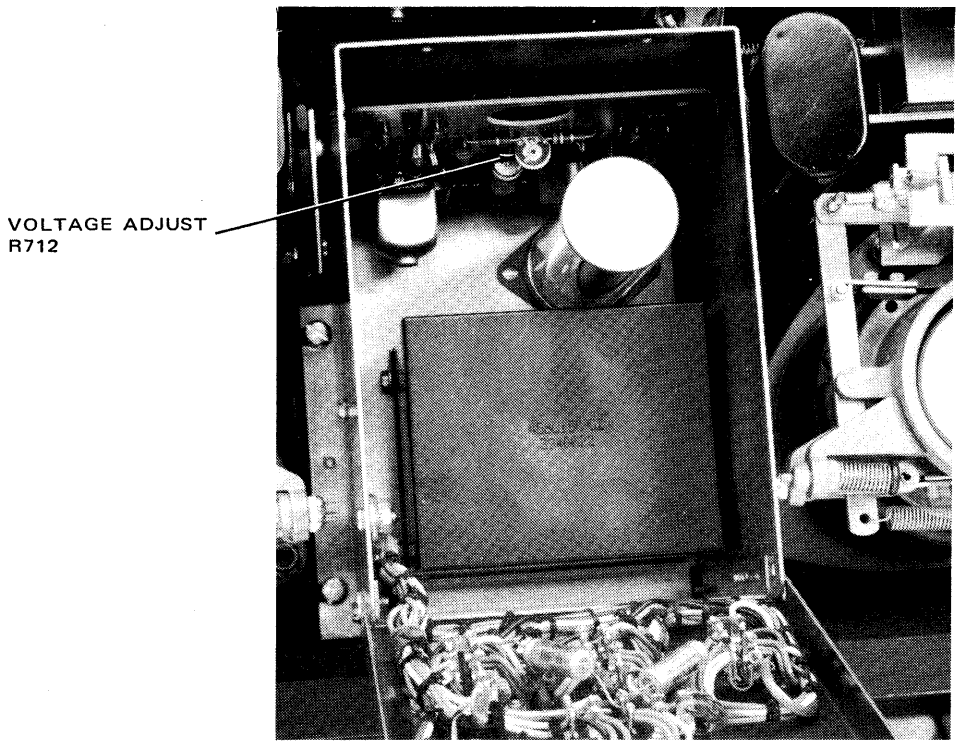
WARNING

FULL LINE VOLTAGE IS PRESENT WITHIN THE POWER SUPPLY BOX. DO NOT TOUCH THE FUSE POST OR TRANSFORMER LEADS WHILE THE SYSTEM IS ENERGIZED.

With the voltmeter connected as previously described, place the equipment in the reproduce mode, then adjust R712 (see Figure 5-8) for an indication of 39 (±1) volts.

Bias Oscillator Frequency

The bias oscillator is mounted on the same plug-in printed circuit board as the 39-volt power supply. The frequency can be measured by connecting a counter or oscilloscope between pin 2 or 3 (positive) and pin 1 (or chassis ground) on any of the four receptacles (J701 through J704) on the power supply box. The counter should read 150 kHz ±3 kHz. The oscilloscope should indicate a period of 6.53 to 6.80 microseconds. If the frequency needs adjustment, install an extender card and adjust the slug of coil T701 for 150 kHz or 6.66 microseconds.



9842-12

Figure 5-8. Power Supply Box Interior

REPRODUCE ALIGNMENT

High Frequency Equalization

One method for adjusting high frequency response is to utilize a flux loop. This is a device which will induce constant flux into the head when placed in contact with the head and fed a constant voltage from a signal generator. In the absence of equalization the reproduce electronics will produce a flat response from a constant flux signal.

When high frequency equalization is added, the response will rise with increasing frequency. In the absence of a flux loop a standard alignment tape may be used to set high frequency equalization. However, when using the standard tape the results will vary with the condition and accuracy of the tape.

Three controls are associated with the reproduce high frequency equalization: the low speed high frequency equalizer, the high speed high frequency equalizer and the head resonance control. The high frequency equalizers (Figure 1-3) set the turnover frequency established by NAB or IEC (CCIR) standard. This frequency is expressed in microseconds. For example at 15 in/s NAB specifies that the high frequency equalization is 50 microseconds. This gives a 6 dB per octave rising characteristic with a transition frequency (3 dB point) of 3183 Hz (the turnover frequency being the reciprocal of $2\pi RC$). The head resonance control affects both speeds equally and is used to make a compromise compensation for the loss due to a finite reproduce head gap length. It does this by changing the frequency where the head resonates with the input capacity. This resonance produces a rise above the curve generated by the high frequency equalizer. This control is located on the reproduce plug-in module. When turned clockwise viewed from the front it raises the resonant frequency and reduces the gap loss compensation.

Initial Test Steps. Connect the equipment and set controls as specified in steps 1 through 7 which follow.

1. Connect the flux loop to the signal generator and clip it on to the reproduce head.

2. Set the signal generator to deliver a maximum output 500-Hz signal.

3. Connect a VTVM, set to the −10 dBm scale, to the output receptacle.

4. Set the SAFE and REPRO pushbuttons.

5. Set the REPRODUCE LEVEL control to approximately 5.

6. Set the speed switch for the 7-1/2 in/s speed (15 in/s for 15-30 in/s machines).

7. Turn on equipment power.

NOTE

Be sure that the signal generator maintains a constant output voltage for output frequencies of 500 Hz to 15 kHz.

Final Test Steps. If equalization is simply being verified or trimmed, proceed with steps 8 through 11. If equalization is suspected to be completely wrong, omit steps 8 through 11 and complete steps 8A through 14A.

8. With the VTVM set on the −10 dBm scale, adjust the reproduce level control and/or the signal generator to produce the 500-Hz reading in Table 5-7 that agrees with the equalization being verified. The dB readings in Table 5-7 should be interpreted as dB with respect to a −10 dBm reference.

9. Switch to 5 kHz and check that response agrees with Table 5-7, and if necessary adjust the HI FREQ equalizer that corresponds with the SPEED switch setting (high or low).

10. Switch to 15 kHz and adjust head resonance control (R32) if necessary. This adjustment is most easily accomplished with the reproduce module plugged into an extender board.

11. Change to the other speed pair and repeat steps 8 and 9.

Table 5-7. High-Frequency Equalization Response

OPERATION	FREQ.	3-3/4 NAB 90 μS	7-1/2 IEC 70 μS	7-1/2 NAB 50 μS	15 NAB 50 μS	15 IEC 35 μS	30 AES 17.5 μS
Set Level	500	+0.35 dB	+0.2 dB	+0.1 dB	+0.1 dB	+0.05 dB	0 dB
Adjust High Frequency Equalization	5,000	+9.5 dB	+7.7 dB	+5.4 dB	+5.4 dB	+3.4 dB	–
	10,000	–	–	–	–	–	+3.5 dB
Adjust Head (R32) Resonance for 3-3/4 – 7-1/2 Recorder	15,000	–	+19 dB[1]	+16 dB[1]	–	–	–
Adjust Head (R32) Resonance for 7-1/2 – 15 Recorder	15,000	–	+18 dB[1]	+15 dB[1]	–	–	–
Adjust Head (R32) Resonance for 15 – 30 Recorder	15,000	–	–	–	+14.5 dB[1]	+11.5 dB[1]	–

[1] Because of variation in head inductance, it may not be possible to reach these center values. Set as close as possible to these readings.

Complete the following steps in place of steps 8 through 11 when equalization appears to be completely wrong.

8A. When starting from unknown equalizer adjustments, begin by turning both low and high speed frequency equalizers to the extreme counterclockwise position. Set SPEED switch in position providing 7-1/2 in/s (15 in/s for 15-30-in/s machines).

9A. With the VTVM set on the −10 dBm scale adjust the reproduce level and/or signal generator to give exactly −10 dBm.

10A. Switch to 5 kHz and adjust the appropriate high frequency equalizer to give the reading in Table 5-7.

11A. Before adjusting head resonance, change to the other speed pair. Set 500 Hz to exactly −10 dBm. Switch to 5 kHz and set the other high frequency equalizer for the appropriate reading in Table 5-7.

12A. Return SPEED switch to original speed setting. Set signal generator output frequency to 500 Hz and adjust the REPRODUCE LEVEL control for the appropriate (Table 5-7) reading.

13A. Switch to 5 kHz and retrim the high frequency equalizer if necessary. This procedure is required because there is some interaction between the high speed and low speed equalizers.

14A. Switch to 15 kHz and adjust the head resonance control for the appropriate (Table 5-7) reading.

Reproduce Head Azimuth

It is recommended that the reproduce head azimuth be adjusted at 7-1/2 in/s for 3-3/4–7-1/2 or 7-1/2–15-in/s machines and at 15 in/s for 15–30-in/s machines. This adjustment may be made using the equipment VU meters. It is made by

adjusting the left-hand nut at the top of the reproduce head (see Figure 5-9).

CAUTION

DO NOT ADJUST ANY OF THE OTHER NUTS ON THE HEAD ASSEMBLY.

1. Remove the head cover by loosening captive screw on its angled back.

2. Apply power. Thread an appropriate standard alignment tape on the transport. Set the speed and reel size switches accordingly.

3. Set the pushbuttons at SAFE and REPRO. Connect head sets or a monitor amplifier speaker to the head phone jack or the output receptacle so the voice announcements on the tape can be heard.

4. Start the tape in the reproduce mode and adjust the reproduce level control for a 0 VU meter reading on the 700-Hz tone.

5. On the 15-kHz tone, adjust the reproduce head azimuth adjustment nut (not the screw) for a maximum reading on the VU meters. On multi-channel equipment if all heads do not peak at the same setting, adjust for optimum output of all the heads.

NOTE

If the azimuth is far out of adjustment, minor peaks will appear on each side of the correct setting. Correct adjustment results in an output markedly higher than the minor peaks.

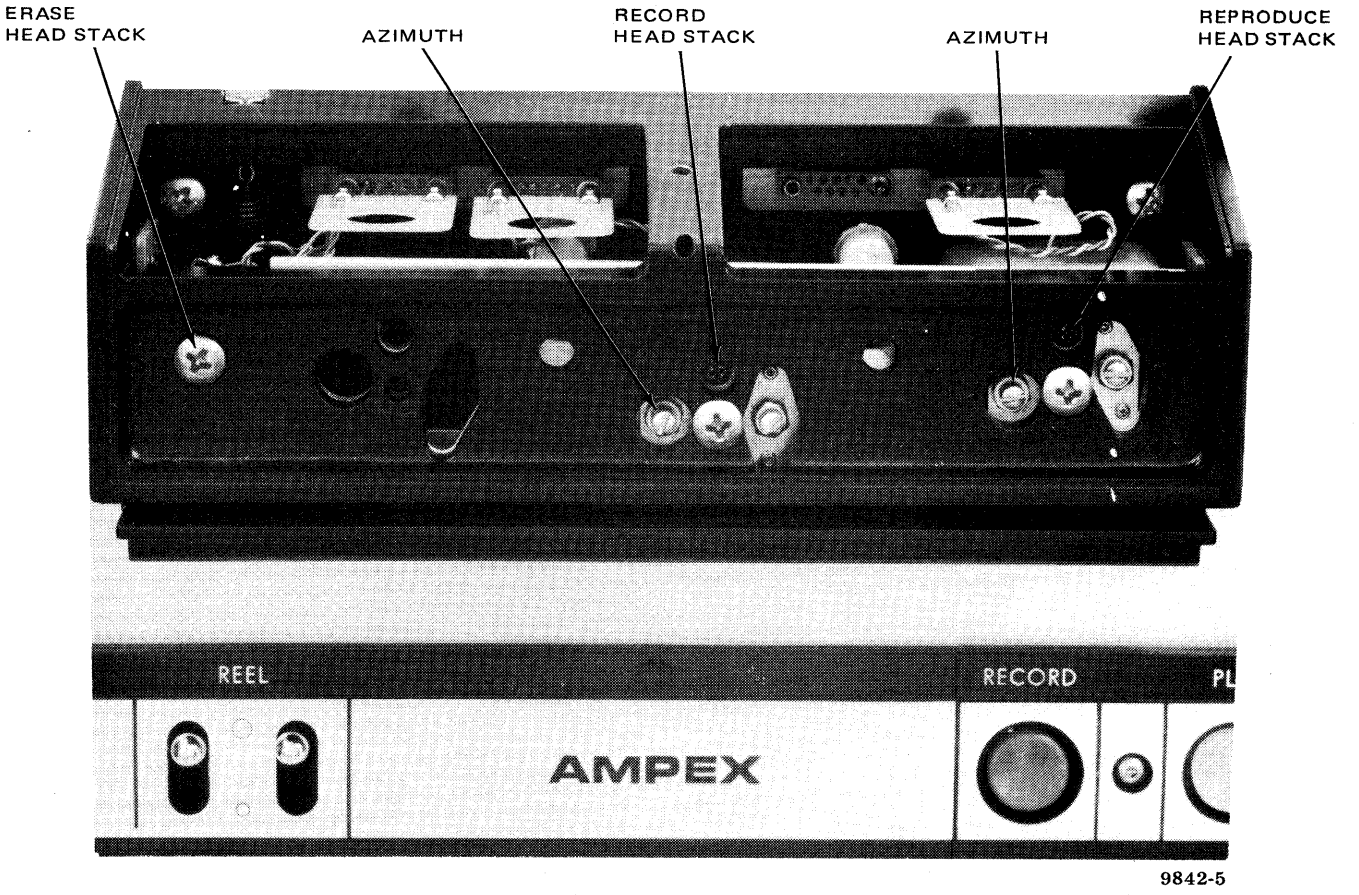


Figure 5-9. Head Azimuth Adjustments

Reproduce Standard Tape Response

If the reproduce equalization has been adjusted with a flux loop, the standard tape response is a double check on this adjustment. If the standard tape plays back within ±1 dB of the 700-Hz reference tone in the 2.5-kHz to 10-kHz region and ±2 dB 12 kHz to 15 kHz, the previous adjustments are probably adequate. If it does not meet these requirements, look for the problem area:

1. Bad alignment tape.
2. Dirty heads.
3. Improper tape wrap on head (racking). Head gap not centered in the tape contact area.
4. Reproduce high frequency equalizers set improperly.

If the standard tape is to be used for reproduce equalizer adjustment, the reproduce high frequency equalizer should be adjusted on the 5-kHz or 7.5-kHz tone for flat response. Then rewind to the 15-kHz tone and adjust the head resonance control for desired 15-kHz response remembering that the head resonance affects both speeds equally. For example, if the 15-kHz response at 7-1/2 in/s is adjusted to 0, thus compensating for all gap loss, the response at 15-kHz 15 in/s (where the gap loss will be less) may be +1-1/2 to +2 dB above the 700-Hz reference.

NOTE

Many test tapes are recorded full track. When reproduced by a half-track or multi-track head, the fringing effect produces invalid response at frequencies below 700 Hz. This effect, which results in high indications in the lower frequencies, does not occur when tapes are recorded and reproduced with heads of the same configuration. Do not adjust the low frequency reproduce equalizers for flat response from a full track standard tape.

Operating Level Adjustment

This adjustment is made with the operating level 700-Hz signal from the standard alignment tape. It is important that this adjustment be accurate since it affects signal to noise ratio, distortion, and tape saturation level. On Ampex standard alignment tapes this level is 185 nWb/m and is the first tone for 15 in/s and 30 in/s tapes, the last tone for 7-1/2 in/s and 3-3/4 in/s tapes. It is suggested that operating level be set at the speed at which the equipment will usually run. If used equally, set at 15 in/s (7-1/2 in/s for 7-1/2–3-3/4 recorders). The adjustment is made with the reproduce calibrate potentiometer when the REPRODUCE LEVEL control is in the calibrate (CAL) position.

Adjusting for a 185 nWb/m Operating Level

Reproduce the 185 nWb/m 700-Hz operating level tone from the alignment tape. With the REPRODUCE LEVEL control in the CAL position, adjust the reproduce potentiometer (Table 3-2) for a 0 reading on the VU meter or a +4 or +8 dBm reading on the VTVM depending upon the line level selected.

Adjusting for a 260 nWb/m Operating Level

Reproduce the 185 nWb/m 700-Hz operating level tone from the alignment tape. With the REPRODUCE LEVEL control in the CAL position, adjust the reproduce calibrate potentiometer for a −3 reading on the VU meter or a +1 dBm reading on the VTVM if a +4 dBm line level is used, or +5 dBm reading if a +8 dBm line level is used.

NOTE

If an alignment tape with a 200 nWb/m operating level is used, add 0.7 dB to the readings called out above. For example, if the VU meter reading with a 185 nWb/m signal should be −3, it should be set to −2.3 with a 200 nWb/m signal.

Sel-Sync Level Adjustment

While reproducing the operating level signal, press the SYNC button. Adjust the sync calibration potentiometer (Table 3-2) for the same VU meter reading that the reproduce position indicates.

RECORD ALIGNMENT

Erase Peaking

The erase peaking consists of adjusting the erase adjust capacitor C40 (ERASE PEAK in Figure 1-3), and the slugs of coils T3 and T4 to produce the maximum erase voltage. An extender card is needed for adjustment of T3 and T4. The coils need adjustment if the bias frequency changes. For example, if a bias module were changed to another recorder, the slugs should be tuned. If the bias module is changed to another channel, only the erase adjust capacitor requires tuning to match it to the head. Proceed as follows:

1. Install the bias module on the extender card.

2. Press the BIAS pushbutton on the channel being adjusted (the remaining channels should be in SAFE).

3. With no input signal applied to the recorder, start the tape in record mode.

4. Adjust the bias calibrate potentiometer to provide an "on scale" reading of the VU meter. The bias reading on the VU meter changes when an extender card is used.

5. Adjust the erase adjust capacitor for maximum VU meter reading, then adjust the slugs on the coils. Since the three adjustments interact slightly, repeat the adjustment until the maximum reading is obtained.

6. If the bias amplifier is equipped with bias balance potentiometer R92, adjust R92 for minimum noise. An alternate method of adjustment of R92 is as follows.

   a. Connect an ASA "A" weighted filter (Figure 5-3) to the OUTPUT connector.

   b. Connect a VTVM to the filter output.

   c. Adjust R92 for minimum reading on the VTVM.

NOTE

For both methods of adjustment of R92, if a noise null cannot be found within range of the control, demagnetize the heads and readjust capacitor C40 and coils T3 and T4.

7. Stop the tape.

8. Press SAFE.

9. Reinstall the bias module and proceed to the next channel.

NOTE

The adjustment of erase adjust capacitor C40 is quite broad but does affect second-harmonic distortion. Usually any spot on the peak produces acceptable second-harmonic distortion. If the absolute minimum second-harmonic distortion is desired, C40 can be trimmed while measuring distortion. This distortion measurement should be made after the remaining steps in the record alignment are completed.

Bias Adjustment

The selection of bias point is an individual decision; some users prefer peak biasing, some overbiasing, or other bias setting. Two bias adjustment procedures will be described; peak biasing at a long wavelength (15 mils), and overbiasing at a medium wavelength (1.5 mils). The overbiasing procedure provides a more precise setting and is recommended when using Ampex 406 high-output, low-noise tape. Biasing should be done at the tape speed commonly used. If both are used equally, adjust at 15 in/s (7-1/2 in/s for 3-3/4–7-1/2 machines).

Long-Wavelength Peak Biasing. Proceed as follows:

1. Adjust the signal generator to 2,000 Hz at 30 in/s, 1,000 Hz at 15 in/s, 500 Hz at 7-1/2 in/s or 250 Hz at 3-3/4 in/s.

2. Select READY and REPRO.

3. Set REPRODUCE LEVEL control to CAL.

4. Start the tape in the record mode.

5. Adjust the RECORD LEVEL control for an on-scale reading of the VU meter.

6. Adjust the BIAS ADJ (Figure 1-3) for maximum reading on the VU meter.

Medium-Wavelength Overbiasing. Proceed as follows:

1. Adjust the signal generator to 20 kHz at 30 in/s, 10 kHz at 15 in/s, 5 kHz at 7-1/2 in/s, or 2.5 kHz at 3-3/4 in/s.

2. Select READY and REPRO.

3. Set REPRODUCE LEVEL control to CAL.

4. Start the tape in the record mode.

NOTE

This adjustment can be made at operating level at 15 in/s and 30 in/s but should be made at least 10 dB below operating level at 3-3/4 and 7-1/2 in/s.

5. Adjust the RECORD LEVEL control for an on-scale reading of the VU meter.

6. Adjust the BIAS ADJ for maximum reading on the VU meter.

7. Since the azimuth must be in approximate alignment to provide a signal at the 1-1/2 mil wavelength, it may be necessary to make a preliminary azimuth adjustment at this time. Place a nut-driver on the left-hand nut of the record head (Figure 5-9) and adjust for a maximum reading on the VU meter.

8. At the 15 and 30 in/s speed, adjust the RECORD LEVEL control for a VU meter reading of +1. Check that this is still the maximum reading point by turning the bias adjust control, then overbias 1-1/2 dB by turning the control clockwise until the VU meter reads −1/2.

9. When adjusting at 3-3/4 or 7-1/2 in/s, after adjusting the bias adjust and record head azimuth for a maximum reading (steps 6 and 7), adjust the RECORD LEVEL so that the VU meter reads between the 20% mark and −10 VU.

   a. Adjust the REPRODUCE LEVEL control so the VU meter reads +1.

   b. Check that this is still the maximum reading point by turning the BIAS ADJ control, then overbias 1-1/2 dB by turning BIAS ADJ clockwise until the VU meter reads −1/2.

NOTE

When using Ampex 406 tape, 1-1/2 dB overbias at 1.5-mil wavelength falls within the range of peak bias at 15-mil wavelength.

Bias Metering Calibration

Immediately after adjusting the bias (see preceding paragraph) and while still recording, press the BIAS pushbutton. Adjust the bias calibration potentiometer so that the VU meter indicates 0.

Record Head Azimuth

This adjustment is similar to the reproduce head adjustment except that it is made while simultaneously recording and reproducing a short wavelength signal. This procedure ensures that the azimuth of both heads coincide. Proceed as follows.

1. Use a 15-kHz signal generator output at 7-1/2 in/s or a 25-kHz signal at 15 in/s.

2. Use pushbuttons to select READY and REPRO.

3. Set REPRODUCE LEVEL control to CAL.

4. Start the tape in the RECORD mode.

5. Adjust the RECORD LEVEL control for a VU meter reading near the 20% mark.

6. Adjust the REPRODUCE LEVEL control so that the VU meter indicates between 0 and –5.

7. Adjust the record head azimuth nut (not the screw) shown in Figure 5-9 for a maximum reading on the VU meters. On multichannel equipment, if all heads do not peak at the same setting, adjust for optimum output of all the heads.

Record High Frequency Equalization

This adjustment can be made at operating level for 15 or 30 in/s, but should be made at least 14 dB below operating level for 3-3/4 and 7-1/2 in/s. Proceed as follows:

1. Select READY and REPRO.

2. Set REPRODUCE LEVEL control to CAL.

3. Set signal generator output frequency to 700 Hz.

4. Start the tape in the record mode.

5. For 15 or 30 in/s speeds, adjust the RECORD LEVEL control so the VU meter indicates 0.

5a. For 3-3/4 or 7-1/2 in/s speeds, adjust the RECORD LEVEL control so that the VU meter indicator is at the 20% mark. Adjust the REPRODUCE LEVEL control so the VU meter indicates 0.

6. Change the signal generator output frequency to 7 kHz.

7. As a preliminary setting, adjust the appropriate low or high speed record equalizer so that the VU meter indicates 0.

8. Check the response above and below 7 kHz and trim the record equalizer for the response desired. If the desired response cannot be obtained, the reason may be:

   a. Heads are dirty.

   b. Improper tape wrap on head (racking). Head gap not centered in the tape contact area.

   c. Attempting to adjust 3-3/4 or 7-1/2 in/s response at operating level.

   d. Forgetting to place the reproduce level in the CAL position when adjusting record level.

   e. Bias set incorrectly. The bias adjustment can be used to improve response. However, remember that compensating for record deficiencies by underbiasing increases distortion.

Before repeating the Record High Frequency Equalization adjustments at the other tape speed, proceed with the Reproduce Low Frequency Equalization procedure given below. Then perform the High Frequency and Low Frequency Equalization procedures at the other tape speed.

Reproduce Low Frequency Equalization

This adjustment is made while simultaneously recording and reproducing to avoid fringing effects present if the adjustment is made with a full track standard tape. Proceed as follows:

1. Using the 700-Hz reference level noted during record high frequency equalization, sweep the signal generator frequency slowly from 700 Hz down to 30 Hz (note the magnitude of the peaks and dips).

2. Adjust the appropriate low or high speed reproduce low frequency equalizer for the flattest possible response. This is done by adjusting the head "bump" excursions for an equal magnitude above or below the 700-Hz reference level.

Input Calibration Adjustment

Adjust the input calibration as follows:

1. Select READY and REPRO.

2. Set RECORD LEVEL and REPRODUCE LEVEL controls to CAL.

3. Set signal generator frequency to 700 Hz and output level at +4 or +8 dBm, depending upon the line level used.

4. Start the tape in the record mode.

5. Adjust the input calibrate potentiometer (Table 3-2) for a 0 reading on the VU meter.

Record Calibrate Adjustment

After completing the Input Calibration Adjustment procedure above, proceed as follows:

1. Press the INPUT pushbutton.

2. Adjust the RECORD calibrate adjustment on the record plug-in module for a 0 indication on the VU meter.

SERVO GAIN ADJUSTMENT

NOTE

This adjustment should be made only when a major component of the servo system is changed. If 1200-Hz carrier whine is audible, reduce servo gain (turn R19 clockwise).

Proceed as follows:

1. Put the capstan servo PWA on extender board 4050695.

2. Attach a scope probe to test point number 2 of the capstan servo PWA.

3. Put recorder in PLAY.

4. Adjust R19 on capstan servo PWA for minimum signal jitter.

5. Remove extender board and re-install PWA.

HEAD MAINTENANCE

Head cleaning and demagnetizing was discussed in the *Preventive Maintenance* portion of this section, under headings *Cleaning* and *Demagnetizing*. Adjustment of head azimuth was discussed in the *Electronic Alignment* portion of this section, under the heading *Record Head Azimuth*. Changing the head assembly is explained in the Installation section (Section II), under the heading *Conversion*. The head and tape adjustment explanations follow. Head height is precisely set at the factory, therefore, height adjustment is seldom required except when a head stack is changed.

ADJUSTING HEAD HEIGHT

Record/Reproduce (All Except Two-Channel Four-Track)

Adjust head height as follows:

1. Remove the head housing cover by loosening the captive screw on the angled back surface.

2. Thread tape on transport, and initiate the play mode at the highest speed available.

3. Loosen the hex nut (Figure 5-10) approximately 1/4 turn.

4. Turn the two hex-socket setscrews (see Figure 5-10) clockwise the same number of turns, until the head laminations barely appear at the tape bottom edge. Keep relaxing

the hex nut and azimuth nut, as necessary to maintain tension and azimuth.

5. Carefully count the turns, while turning the two hex-socket setscrews counterclockwise (in exactly equal turns) until the head laminations barely appear above the tape top edge. Keep tightening the hex nut and azimuth nut as necessary to maintain tension and azimuth.

6. Turn the same two setscrews back (clockwise) half the number of turns counted in step 5. Again relax the hex-nut and azimuth nut as necessary to maintain tension and azimuth. Finally tighten the hex nut until it is snug.

7. Stop tape motion.

8. Check head azimuth and tape wrap. Check head azimuth as explained earlier in this section.

9. Replace head housing cover.

Record/Reproduce (Two-Channel Four-Track)

To set the height of a two-channel four-track record or reproduce head: repeat steps 1, 2, and 3, given in the paragraph above; then adjust the two hex-socket setscrews so that the mu-metal portion of the outermost head (head furthest from tape transport) is exactly even with the edge of the tape furthest from the tape transport.

Erase Heads

Erase head height is adjusted with shims (0.010, 0.002, 0.003, and 0.005 inch thick, Ampex Part Nos. 4350025-01, 4350025-02, 4350025-03, and 4350025-04 respectively). To change shims, the head must be removed by removing one cross-head screw (Figure 5-10).

Except for four-track 1/4-inch erase heads, shim the head until the ferrite portion of the outermost head (head furthest from tape transport) is just visible at the outermost edge of the tape. Add shims until the similar portion of the bottom head is barely visible below the tape bottom edge. Then

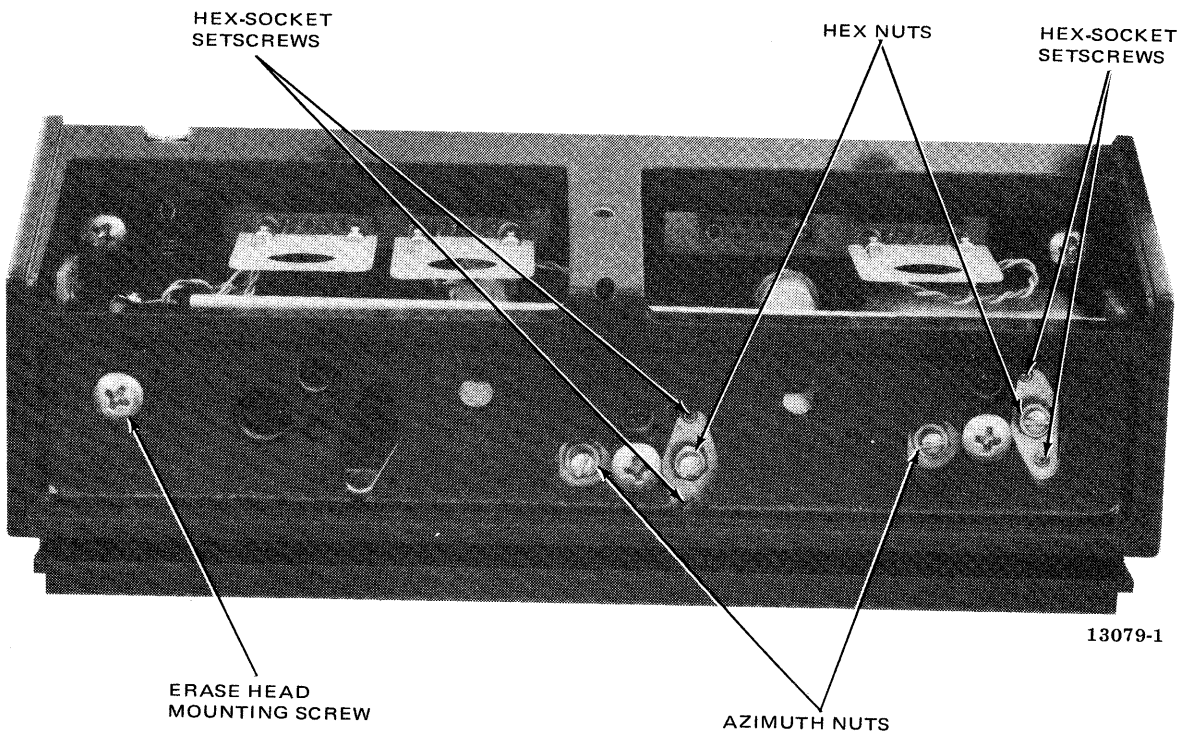


Figure 5-10. Head Height Adjustments

remove exactly half the shim thickness that was needed to move the head stack from the top to the bottom of the tape.

Adjust four-track 1/4-inch erase head height to dimension shown on drawing 4020355.

ADJUSTING TAPE WRAP AND ZENITH

The head gap must be centered in the tape contact area, and the tape must contact the head top and bottom equally.

To check tape wrap (racking) and head zenith (perpendicularity), lightly cover the head face with grease pencil or crayon. Thread tape on transport, initiate the high speed play mode, and stop it after ten seconds. Lift the tape from the head; the head area visibly cleaned by the tape should be centered on the head gap (this checks tape wrap). The head tape-contact area should also be equally clean at the top and bottom (this checks head zenith).

If tape wrap adjustment is indicated, remove the head housing cover by loosening the captive screw on the angled back surface. Loosen the large cross-head screw (Figure 5-11). Adjacent to the large cross-head mounting screw there is a smaller cross-head screw in a hole. Loosen the small cross-head screw, and carefully use a screwdriver to pry at the side of the aluminum plate (through which the head stack mounting screws protrude) in the required direction. Check that the shield can is aligned with the head gate shield, then tighten the screws. Recheck the tape wrap per the preceding paragraph. Repeat the process until the tape wrap is correct. The erase head is adjusted for tape wrap by loosening the mounting screw, rotating the head as required, and tightening the screw.

To adjust the head zenith, loosen the hex nut and use the two hex-socket setscrews (also used for head height adjustment, see Figure 5-11). As the adjustment is being made, visually check the zenith by lining up the head (by viewing from the side) with the capstan or the scrape-flutter idler. Turn the outermost setscrew in and the innermost setscrew out, to move the stack bottom in (away from the tape). To move the bottom of the head out (toward the tape), reverse the procedure. Be sure both setscrews remain snug. When the zenith adjustment seems correct, recheck it with the

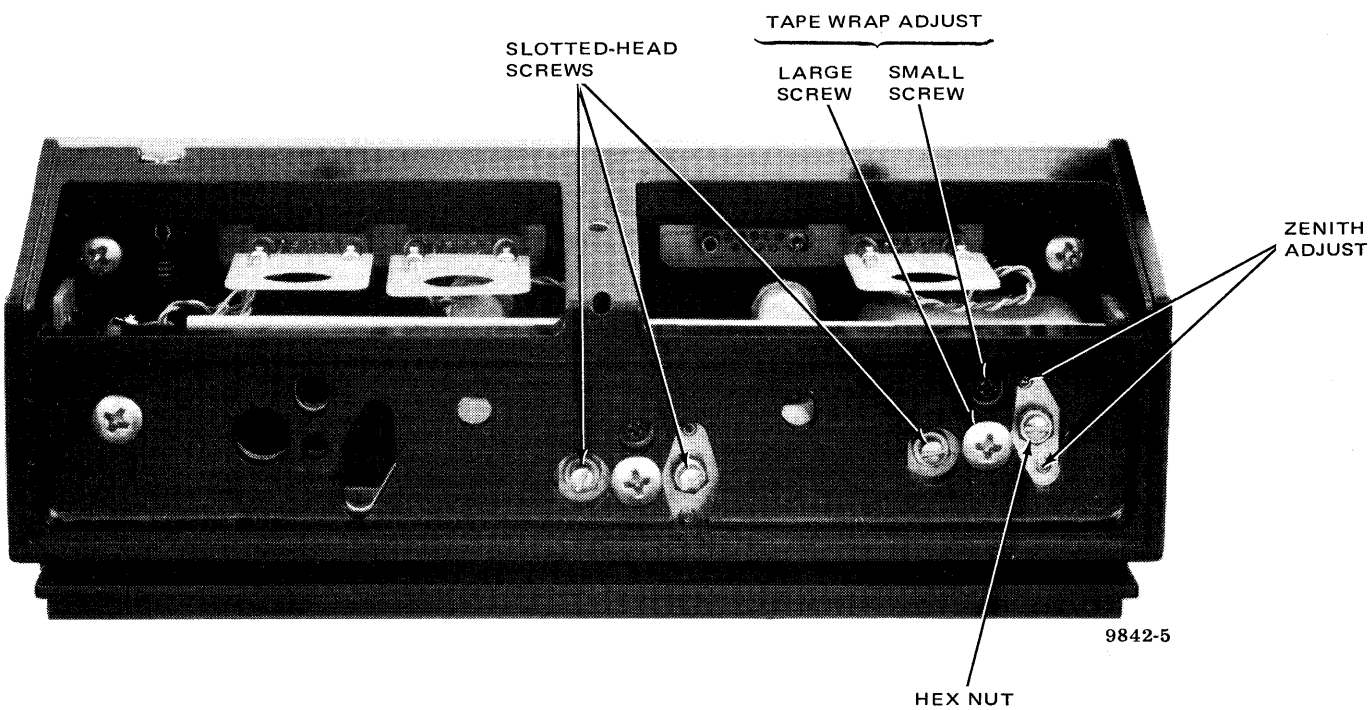


Figure 5-11. Tape Wrap and Zenith Adjustments

grease pencil method described above. Repeat the adjustment until the head zenith is correct (no zenith adjustment is required for the erase head).

Whenever head zenith or tape wrap is changed, check the head azimuth and height.

CHANGING HEAD STACKS

Record or Reproduce Stack

To change the record or reproduce head stack, proceed as follows:

1. Remove the complete head assembly. Head assembly drawings are provided in Section VI.

2. Remove the large cross-head screw (Figure 5-11) and then the shield can (containing the head stack).

3. If the replacement head stack is in a shield can, mount the shield can in position. Check (through the bottom of the casting) that the head stack shield can is aligned with the gate shield, and is parallel to the casting top front edge, then tighten the mounting screw.

4. If the head stack is not in a shield can, use a screwdriver to remove the two slot-head screws and the nuts (Figure 5-11) and remove the head stack from the shield can. Be careful not to lose the double-coil lockwasher. Remove head stack and two head springs from the shield can.

CAUTION

WHEN SOLDERING LEADS ON A HEAD STACK, USE A SMALL-WATTAGE PENCIL-TYPE SOLDERING IRON. EXCESSIVE HEAT CAN CAUSE IRREPARABLE INTERNAL DAMAGE TO THE HEAD STACK.

5. Unsolder the leads at the terminals of the old head stack and solder the leads to the terminals of the new head stack.

6. Turn the two hex-socket setscrews out until the ends are even with inside of the shield.

7. Obtain the two slot-head screws and the nuts removed in step 3. Turn the nuts tightly against the screw heads. Place the double-coil lockwasher over the end of the screw with the plain hex nut (the other screw has a self-locking nut).

8a. On heads for 1/4-inch tape, place the two head springs in the indentations in the top of the head stack. Slip the head stack into the shield can without displacing the springs.

8b. On heads for 1/2-inch tape, hold the shield can upside down, and place the two head springs in the indentation in the shield can (looking through the shield can open side, the indentations are at the right front and right rear). Without displacing the springs, slide the head stack (upside down) into the shield can.

9. Insert the two slot-head screws through the plate and shield can, along with the azimuth nut, plain hex nut, and double-coil lockwasher. Engage the two screws in the head stack holes, and tighten them firmly.

10. Secure the head stack and shield can in the head assembly with the large cross-head screw removed in step 2. Check (through the bottom of the casting) that the head stack shield can is aligned with the gate shield, and is parallel to the casting top front edge; then tighten the mounting screw.

11. Turn-in the two hex-socket-head setscrews to lower the head stack, until head height is approximately correct.

12. Turn the two nuts on the slot-head screws down against the plate, and use the azimuth-adjusting nut (see Figure 5-9) to set the head azimuth to the approximate correct position.

13. Install head assembly on the transport and mate the connectors with the correct receptacles.

14. Check and adjust head height, tape wrap, zenith, and head azimuth.

Erase Head Stack

To change an erase head stack, remove the complete head assembly from the transport. Remove the large cross-head screw, then remove the erase head stack, spacer, and shims. Place the spacer and shims on the new assembly and mount them on the casting with the mounting screw. Check erase head height and tape wrap.

REPLACING HEAD TAPE GUIDES

If any of the three sapphire tape guides on the head assembly are replaced or become misadjusted, the tape guide must be properly positioned. A special tool (4930512-01 for 1/4-inch guides and 4930512-02 for 1/2-inch guides) is used to ensure the positioning accuracy required for proper tape guidance. Use of this special tool is illustrated and explained in Figure 5-12.

If the sapphire guide on the scrape flutter idler requires replacement or is loose, adjust the guide to the dimension shown in Figure 5-12 (use a vernier caliper for measurement).

TRANSPORT MAINTENANCE

The following paragraphs contain transport corrective maintenance, parts replacement, instructions and the special adjustment procedures required thereafter. Most of these procedures require removal of the console front panel.

SERVICING HINTS

Brake Bands

Glazed brake bands that are not contaminated with oil can sometimes be renovated by abrading them

SAPPHIRE GUIDE SET-UP

ARRANGE HEAD ASSEMBLY WITH TOOL 4930512-XX ON A FLAT SURFACE AS SHOWN BELOW.

1. LOOSEN BOTH 4-40 SCREWS.
2. PUSH THE TOOL FORWARD SLIGHTLY AND GENTLY UNTIL IT CONTACTS THE SAPPHIRE TAPE GUIDES ON BOTH UPPER AND LOWER EDGES.
3. TIGHTEN BOTH SCREWS.
4. PULL THE TOOL BACK OFF THE TAPE GUIDE, THEN PUSH IT FORWARD AGAIN GENTLY TO CHECK AND FEEL IF THE TAPE GUIDE HAS BEEN SET-UP TO THE PROPER LEVEL; IF NOT, REPEAT THE PROCEDURE.

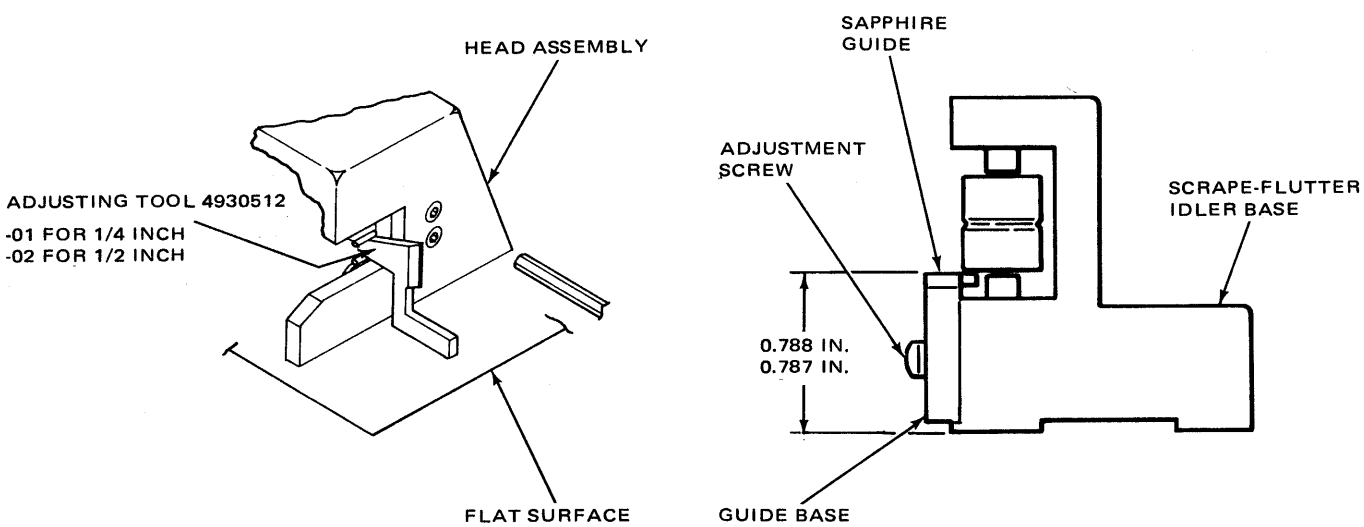


Figure 5-12. Sapphire Tape Guide Adjustment

only with 600-grit sandpaper. (Do not use emery cloth or carborundum-coated paper.)

Solenoids

A corroded solenoid plunger, which does not slide freely, can be renovated by rotating it in a drill press while holding crocus cloth against it.

CAUTION

DO NOT LUBRICATE PLUNGERS, SINCE OIL CAN EVENTUALLY CAUSE STICKING.

Relays

To visually check if a relay is energizing, remove the snap-on cover with a thin-blade tool. Rub any contaminated relay contacts clean with bond paper or a relay-contact burnishing tool.

The four control circuit relays are identical to the electronics record relay. In an emergency the record relay of a channel that will not be placed in record may be interchanged with a defective control circuit relay.

Capstan Idler

The capstan idler (Figure 5-13) is removed from the idler arm by loosening the retaining setscrew. Instructions for removing the idler wheel from the idler shaft are given later in this section under the heading *Idler Assembly Replacement.*

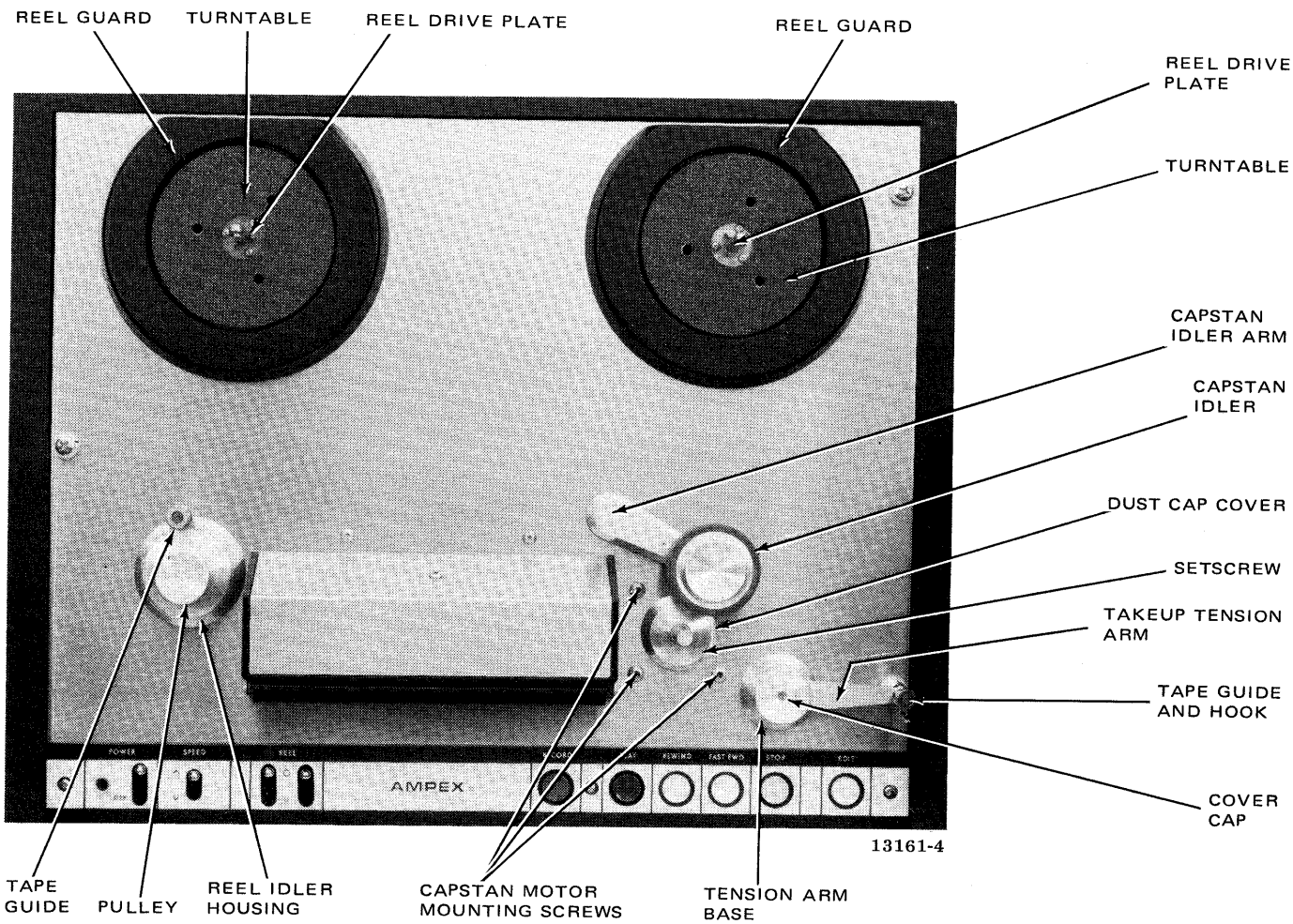


Figure 5-13. Tape Transport Components (Top View)

REPLACEMENT OF HEAD-CABLE BOX

Remove and install the head-cable box as explained under the heading *Changing Heads* (Section II of this manual).

REPLACEMENT OF POWER SUPPLY BOX

Power Supply Removal

To remove the power supply (Figure 5-14), disconnect cables from receptacles J701 through J704. Disconnect the captive power-supply cable from the receptacle on the transport control box. Remove the four mounting screws and remove the power supply box.

CAUTION

A POWER TRANSISTOR IS MOUNTED ON THE SIDE OF THE POWER SUPPLY, NEXT TO THE TRANSPORT. USE CARE NOT TO DAMAGE THE TRANSISTOR WHILE REMOVING THE POWER SUPPLY.

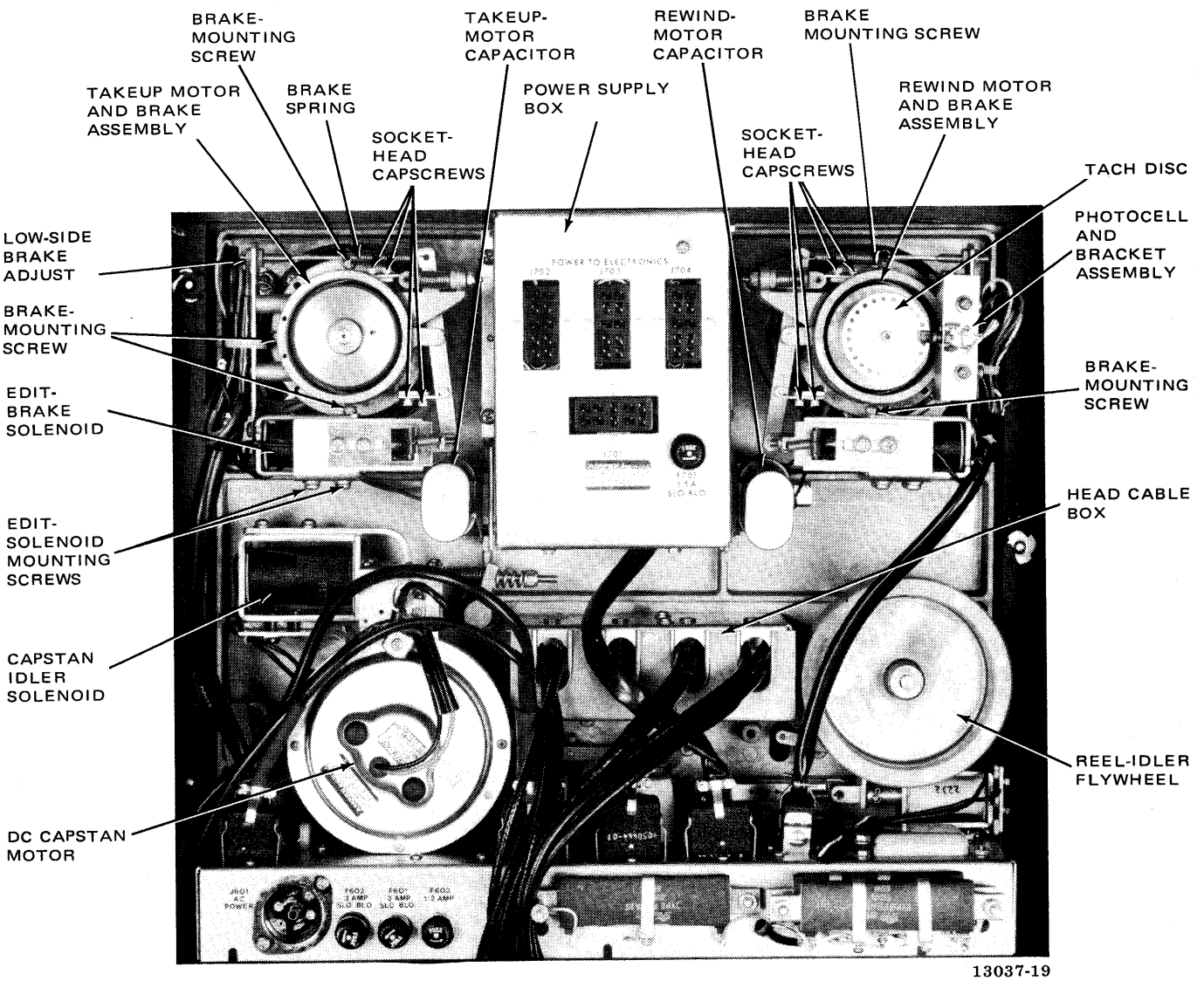


Figure 5-14. Tape Transport Components (Bottom View)

Power Supply Installation

Install the power supply in reverse order of removal procedures. (The captive cable is routed from under the power supply box, out of the side toward the transport control box.)

TAKEUP AND REWIND ASSEMBLIES

Major components in the takeup and rewind assemblies (Figure 5-14) are the torque motor and the brake. The turntable (fixed to the motor shafts) cannot be adjusted or individually replaced. The fixed position of the turntable also prevents removal of the motor flange. If any of these components are damaged beyond use, the complete motor assembly must be replaced.

Adjustment of tape tension (motor torques) and braking force are discussed earlier in this section (see *Tape Tensions* and *Brakes*).

Replacing Takeup or Rewind Assembly

The takeup and rewind assemblies are each secured, through slotted holes in the top plate, to the reel guards (for quick conversion to 11-1/2-inch CCIR reels). When either assembly is removed, the reel guard (Figure 5-13) will also be released.

To remove either assembly (Figure 5-14), disconnect the connector from the tape transport, slide the plastic sleeving from the capacitor solderless connectors and disconnect them. Manually support the assembly, and remove the three mounting nuts and washers (Figure 5-15).

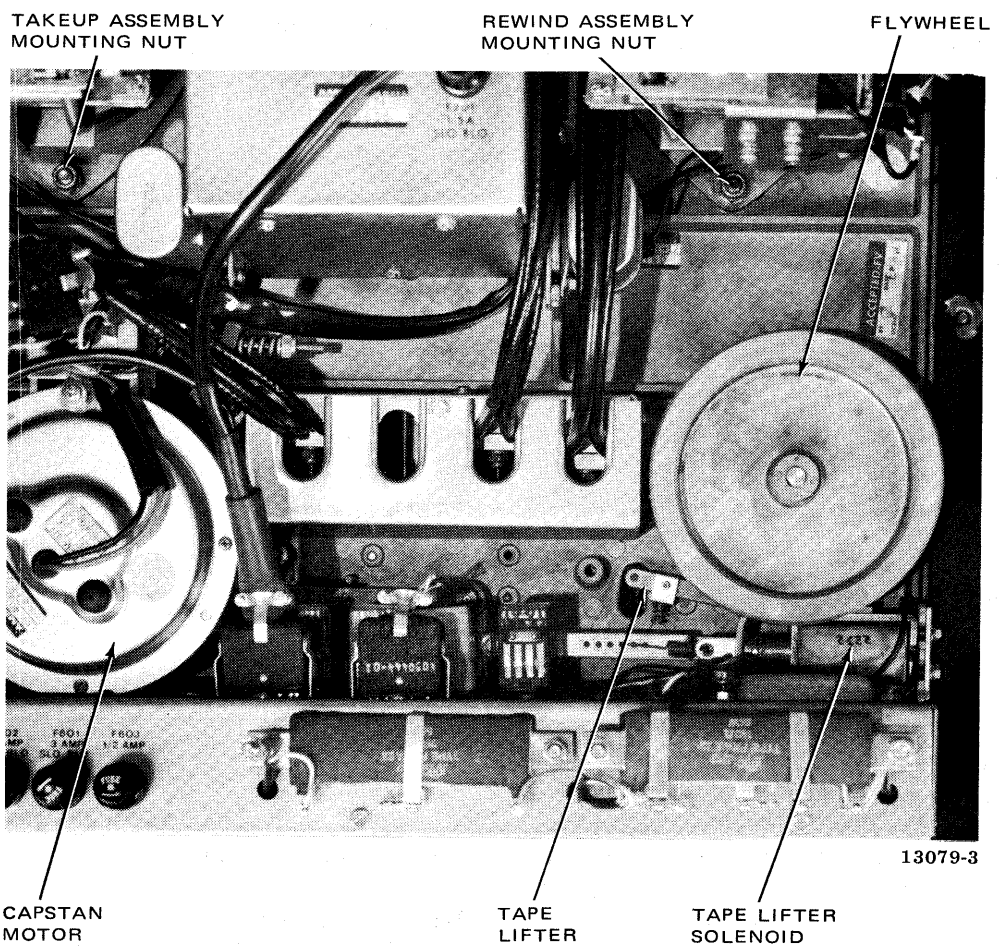


Figure 5-15. Takeup and Rewind Assembly Mounting Nuts

Reinstall the assembly in the reverse order of removal procedures. If the 10-1/2-inch NAB reel is the largest to be used, secure the assembly in the innermost position. If the 11-1/2-inch CCIR reel is to be used, secure the assembly in the outermost position. Before tightening the mounting nuts, check that the flat portion of the reel guard is parallel with the transport top edge and that the turntables are centered in the guard.

Reel Drive Plate Replacement

A reel drive plate (Figure 5-13) in the center of each turntable has three extrusions which mate with the EIA reel hubs. Three screws secure the plates to the turntable. To replace the drive plate, remove the three screws, lift the plate from the spindle, place the new drive plate in position, and reinstall the screws.

Turntable Pad Replacement

To replace the cork pad on the turntable top, use a putty knife (or similar tool) to lift one edge of the pad, then peel it off the turntable. Clean all adhesive from the turntable, with lacquer thinner, MEK, or similar solvent. Peel the backing from the new pad (exposing the adhesive surface) and carefully align the reel holddown holes in the pad with those in the turntable. Press the pad firmly in position.

Brake Assembly Removal

To remove the brake assembly proceed as follows:

1. Remove the cable clamp that secures the wires to the solenoid bracket.

2. Slide the plastic sleeving from the solderless connectors on the two solenoids.

3. If the brake is being removed from a rewind assembly, remove the photocell and bracket assembly (Figure 5-14). Loosen the two screws that hold the photocell mounting bracket to the solenoid bracket to expose the third brake assembly mounting screw.

4. Remove the three brake assembly mounting screws.

5. Manually actuate the main brake solenoid (the one closest to motor) and slide the entire assembly from the brake drum.

Brake Band Replacement

To replace the brake band, proceed as follows:

1. Remove the brake spring (Figure 5-14).

2. Remove the two socket-head cap-screws and washers which secure the brake band (at the end farthest from the solenoids). A band link clamp will also be released.

3. Loosen (do not remove) the two socket-head cap-screws at the other end of the brake band. Take care not to lose the leaf spring, then slide the brake band end from between the clamp and the screws, and remove the brake band.

4. Insert the new brake band through the holes in the housing, with the slotted end toward the solenoids.

5. Secure the brake band end farthest from the solenoids with the band link clamp, the two socket-head cap-screws, and the lockwashers removed in step 2.

6. Insert the brake band's slotted end between the band link and its clamp. Install the leaf spring between the brake band and the band-link clamp (so the spring is on the band inner side, which is on the same side as the lining). Tighten the two socket-head cap-screws snugly, but so the brake band will still slide in and out of the clamp.

7. Reinstall the brake spring removed in step 1.

8. Adjust the brake assembly (see *Brake Installation and Adjustment*).

Brake Solenoid Replacement

Remove cable clamp which secures the wires to the solenoid bracket. Slide the plastic sleeving from the solderless connectors on the two solenoids, and disconnect the wires.

To remove the edit brake solenoid (the solenoid farthest from the motor), remove the two screws and washers (Figure 5-14) from the edit solenoid and its bracket. The solenoid plunger will slide partly out. If the plunger must be removed, remove the self-locking nut (edit brake adjustment) and the spring beneath it (Figure 5-5), and slide the spade bolt out through the hole in the edit-solenoid stop-plate. Remove the plunger from the spade bolt by removing the cotter pin and clevis pin.

To remove the main brake solenoid, remove the two screws and washers from the end of the main brake solenoid and the solenoid bracket. Pivot the edit brake solenoid bracket for access, then remove the main brake solenoid (the plunger slides partly out of the solenoid). If the plunger must be removed, remove the cotter pin and clevis pin.

Replace the solenoids in the reverse order to removal procedures. Perform adjustment procedures given in the following paragraph.

Brake Installation and Adjustment

To install the complete brake assembly on the reel motor, manually actuate the main brake solenoid, insert the brake band over the brake drum on the motor shaft, and secure the assembly in position with the three brake assembly mounting screws.

After installing any item on the brake assembly, adjust the brakes as follows:

NOTE

Parts that are adjusted are illustrated in Figures 5-5 and 5-14.

1. Check that the edit-brake solenoid is flush with the edit solenoid bracket. Adjust the edit solenoid bracket so it is 1/16 inch above the inboard face of the main-brake solenoid.

2. Remove the end of the low side brake spring that goes to the adjusting bolt. This allows the brake solenoid to be easily operated manually.

3. Check that the brake band is correctly aligned to the drum. Slide the slotted end of the band into its clamp (clamp nearest the solenoids). The brake band should be secured at a position that allows it to clear the brake drum when the solenoid is in the energized (seated) position yet does not cause the band to buckle. This buckling will be visible near the clamp when the solenoid is seated. The brakes should not drag on the drum with the solenoid seated. Tighten the two clamp screws.

4. Attach the low side brake spring to the adjusting bolt.

5. Position the edit solenoid spring anchor bracket so the edit solenoid stop plate is 1/16-inch to "just touching" the end of the main brake solenoid plunger.

6. Connect the solderless connectors to the solenoids and slide the plastic sleeving over the connectors.

7. Secure the wires to the solenoid bracket with the cable clamp.

8. Mount the photocell assembly on its bracket, if working with a rewind assembly. The photocell bracket should be vertically adjusted so that the photocell does not touch the tach disk.

9. Adjust the photocell horizontal alignment (see *Motion Sense Photocell Alignment*). Adjust the main brake tension and edit brake tension as explained earlier in this section.

Motion Sense Photocell Alignment

Align the motion sense photocell as follows:

1. Tape the takeup tension arm in a position so the safety switch is on.

2. Connect an AC VTVM or oscilloscope to the collector of the photocell assembly located on a tie point on the photocell bracket with a green/white wire attached.

3. Apply power. Place the transport in play mode, without tape, and allow the rewind

motor to turn freely. Do not attempt to make this adjustment in the fast wind mode since the circuitry clips the photocell output in fast forward or rewind.

4. Loosen the two screws holding the photocell/bracket assembly (Figure 5-14) to the photocell bracket and adjust this assembly with respect to the tach disk holes to give a maximum AC reading on the VTVM or oscilloscope. The maximum voltage should be between 2-1/2 and 8 volts rms. Tighten the mounting screws.

Rewind and Takeup Clutch Defeat

The clutch associated with the rewind and takeup assemblies ensures proper stopping with any combination of reel sizes. If only one reel size is to be used, the clutches may be defeated as follows:

1. Remove one of the setscrews that hold the brake drum to the motor shaft on both rewind and takeup assembly.

2. In place of the setscrew, insert a 4-40 X 3/8 long socket-head cap-screw. In absence of a cut-down Allen wrench, use a pliers to tighten this screw.

3. Check the low side braking tension with a NAB reel, twine and a spring scale. The tension should be 5 to 6 ounces with clockwise direction of the rewind turntable and counterclockwise direction of the takeup turntable. If the tension is incorrect, adjust the low side spring tension with the low side adjusting nuts (Figure 5-14).

Takeup and Rewind Motor Capacitor Replacement

To remove a takeup or rewind motor capacitor (Figure 5-14) remove the power supply (see *Power Supply Removal*). Slide the plastic sleeving from the solderless connectors on the capacitor leads, and disconnect the wires. Loosen the two screws on the mounting plate and slide the capacitor and plate from the casting. Remove the mounting plate and use the removed screws, nuts, and washers to secure the new capacitor on the plate (do not tighten the screws). Slide the capacitor and plate into position, then tighten the screws. Connect the leads and reinstall the power supply.

AC AND SERVO CAPSTAN MOTOR

AC Capstan Motor Lubrication

Lubrication instructions for the AC capstan motor are provided earlier in this section under the heading *Lubrication*. (The servo controlled DC capstan motor does not require lubrication.)

AC Capstan Motor Fan and Flywheel Replacement

The fan and the flywheel are secured to the AC capstan motor shaft by setscrews. To remove the components, loosen the setscrews and slide the parts off the shaft.

To reinstall the components, slide the flywheel on the shaft until the hub is against the shaft shoulder (the hub setscrew portion should be away from the motor). Tighten the setscrew against the shaft flat. Slide the fan on the shaft (setscrew side toward the motor) and bottom it against the flywheel hub. Tighten the setscrew against the shaft flat.

Capstan Motor Replacement

Replace the capstan motor as follows:

CAUTION

DO NOT BUMP OR SCRAPE THE CAPSTAN AS THE MOTOR IS REMOVED OR INSTALLED.

1. Disconnect the motor cable at the control box (AC motor) or at the servo chassis (DC motor).

2. Remove the capstan dust cap cover from the DC motor by loosening the setscrew (Figure 5-13), pushing the capstan idler back, and lifting the dust cap from the capstan shaft. For an AC motor, use a knife blade or similar tool and gently pry the dust cap cover off from the top plate.

3. Manually support the motor and remove the four screws from the motor and top plate. The motor shield used with AC motors will also be released.

4. Install the capstan motor in the reverse order of removal. Be sure to install the motor shield removed with the AC motor.

Motor Capacitor Replacement

The AC capstan motor capacitor is fastened to the capstan-idler solenoid mounting plate by two screws (Figure 5-14). Unplug the capacitor from the transport control box. Use a short screwdriver (or offset screwdriver) to remove the two screws and washers, and remove the capacitor. Use the removed screws and washers to mount the new capacitor in position. Reconnect the capacitor to the transport control box.

REEL IDLER

Tape Guide Replacement

To remove the tape guide from the reel idler arm, unscrew the spring-loaded screw (Figure 5-13), then remove the guide, screw, spring, and flat washers (used as shims). To install the tape guide, insert the spring and screw in the top of the guide, and install all of the washers; seat the guide slot (in the bottom) over the spring pin on the arm, and tighten the screw.

Pulley Replacement

The pulley (Figure 5-13) is held in the reel idler housing by the reel idler flywheel (Figure 5-14), which is secured to the pulley shaft by a setscrew. The setscrew is in the side of the flywheel toward the transport, and must be found by touch. Rotate the flywheel so the pulley shaft flat is toward the outer edge of the rewind motor. Insert a 3/32 Allen wrench (with a handle and long-shaft) past the outer edge of the rewind motor, and then into the setscrew hole by touch. If the transport is face down, manually support the reel idler pulley while loosening the setscrew and removing the flywheel, then slide the pulley and pulley shaft out of the housing.

Install the pulley by sliding the pulley shaft back through the housing, and then remounting the flywheel. End play must be 0.003 to 0.005 inch to avoid damaging the ball bearings. Check the play by firmly holding the pulley down in the housing, and using a feeler gauge, measure the clearance between the pulley and the housing (at the side opposite the arm). To this measurement add 0.004 inch, and select the feeler gauge leaves equal to the total. Insert the gauge between the pulley and housing, at the side opposite the idler arm. Hold the pulley firmly down on the gauge, and push the flywheel (setscrew side in) so it firmly contacts the bottom of the housing. Tighten the flywheel setscrew, and remove the feeler gauge.

Idler Tension Adjustment

The idler tension is not critical; however, if it becomes too high, and cannot be correctly adjusted, it indicates that reel idler damage is causing binding.

Measure the tension with the transport in the horizontal position at the outer end of the arm with a spring scale. Between 1/3 and 1 ounce (10 to 30g) of pressure should be required to move the arm from its stop.

If adjustment is indicated, remove the pulley assembly (see *Pulley Replacement*), which reveals two screws. Loosen the screws, and rotate the bushing clockwise to increase tension, or counterclockwise to decrease tension. Tighten the two screws, and recheck the tension. Reinstall the pulley.

Arm Assembly Replacement

To remove the arm assembly, remove the pulley then remove the two screws that are revealed. Remove the arm, bushing, and idler mount from the housing. The arm is between the bushing and the mount; they are press-fit together to a very close tolerance and, therefore, cannot be ordered separately. Contact Ampex Audio Technical Support Department if replacement is required. The tension spring can easily be replaced by unhooking it from two pins, one on the arm and the other on the mount.

To install the arm assembly, insert it in the housing with the arm in the upper left slot. Install the two screws loosely, then check and adjust arm tension and replace the pulley.

Reel Idler Assembly Replacement

To remove the complete reel idler assembly, remove the pulley (Figure 5-13). Remove the two screws that secure the reel idler assembly to the casting (Figure 5-14), and remove the assembly from the transport.

Install the assembly in the reverse order of removal procedures. If the arm was removed from the housing, check and adjust the arm tension. Install the pulley and flywheel.

Ball Bearing Replacement

To replace the ball bearings in the reel idler, remove the idler assembly from the transport (see *Reel Idler Replacement*). Remove the arm from the housing. Insert a pencil (or similar object) up through the hole in the lower bearing to push the top bearing out.

To remove the lower ball bearing, use Truarc pliers to remove the lower retaining ring, then insert the pencil (or similar object) from the top of the housing to push the bearing out.

CAUTION

WHEN INSTALLING THE NEW BEARINGS, USE NO LUBRICATION. INSERT THE BEARINGS INTO THE HOUSING WITH FINGER PRESSURE ONLY, BEING VERY CAREFUL NOT TO COCK THE BEARINGS IN THE HOUSING.

Install the lower bearing, against the retaining ring, by pushing only the bearing outer race (not toward the inside) with equal pressure on opposite sides of the bearing. Install the lower retaining ring below the bearing, then push the other bearing into position.

Reinstall the reel idler assembly on the transport, and install the arm assembly. Check and adjust the arm tension. Reinstall the pulley and flywheel.

TAKEUP TENSION ARM

Arm Spring Adjustment

The only time the spring requires adjustment is when the arm is removed from the housing (Figure 5-13) for some reason. Remove the cover cap from the tension arm base (socket-head screw in cap must be removed) for access to the spring.

If the spring is completely loose, it should be wound approximately one turn around the hub and hooked over the drive pin in the housing. Usually the spring will not be completely loose but will be hooked on the pin associated with the arm assembly. In this case use a sharp pick to remove the spring from the pin and extend it to the drive pin. To check that the spring position is correct, the tension required to move the arm off of the stop can be measured at the tape guide. When in a horizontal position this tension should be between 0.4 and 0.9 ounce (12 to 25g).

Safety Switch Adjustment

To check the position where the takeup tension arm actuates the safety switch (to stop tape motion), move the arm to the tape threaded position. Allow the arm to return slowly toward the rest position, listening closely for the click when the safety switch actuates. At that point, the tape guide tape-contacting surface should be 3-1/2 to 4-3/8 inch from the transport edge.

Required adjustments are made from the transport back. Remove the connectors for capstan and takeup motors from the transport control box. Hold other wires aside so the safety switch (Figure 5-16) is accessible. Use long-nose pliers to bend the safety switch actuator out from the switch to actuate with the takeup tension arm at a higher position and toward the switch for a lower position. Reconnect the capstan motor and takeup motor connectors.

Tape Guide and Hook Replacement

Remove and replace the tape guide and hook (Figure 5-13) from the takeup tension arm as follows.

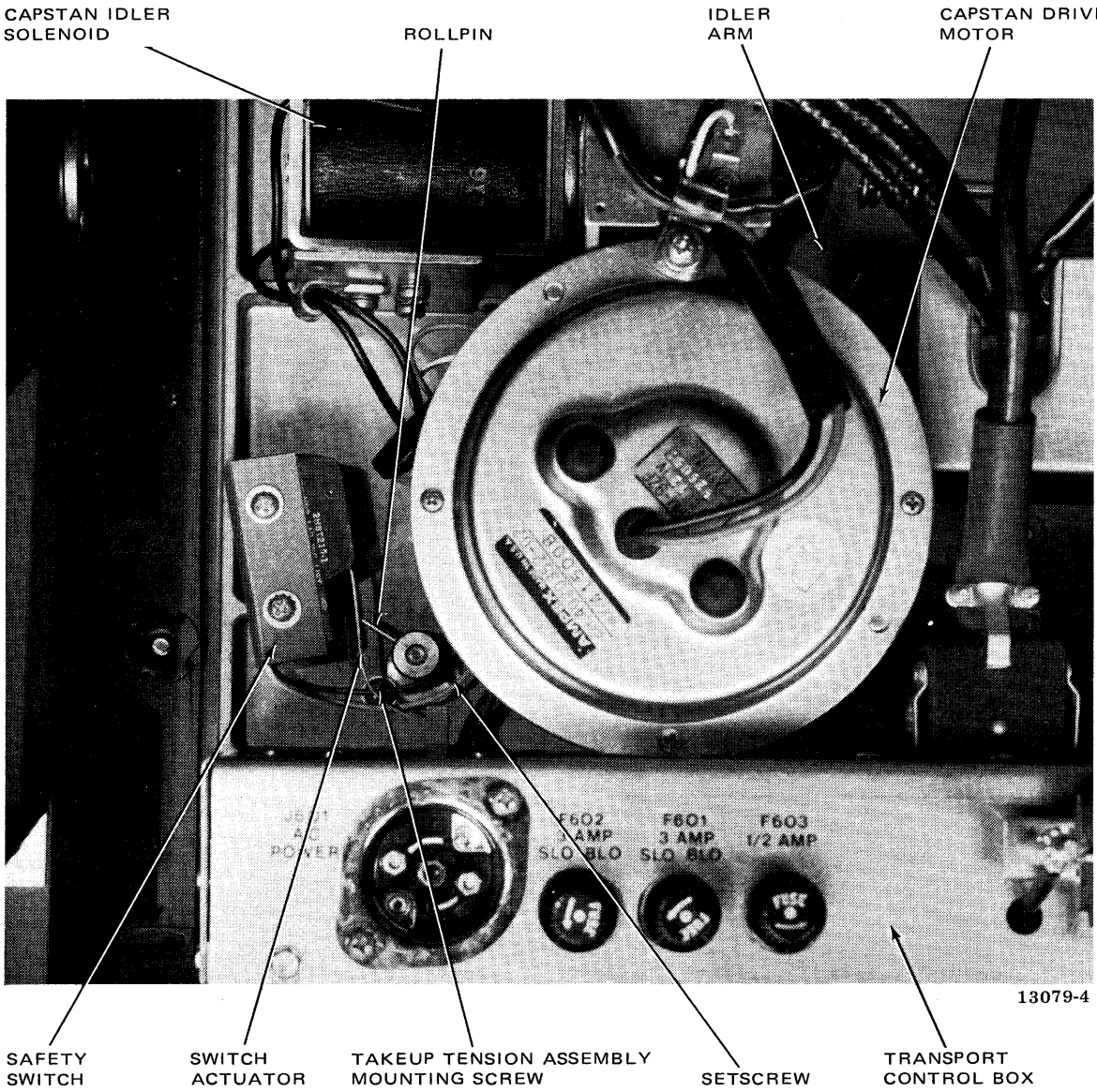


Figure 5-16. Takeup Tension Safety Switch

CAUTION

WHILE PERFORMING THE REPLACEMENT PROCEDURE, SUPPORT THE TAKEUP TENSION ARM TO PREVENT BENDING THE ARM.

Remove the spring-loaded screw from the top of the guide to remove the tape guide and hook.

To install the hook and guide, use the rollpin on the arm to align the locating hole in the hook and the slot in the bottom of the guide. Insert the spring and screw in the guide, then tighten the screw.

Tape Tension Arm Replacement

To remove the takeup tension arm assembly, disconnect the capstan drive motor and takeup motor cables from the transport. Secure other wires aside for access to the tension arm base. Remove the screw and washer (Figure 5-16) and

lift the assembly off the transport while carefully guiding the protruding rollpin out through the top plate.

Remove the setscrew from the base, and install it in the new assembly so it protrudes 3/16 inch. Guide the end of the new assembly through the top plate hole and mate the setscrew with the upper left hole. Secure the assembly to the transport with the screw and washer previously removed.

CAPSTAN IDLER

Lubrication and Adjustment

Lubrication of the capstan idler is discussed earlier in this section under the heading *Lubrication*. The adjustment of idler force against the capstan is given under the heading *Tape Tension (Capstan Idler).*

Non-Removable Parts

The capstan idler arm (Figure 5-13) and associated components cannot be removed from the transport, because the solenoid arm (Figure 5-17) is secured to the idler arm shaft by a press-fit rollpin. Removing and installing this rollpin requires special tools. The solenoid arm will not pass through the hole in transport, so parts between the idler arm and the solenoid arm cannot normally be removed. If any of these parts should ever require replacement, the transport should be returned to the factory for repair.

CAUTION

DO NOT USE A DRIFT PIN AND HAMMER TO DRIVE THE ROLLPIN OUT OR IN, SINCE IRREPARABLE TRANSPORT DISTORTION CAN RESULT.

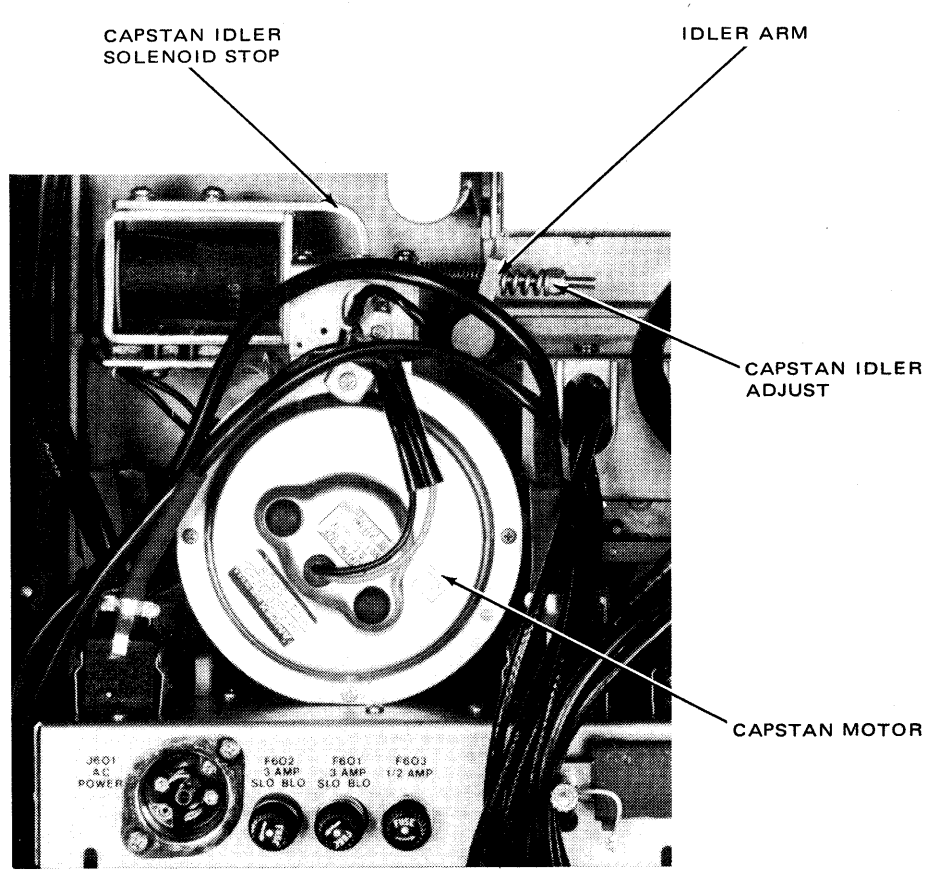


Figure 5-17. Capstan and Capstan Idler Components

Idler Positioning

The normal clearance between the idler tire and the capstan (Figure 5-13) should be 0.460 ±0.02 inch for AC capstan motors and 0.400 ±0.02 inch for capstan servo motors. This clearance can be increased if low line voltages will not be experienced. Under low line voltage, the capstan idler solenoid may not pull in with increased clearance.

To adjust the clearance, tilt the transport to a vertical position with the pushbuttons on top. Loosen the two screws that hold the capstan idler solenoid stop to the capstan idler solenoid. Move the solenoid stop inboard so as to give maximum clearance. Place an appropriately dimensioned spacer between the capstan and the idler tire. For AC motors, this spacer could be a 15/32 drill bit; for servo motors, a 13/32 drill. Tape wound on a pencil to give the proper dimension will also work. While holding the spacer with the right hand, move the solenoid stop outboard with the left hand until the tire just touches the spacer. While holding the stop in position, remove the spacer and tighten the solenoid stop screws with the right hand. Place the transport in the normal operating position and recheck the dimension. If the tire is held too tightly against the spacer, the idler will shift position when the spacer is removed. Make sure the solenoid stop is not cocked so that the space bolt drags on the solenoid stop.

Idler Assembly Replacement

The rubber-tired idler assembly is held on the capstan idler arm (Figure 5-13) by a setscrew. To remove the idler assembly, loosen the setscrew and slide the iderl shaft from the arm.

To remove the idler wheel from the idler shaft, use a knife blade or similar tool and gently pry up the dust cap from the hub of the idler assembly. Remove the retaining ring (with Truarc pliers) and the shims. Lift idler wheel from shaft. Transfer the felt wick and cap spring to the new idler wheel. Install the idler wheel in the reverse order using the shims to allow slight end play.

Install the idler assembly on the capstan idler arm so that the bottom surface of the idler is 0.66 inch ±0.015 inch above the stainless steel overlay. For 3-3/4 and 7-1/2 in/s machines with AC capstan motors, this dimension should be 0.56 inch ±0.015 inch.

Capstan Idler Solenoid Replacement

To remove the capstan solenoid (Figure 5-17), remove the drive motor (with capacitor). Disconnect the takeup motor cable from the transport control box. Remove the self-locking nut (capstan adjust) and spring from the end of the bolt in the solenoid arm. Slide the plastic sleeving from the solderless connectors on the solenoid leads, and disconnect them. Remove the mounting plate that clamps the solenoid to the transport by loosening the four mounting screws. Slide the plate and solenoid off, while guiding the bolt out of the idler arm.

To install the solenoid, loosely secure the mounting plate to the solenoid with the four removed screws and washers. (The solenoid leads are fastened in a cable clamp that is secured with one screw.) Place the idler return spring on the bolt, then insert the bolt end through the idler arm. Slide the plate and solenoid over the casting extrusions. Tighten the screws to clamp the solenoid in position. Install the idler adjusting spring, and then the self-locking nut on the bolt. Connect the leads to the solenoid. Install the drive motor and its capacitor. Reconnect the takeup motor cable. Check and adjust the capstan idler position. Check and adjust the capstan idler pressure.

TAPE LIFTER

During the play mode the tape lifter arms must not touch the tape. In the fast wind modes the lifter must remove the tape from head contact; however, the tape must not contact the head gate shield covers. Adjustment is usually required only when a tape lifter component or the solenoid is replaced.

Tape Lifter Adjustment

To adjust the tape lifter proceed as follows:

1. Remove the head assembly and the reel idler flywheel and pulley. Disconnect the capstan motor cable, the electronic power

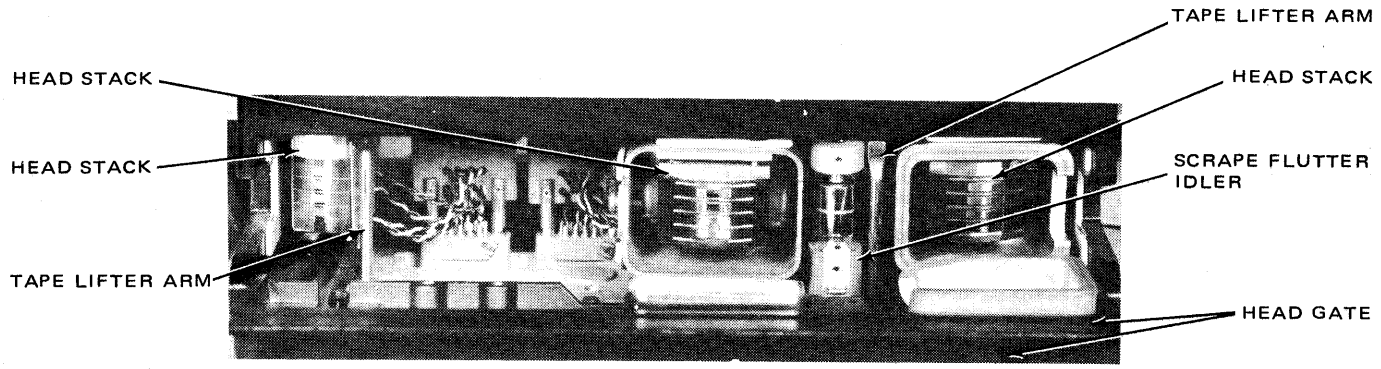
cable and the supply motor cable and the takeup motor cable. Use pressure sensitive tape to hold the takeup tension arm away from the safety switch. Loosen the two hex head screws at each end of the tape lifter bracket (Figure 5-18). Make sure the spring that connects the solenoid to the bracket is in the third hole.

2. Working from the top of the transport, stuff sponge rubber or some other resilient material into the left tape lifter opening in such a way so that the distance between the front surface of the right-hand lifter and the front surface of the scrape-flutter idler is 9/32 to 5/16 inch. This will not be the final dimension since approximately 1/32 spring back can be anticipated. Energize the tape lifter solenoid by pressing one of the fast mode pushbuttons.

3. Working from the rear of the transport, pull the tape lifter bracket inboard until all the slack is removed from the spring connecting the bracket and solenoid. However, do not extend the spring. While holding the bracket in this position, tighten the inboard hex head screw; then tighten the hex head screw under the spring.

4. Working from the front of the transport, remove the resilient material and again check distance measured in step 2. It should be 1/4 to 9/32 of an inch. If not, repeat steps 2 and 3 using a different allowance for spring back.

5. Press the STOP button. Measure the distance between the front surface of the scrape-flutter idler and the front surface of the lifter in the retracted position. This should be 1/8 ±1/32 inch. If not, loosen the two screws that hold the solenoid stop to the



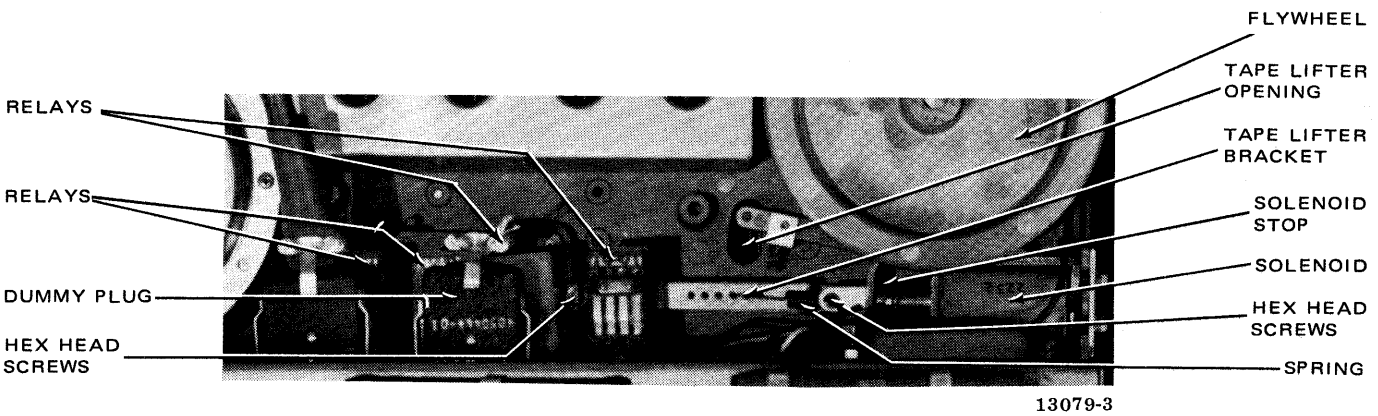


Figure 5-18. Tape Lifter Components

solenoid. Move the stop to attain this dimension making sure that there is no slack in the solenoid-lifter bracket spring. Tighten these screws.

6. Replace the reel idler flywheel and pulley, and the head assembly. Reconnect the cables previously removed.

Solenoid Replacement

To remove the tape lifter solenoid (Figure 5-18), remove the reel idler pulley and flywheel. Disconnect the rewind-motor and electronic-power-supply cables from the transport control box. Remove tape lifter spring (refer to Figure 5-18). Slide the plastic sleeving from the solderless connectors on the solenoid leads and disconnect the wires. The solenoid is clamped to the transport casting by a mounting plate. Use an open-end wrench to loosen the two hex-head screws, then slide solenoid and plate off.

To install the solenoid, mount the plate on the solenoid end with the two removed screws, lockwashers, and flat washers. Slide the solenoid and plate onto the extrusions on the casting, and use an open-end wrench to tighten the two mounting screws. Connect the leads to the solenoid and reinstall the tape lifter spring in its original position. Adjust tape lifter action. Reinstall the reel idler pulley and flywheel, and reconnect cables.

Tape Lifter Replacement

To remove the tape lifter assembly, remove the reel idler pulley and flywheel. Disconnect the transport rewind-motor and power-supply cables, remove the dummy plugs (or cables) from the transport control box, and remove the four plug-in relays (Figure 5-18).

Remove the tape lifter solenoid. Remove the tape lifter return spring from between the tape lifter assembly and the transport post. Remove the two socket-head shoulder screws and remove the complete assembly (note that flat washers are between the tape lifter and the transport).

The tape lifter assembly drawing is provided in Section VI. Replaceable parts are listed in the tape transport parts list. The tape lifter return spring takes up slack at the end of the clevis pins on the tape lifter arms to prevent backlash and rattle.

To install the tape lifter assembly, reverse the removal procedures. Be sure to install the washers between the assembly and the transport. Install the tape lifter solenoid. Adjust the tape lifter action. Reinstall the reel idler pulley and flywheel. Reinstall the connecting cables, dummy plugs, and relays.

SAFETY SWITCH REMOVAL

To remove the safety switch (Figure 5-16), disconnect the capstan motor and takeup motor cables from the transport control box. Move other wiring aside for access. Slide the plastic sleeving from the solderless connectors on the safety switch leads and disconnect the wires. The switch is secured to mounting posts on the transport casting by two screws and washers. Remove these screws and the switch, along with the shield.

To install the safety switch, place the shield over the switch, then use the two screws to secure the switch and shield. Connect the leads to the switch, check and adjust actuation of the switch, and reconnect cabling.

REMOVAL OF ELECTRONIC ASSEMBLIES AND COMPONENTS

CONTROL BOX COVER

The control box bottom cover must be removed for access to components inside. To remove the cover, turn power OFF, and remove the cover from over the tension-adjust resistors (Figure 2-3). Use an open-end wrench to loosen the seven hex-head screws (two at each end, and three on one side of the bottom cover). Use the access finger holes to pull the cover off (the screws slide out of the slots on the box).

WARNING

DANGEROUS VOLTAGES ARE PRESENT INSIDE THE CONTROL BOX AND ACROSS THE TENSION-ADJUST RESISTORS WHEN POWER IS CONNECTED TO THE RECORDER. ONLY THOROUGHLY EXPERIENCED PERSONNEL SHOULD SERVICE THE UNIT WITH POWER ON.

CONTROL BOX

To remove the control box, disconnect all cable connectors. Disconnect the solderless connectors from the tape lifter solenoid, the capstan idler solenoid, and the safety switch.

At the front of the transport, remove the two screws from the pushbutton escutcheon, and remove the released parts. Remove the two screws from the toggle switch escutcheon, and remove the escutcheon.

Manually support the control box, remove the three screws securing the front of the control box, and remove the control box.

Relay actuation and power distribution can be checked with: 1) control box removed, 2) dummy plugs in their receptacles, 3) the two safety switch leads joined and tape-insulated, 4) each solderless connector separately tape-insulated, and 5) cover reinstalled over the tension-adjust resistors. The power cord can then be connected, power applied, and circuits checked.

WARNING

DANGEROUS VOLTAGES ARE PRESENT INSIDE THE CONTROL BOX AND ACROSS THE TENSION-ADJUST RESISTORS. ONLY THOROUGHLY EXPERIENCED PERSONNEL SHOULD ATTEMPT SERVICING THE ENERGIZED UNIT WITH THE BOTTOM COVER OR THE RESISTOR COVER REMOVED.

To install the control box, reverse the removal procedures. Check for correct connection of leads to the solenoids, drive motor capacitor, and safety switch.

POWER LAMP

To replace the power lamp, remove the two screws securing the escutcheon over the pushbuttons and remove the released parts. Remove the two screws securing the escutcheon over the toggle switches, and remove the released parts. Remove the lamp from the socket with a lamp extracting tool; if the tool is not available, the lamp may be removed with the eraser end of a pencil onto which is attached a piece of adhesive tape with the sticky side out.

CONTROL BOX SWITCHES

Remove the control box from the transport. When new pushbutton switches are installed, set the switch face to 19/32 (±1/32) inch above the chassis. Set toggle switch handles 1-5/16 (±1/32) inch above the chassis.

INDICATOR LAMP REMOVAL

The record and ready lamps may be replaced from the front by pulling the lamps from their sockets with pliers. When replacing the lamps, note that the terminals are not centered on the lamps.

The lamps should be replaced with the lamp terminals closest to the bottoms of the sockets. The easiest way to align the lamps is to do it under power. If a ready lamp is to be replaced, place the channel in ready. Insert the lamp in the socket until it lights, then push it home. When replacing a record lamp, press ready on that channel, then place the transport into the record mode of operation. Insert the lamp into the socket and push it home when it lights.

NOTE

If a record lamp burns out, that channel will not go into full record operation since the record relay will not energize. The tape will not be damaged even though the bias amplifier is energized. If a replacement lamp is not available, remove the ready lamp and install it in the record lamp socket.

To replace the meter lamp, it is necessary to remove the top cover of the electronics. Remove the screw holding the lamp socket to the meter bracket. Pull the lamp and socket outboard from behind the meter bracket. Replace the lamp and reinstall the socket.

CIRCUIT BOARD COMPONENTS

Required removal tools are:

1. 50-watt (maximum) pencil-type soldering iron.

2. Noncorrosive soldering flux with rosin-alcohol base.

3. Piece of small-diameter shielding braid.

Use a plunger-type solder remover if available instead of the soldering flux and shielding braid.

To remove a component, dip the shielding braid in the soldering flux. Heat the solder joint with the soldering pencil (never use a soldering gun or high-wattage iron), and dip the braid into the molten solder (the solder flows into the braid). Do not overheat soldering joints during this procedure, and especially avoid heating joints that are not to be unsoldered. When solder has been removed from all component leads, the part should then be removed without exerting excessive force.

To install the replacement part, bend the leads to fit in the mounting holes. Insert the leads through the holes, then bend them flat against the foil path. Use the soldering pencil, and low-melting-point rosin-core solder to solder the joints. Do not overheat the junction or nearby junctions. Remove excess rosin from the joint with a clean lint-free cloth moistened with alcohol.

After replacing a diode or transistor, allow the board to cool approximately two minutes before reinstalling it.

CAUTION

RESIDUAL SOLDERING HEAT COULD CAUSE THERMAL RUNAWAY IF POWER IS APPLIED TO A SEMICONDUCTOR DEVICE DURING THE TWO-MINUTE COOLING PERIOD.

OTHER COMPONENTS

All other components are accessible when the top or bottom cover is removed. Component location on the schematic diagram is indicated by a number before the identification letter. A table on the diagram gives the prefixes used, and the component locations. The assembly drawings are helpful in locating parts.

TROUBLESHOOTING

Use standard audio troubleshooting techniques to isolate faults to a certain stage or component. The DC, signal, and bias voltages are given at many points on the schematic diagram, as an aid in locating malfunctions. Schematic diagrams for the recorder/reproducer circuits and power distribution are in Section VI.

POSSIBLE CORRECTIVE ACTIONS

Any of the following corrective actions (see Table of Contents for Section V) may be required to bring the equipment within specifications.

1. Clean the heads.

2. Demagnetize the heads.

3. Adjust signal generator for flat output over the frequency range in use.

4. Adjust head azimuth.

5. Adjust bias level.

6. Adjust reproduce equalization.

7. Adjust record calibration.

8. Adjust tape tensions.

Adjustment and alignment procedures that may be needed during maintenance or troubleshooting are given earlier in this section.

CAUSES OF TAPE SPEED ERROR

Some causes of tape speed errors are given below.

1. Incorrect tape thickness. If a 1-mil tape is run with the 7-1/2–15 in/s AC capstan motor, the actual tape speed will be approximately 0.15% slower than if 1.5-mil tape were used. The NAB pulley will measure this speed as 0.18% slow because the pulley, as well as the capstan, is designed to 1.5-mil tape.

2. Tape slippage at the capstan. This may be caused by any of the following:

   a. Slick or oily capstan or capstan idler.

   b. Insufficient capstan idler pressure.

   c. Capstan idler solenoid not bottoming.

   d. Incorrect tape tensions.

   e. Dragging brakes.

   f. Improper position of reel hub size switches.

   g. Reel idler dragging so that it does not come up to the tape speed.

   h. Capstan surface is polished.

3. Defective capstan motor.

4. Defective AC capstan-motor capacitor.

CAUSES OF NOISE

NOTE

The signal-to-noise ratios listed in Table 1-2 apply to Ampex 406 tape referenced to a 520 nWb/m peak record level.

Some causes of excessive noise (a low signal-to-noise ratio) are listed below.

1. Incorrect setting of operating level (reproduce calibrate potentiometer).

2. Head gate open during noise check, causing hum.

3. External fields from nearby motor and transformers being introduced into heads, head cables or electronics, causing hum.

4. Heads need demagnetization, causing popping-type noise.

5. Erase peaking adjustment not at peak, causing unsymmetrical bias and popping-type noise.

6. Reproduce equalization incorrect, causing excessive high-frequency noise.

7. Reproduce head height incorrect, so that a portion of the head rides off of the recorded track.

CAUSES OF DISTORTION

Some causes of distortion, detected during performance tests, are given in the following paragraphs.

Second Harmonic Distortion

Excessive second harmonic distortion may be caused by:

1. Magnetized heads.

2. Erase peaking adjustment or erase transformers not at peak causing unsymmetrical bias and high distortion.

3. Malfunction in the bias oscillator or bias balance potentiometer R92 (if present on the bias module) is misadjusted, resulting in unsymmetrical output.

4. Malfunction of record or reproduce amplifiers.

Third Harmonic Distortion

Excessive third harmonic distortion may be caused by:

1. Reproduce calibration control incorrectly adjusted so that operating level is not correct.

2. A conventional tape used at a 260 nWb/m operating level will cause more than normal distortion and a high output tape used at 185 nWb/m operating level will produce less than normal distortion.

3. Bias setting incorrect.

4. Head height incorrect so that record and reproduce heads do not line up.

5. Malfunction of record or reproduce amplifiers.

6. Reel idler – bent shaft, flywheel not balanced, damaged bearing.

7. Head assembly – poor tape guiding.

8. Tape scrape, warped or damaged reels.

CAUSES OF FLUTTER

Excessive flutter can be caused by any component that affects the tape motion, but is usually caused by the following:

1. Oxide or dirt on components in the tape-handling path.

2. AC capstan motor – not in synchronism (too low line voltage), excessive tape tension, defective motor capacitor, bearings defective or need lubrication, or motor shaft bent.

3. Servo motor – servo gain incorrectly adjusted, loose or misadjusted rotor, loose or misadjusted tach probe, malfunction of servo electronics.

4. Supply motor – excessive or erratic holdback tension, dragging brakes, or bent shaft.

5. Capstan idler – defective rubber tire, bearing defective or needs lubrication, pressure incorrectly adjusted.

FLUTTER TROUBLESHOOTING HINTS

As an aid in troubleshooting, 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 meter output. Compare the results with the rotational rates in Table 5-8 for an indication of the cause of trouble.

If flutter is caused by the supply motor assembly, the frequency will vary, starting from low when the tape pack on the supply reel is large, and progressively increasing as the tape pack gets smaller. The takeup motor assembly seldom causes appreciable flutter because it is isolated from the heads by the capstan and capstan idler. If this is causing flutter, the frequency would vary inversely to that of the supply motor (high with a small tape pack on the takeup reel and decreasing as the pack increases).

EXTENDER BOARDS

Corrective maintenance procedures are greatly simplified by using the optional extender boards. The extender board, when installed between a circuit

Table 5-8. Rotational Rates (Hertz)

COMPONENT	TAPE SPEED			
	3-3/4 IN/S	7-1/2 IN/S	15 IN/S	30 IN/S
AC Capstan Motor	10	20 or 10	20	–
Servo Motor	3.125	6.25	12.5	25
Capstan Idler	0.6	1.2	2.4	4.8
Reel Idler	0.8	1.6	3.2	6.4
Scrape-Flutter Idler (Normal)	3.4	6.3	12.7	25.4
(Optional)	2.5	5.1	10.2	20.4

board and its receptacle, moves the circuit board outside the chassis so all components are accessible for testing/adjustment (the extended circuit boards must be mechanically supported).

Extender board catalog numbers are as follows: reproduce, 4020151; record, 4020152; bias amplifier, 4020153; power supply, 4020154; and capstan servo, 4050695.

TROUBLESHOOTING THE REPRODUCE AMPLIFIER

There are two methods of troubleshooting the reproduce amplifier:

1. Use of the flux loop to introduce a constant flux into the reproduce head thus introducing a constant current into the reproduce preamplifier.

2. Use of a resistor divider in place of the head to induce a constant voltage into the reproduce preamplifier.

The response curves expected when using a constant flux input are shown in Figures 5-19 and 5-20. The test set-up for inducing a constant voltage is shown in Figure 5-21. Typical response curves for the various speeds are shown in Figures 5-22 and 5-23.

TROUBLESHOOTING THE RECORD AMPLIFIER

There are also two methods of troubleshooting the record amplifier:

1. Use of a current probe to measure the current in the record head.

2. Measuring the voltage across a resistor substituted for the record head (see Figure 5-24).

In both methods, remove the bias amplifier module and place the channel into the record mode. The response expected is similar in both methods. Typical response curves are shown in Figure 5-25. The high-frequency response will vary with the high-frequency preemphasis used. Typical mid-frequency operating level signals will be approximately 1/2 mA with method 1 and 0.05V (–24 dBm) with method 2.

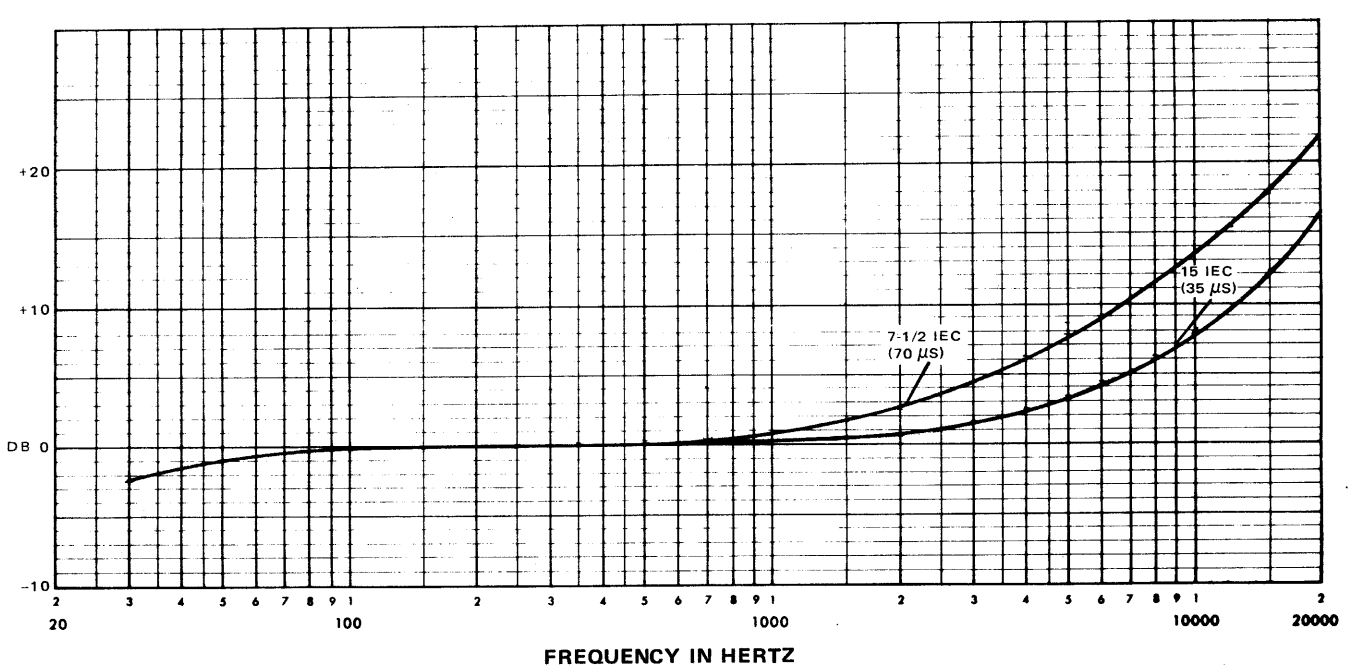


Figure 5-19. Reproduce Amplifier Response with Constant Flux to Head (IEC)

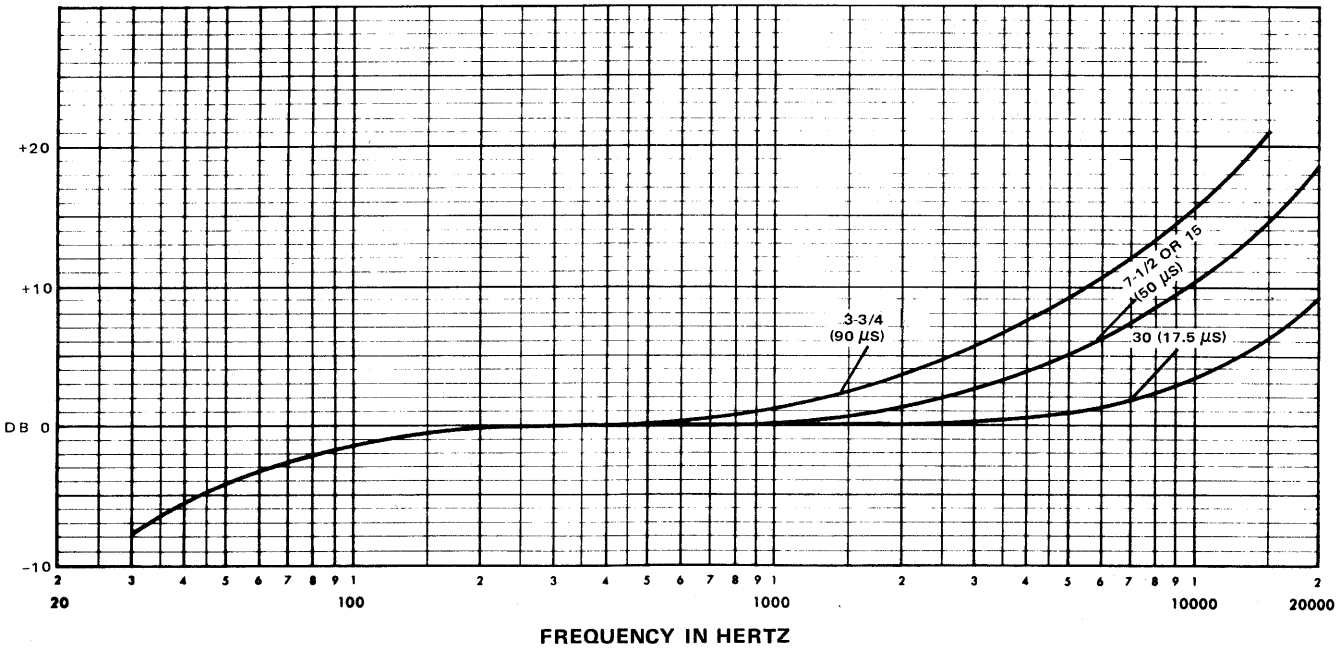


Figure 5-20. Reproduce Amplifier Response with Constant Flux to Head (NAB and AES)

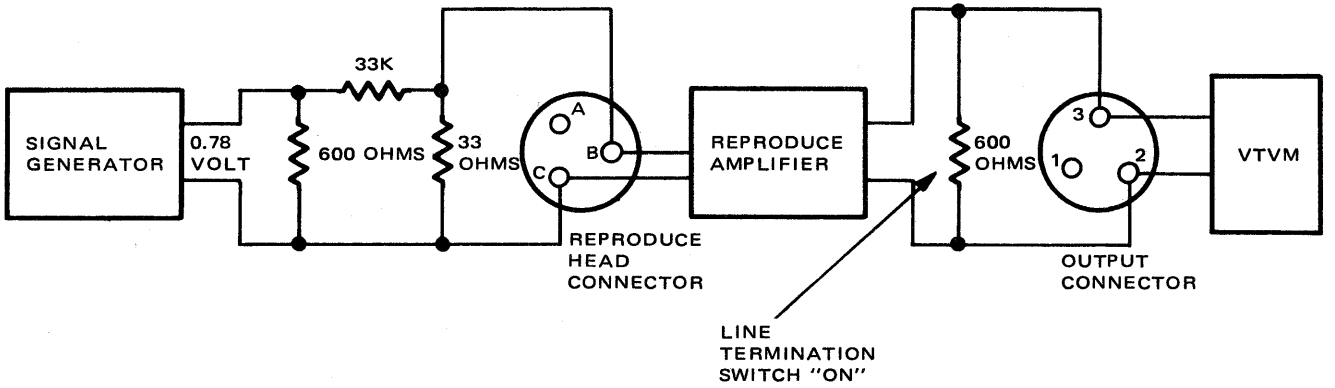


Figure 5-21. Troubleshooting Setup for Reproduce Amplifier

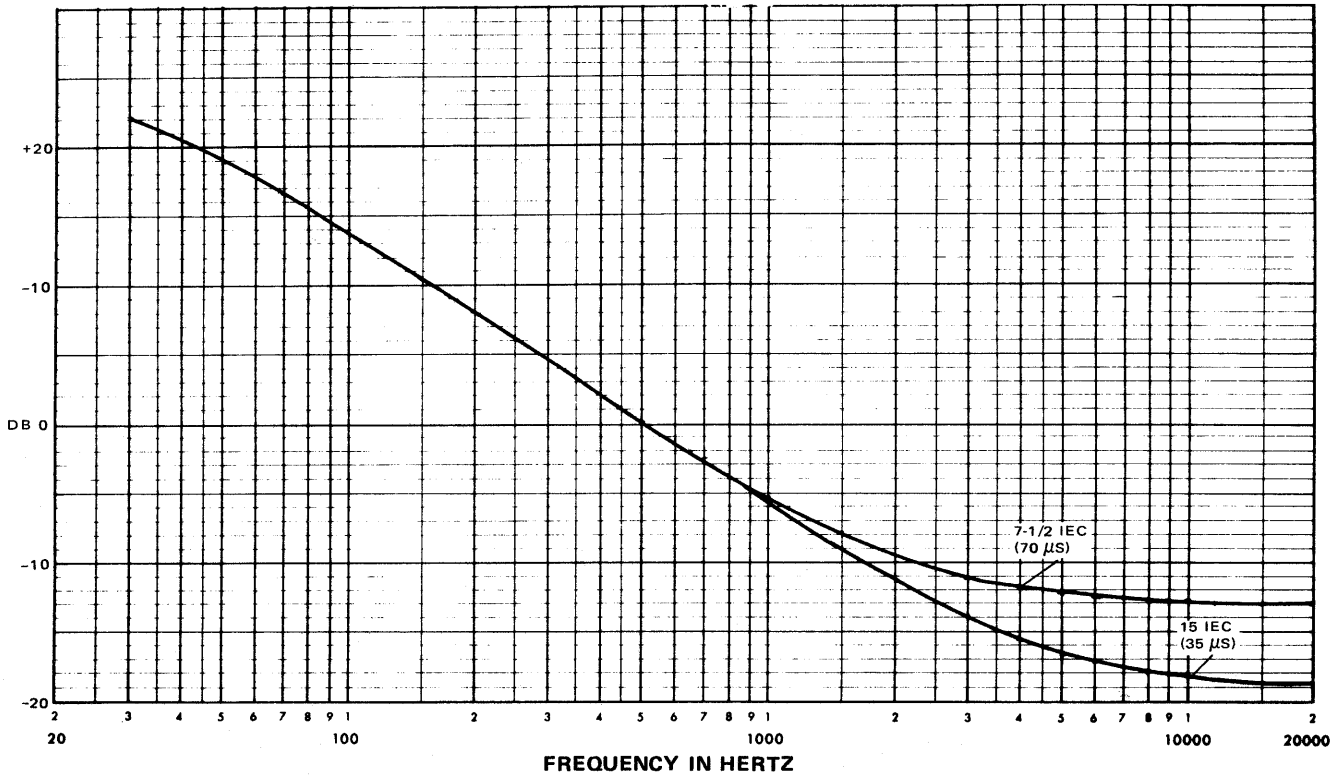


Figure 5-22. Reproduce Amplifier Response with Constant Voltage Input (IEC)

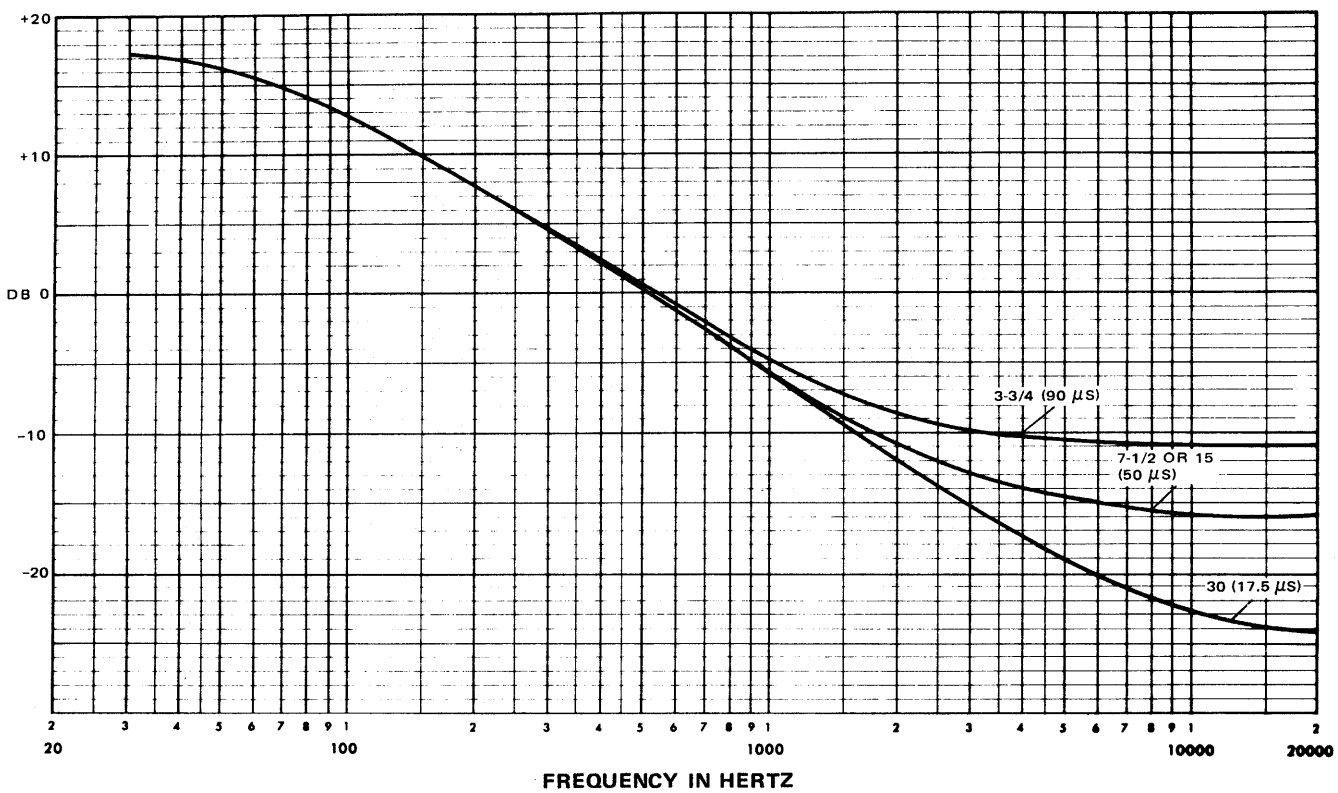


Figure 5-23. Reproduce Amplifier Response with Constant Voltage Input (NAB and AES)

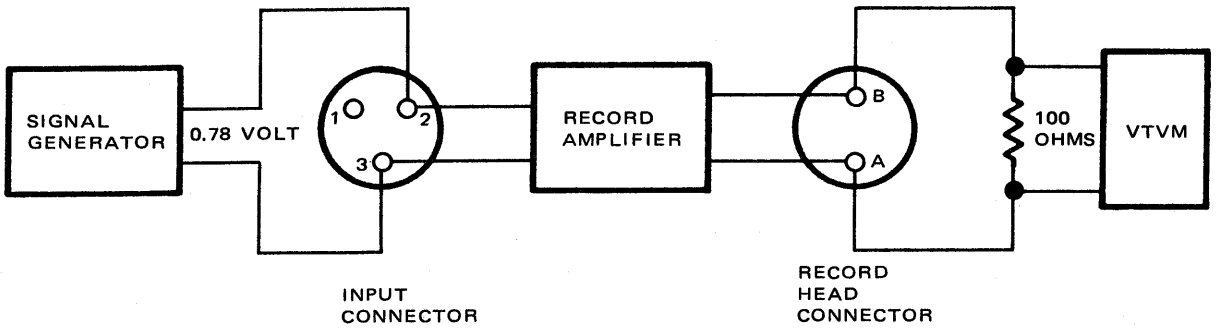


Figure 5-24. Troubleshooting Setup for Record Amplifier

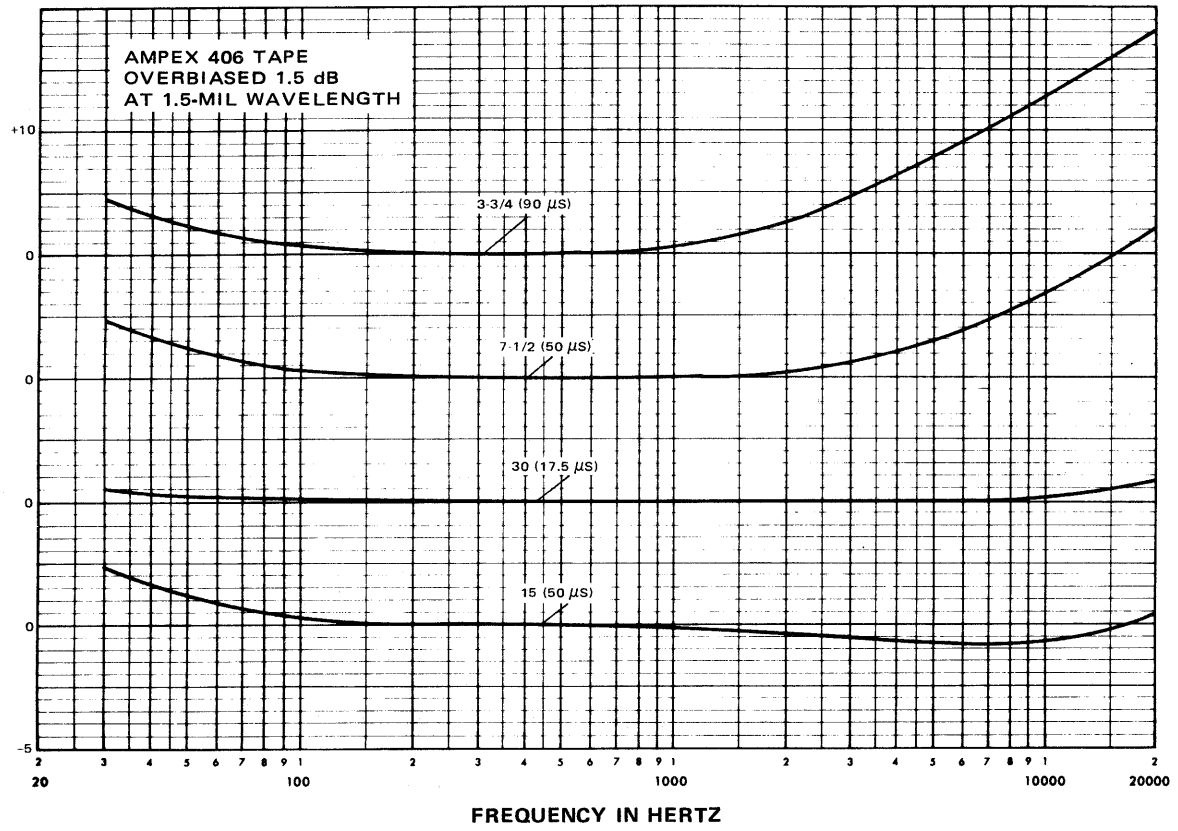


Figure 5-25. Record Current Response (Pre-Emphasis Set for Flat Response)

TROUBLESHOOTING HINTS

Electronic

Troubleshooting hints for electronic portions of the recorder/reproducer are given in Table 5-9.

Table 5-9. Troubleshooting Hints – Electronic

SYMPTOM	POSSIBLE CAUSE
Neither VU meter lamp or ready lamp lights.	+39V power supply disconnected or defective (F701 on power supply blown) or F1 on electronics blown.
No output indicated on VU meter or output line when monitoring input or reproduce.	Defective line amplifier or impedance switch set half way between 150 and 600 ohm position.
No output indicated on VU meter but output exists at line output.	Bias pushbutton pressed.
When placed in record, record lamp will not light and metering of bias indicates excessive bias.	Failure of record light, record relay or 9Q4 on record control board.
When placed in record, record lamp lights and metering of bias is correct but will not record. Signal present when monitoring input and when reproducing a pre-recorded tape.	Open record head or record cable, or open circuit in record relay contacts, or defective record amplifier.
Record light lights when record pushbutton is pressed but will not stay on.	9Q2 on record control board open or open circuit between 9Q2 and transport control box.
Record lights come on when power is turned on and ready switch is in Safe.	9Q3 or 9Q4 on record control board shorted.
Record light comes on when ready switch is placed in ready.	9Q1 on record control board shorted.

Tape Transport

Troubleshooting hints for the tape transport are given in Table 5-10.

Table 5-10. Troubleshooting Hints – Transport

SYMPTOM	POSSIBLE CAUSE
Neither transport pilot lamp nor VU meter lamp lights.	F601 or F602 on control box blown. Lamp defective.
No action when play, RW or FF buttons are pressed but edit operates and latches.	Safety switch inoperable.
No action when play, RW or FF button are pressed and edit operates when button is pressed.	Failure in 24V power supply.
Relays click when play, RW or FF are pressed but tape will not move.	Dummy plug missing in the remote receptacle J605 or failure in 120V power supply (F603 on control box blown).
Edit function fails to operate with safety switch "off."	Reproduce head cables disconnected (ground carried through outer shield) or +39V power supply inoperative or cables disconnected.
Servo motor fails to start when tape is threaded and safety switch is activated.	Capstan stop option selected in error.
Servo motor fails to start when play mode selected.	Dummy plug missing in servo chassis accessory socket J4.
AC motor fails to start when tape is threaded.	Dummy plug missing in transport control box socket J604.