SECTION IV

CHECKOUT AND ADJUSTMENT

4-1. GENERAL.

4-2. Each Ampex TM-2 Tape Transport is carefully checked out before shipment from the factory, and barring major shipping damage, is ready for operation immediately upon unpacking.

4-3. Information contained in this section will permit the customer to check operating parameters of the tape transport while adjusting for optimum performance. The tests and adjustments indicated in this section are also advisable after extensive maintenance operations have been performed on the tape transport.

4-4. PRELIMINARY OPERATIONS.

CAUTION

Read Section III, Operation, before undertaking adjustment of the tape transport.

4-5. The servo oscillator card, actuator control unit card, and servo amplifier card are not shipped in their sockets on the tape transport. The servo oscillator should be placed in its housing on the rear of the tape transport, and the actuator control unit and the servo amplifier in their respective positions on the transport electronics assembly.

4-6. When the cards have been inserted in their sockets, power may be applied to the tape transport, and an initial setting of servo adjustments undertaken. The following equipment is required to adjust the servos:

1) Voltmeter, Simpson Model 260 or equivalent

2) Screwdriver with 3/16 inch blade

3) 18 inch ruler

Step 1: Connect the meter leads to TP501 and TP502, located at the rear panel of the transport electronics assembly. Observe proper polarity.

Step 2: Apply power to the tape transport, and place the transport in the STANDBY mode.

NOTE

The tape transport should be permitted to warm up for approximately five minutes before adjustments are undertaken.

Step 3: Using the screwdriver, place switch S501 in position 2.

Step 4: Adjust the upper servo balance control on the servo amplifier card (Figure 4-1) for a zero vdc differential reading of the voltmeter.

Step 5: Turn switch S501 to position 3.

Step 6: Adjust the upper servo bias control for a voltmeter reading between -5.5 vdc and -7.5 vdc.

NOTE

Servo performance is partially determined by bias setting. In general, servo bias may be set at any point between -5.5 and -7.5 vdc. The more positive settings produce improved servo performance, but at the expense of servo motor heating. The setting chosen for servo bias will be a compromise of these two factors. Once an appropriate servo bias for the program requirements of the tape unit has been determined by experimentation, this setting should be used consistently. Under no circumstances should bias be set to a level more positive than -5.5 vdc.

Step 7: Turn switch S501 to position 4.

Step 8: Adjust the lower servo balance control for a zero vdc differential reading on the voltmeter.

Step 9: Turn switch S501 to position 5.

Step 10: Adjust the lower servo bias control for an appropriate level between -5.5 vdc and -7.5 vdc (see Step 6 and Note above).

Step 11: Turn switch S501 to position 6.

Step 12: Press the lower REEL BRAKE pushbutton and rotate the take-up reel so that a 13-1/2 inch ± 1/2 inch loop (measured from end-of-loop to end-of-loop) is formed in the right vacuum chamber. 34±1cm

Step 13: Close the transport access door.

Step 14: Manipulate the adjustment screw on the transducer mounted on the lower servo control assembly (Figure 4-2) for a zero indication of the voltmeter.

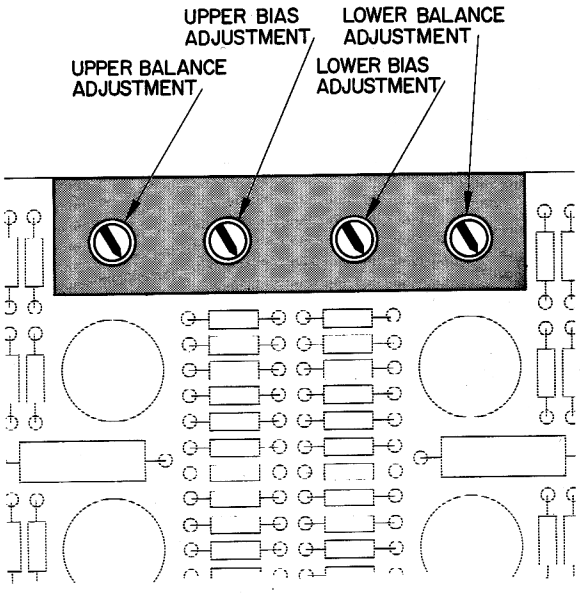


Figure 4-1
Servo Amplifier Adjustment Points

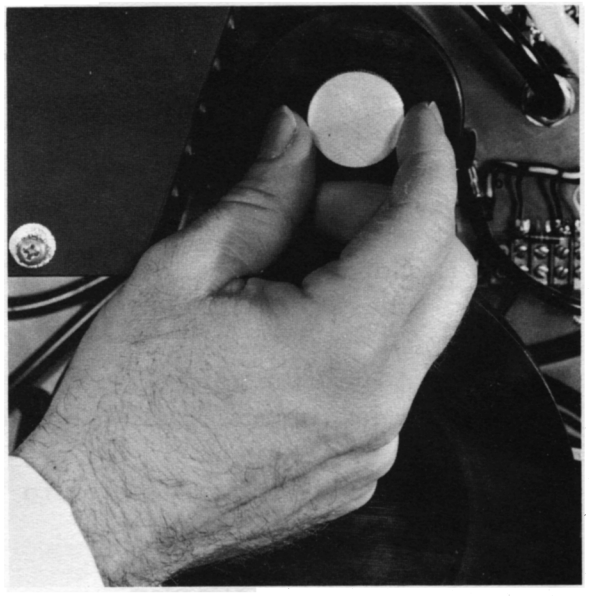


Figure 4-2
Adjusting Servo Transducer

Step 15: Turn switch S501 to position 7.

Step 16: Open the transport access door. Press the upper REEL BRAKE pushbutton and rotate the file reel so as to form a 12-1/2 inch ±1/2 inch tape loop in the left vacuum chamber.

Step 17: Close the transport access door.

Step 18: Manipulate the adjustment screw on the transducer mounted on the upper servo control assembly for a zero indication of the voltmeter.

Step 19: Return switch S501 to position 1.

Step 20: Place the tape transport in the MANUAL READY mode. There should be no appreciable change in the length of tape loop in either vacuum chamber. Change of more than 1/2 inch from the nominally 13-1/2 inch setting requires that the adjustment procedure be repeated.

NOTE

The following steps provide an approximate initial setting of servo gain. In practice, servo gain settings are dependent on tape unit program requirements. For unidirectional operation, servo gain is best set at a point just below reel oscillation; for a bi-directional program, lower servo gain is indicated for optimum performance.

Step 21: Connect the voltmeter to TP702 and TP703 on the oscillator chassis at the rear of the tape transport.

Step 22: Adjust the lower servo gain control potentiometer (Figure 4-3) for a 4 volt rms reading of the voltmeter.

Step 23: Connect the voltmeter to TP~~702~~ 701 and TP703 on the oscillator chassis.

Step 24: Adjust the UPPER servo gain control potentiometer for a 4 volt rms reading on the voltmeter.

NOTE

In determining a final servo gain setting, the tape transport is programmed as for normal operation. Servo gain is first increased to the maximum level consistent with short loop operation, i.e., the tape stops short of the short loop sensing port in the vacuum chamber. Gain is then decreased to a point short of the condition where tape passes the long loop sensing port. Correct adjustment lies between these two extremes; when the proper setting has been found, it should be noted and used consistently.

4-7. CHECKING START/STOP TIME.

4-8. The start time is defined as the time after the actuator ON command until the tape motion falls within prescribed tolerances. The stop time is defined as that time required for the output of the read head to drop to zero following the actuator OFF command.

4-9. A test tape is required to check start/stop time. This tape should be recorded at normal tape drive speed with an NRZ signal used to write logical ONES on all tracks at a frequency of 50 kc for 150 ips tape transports, 40 kc for 120 ips tape transports, or a comparable ratio for other speeds. In addition to this test tape, the following equipment is required to check start/stop times:

1) Read amplifier capable of developing 2.0 volts peak-to-peak across 600 ohm load.

2) Calibrated oscilloscope, Tektronix 535A or equivalent.

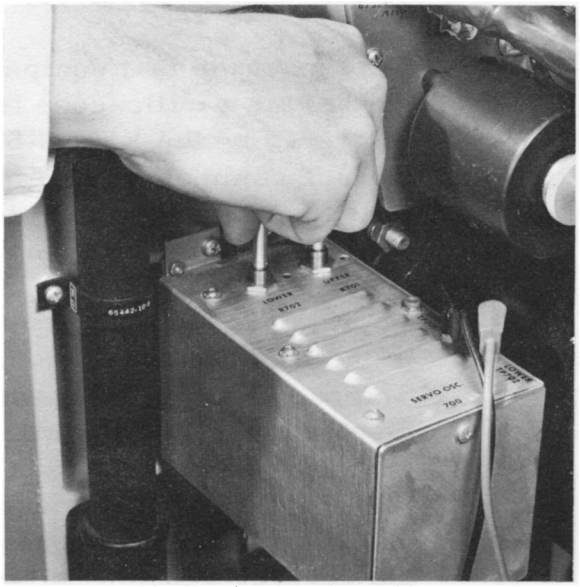


Figure 4-3
Adjusting Servo Gain

Step 1: Thread the test tape on the tape transport.

Step 2: Connect the test equipment as shown in Figure 4-4. The oscilloscope should be triggered by the FORWARD START command (positive pulse).

Step 3: Program the transport at a convenient rate in the AUTOMATIC mode. The oscilloscope will display the forward start time characteristic of the tape transport, which should resemble Figure 4-5(a). Start time, as determined from the oscilloscope display, should be under 2.0 milliseconds. If this specification is not met, adjustment of the forward capstan roller gap will be required, as detailed in paragraph 4-13 below.

Step 4: Readjust the oscilloscope to trigger on a negative pulse. The oscilloscope will now display the forward stop time characteristic of the tape transport, which should resemble Figure 4-5(b). Stop time of the transport should be under 1/5 milliseconds. If this specification is not met, adjustment of the forward tape brake, as detailed in paragraph 4-13 below, will be required.

Step 5: Reconnect the test equipment so that the oscilloscope is triggered by the REVERSE START command. The oscilloscope should be set to trigger on a positive pulse.

Step 6: Operate the tape transport in the AUTOMATIC mode. The oscilloscope will again display the reverse start characteristic of the tape transport. Start time should be under 2.0 milliseconds; the reverse capstan roller gap should be adjusted as required to achieve this specification.

Step 7: Reset the oscilloscope to trigger on a negative pulse.

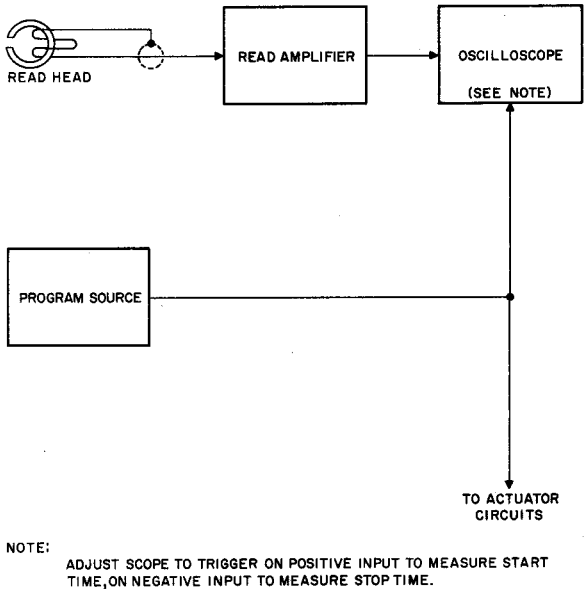


Figure 4-4
Test Set-up, Start/Stop Time Measurement

The oscilloscope will display the reverse stop characteristic of the tape transport, which should be under 1.5 milliseconds. The tape brake should be adjusted as required until this specification is met.

NOTE

In cases where the tape transport does not meet start/stop time specifications after the capstan roller gap and tape brake gap have been checked, rotation of the buffer guides around their axes on the vacuum chamber is indicated. Refer to paragraph 4-16 below.

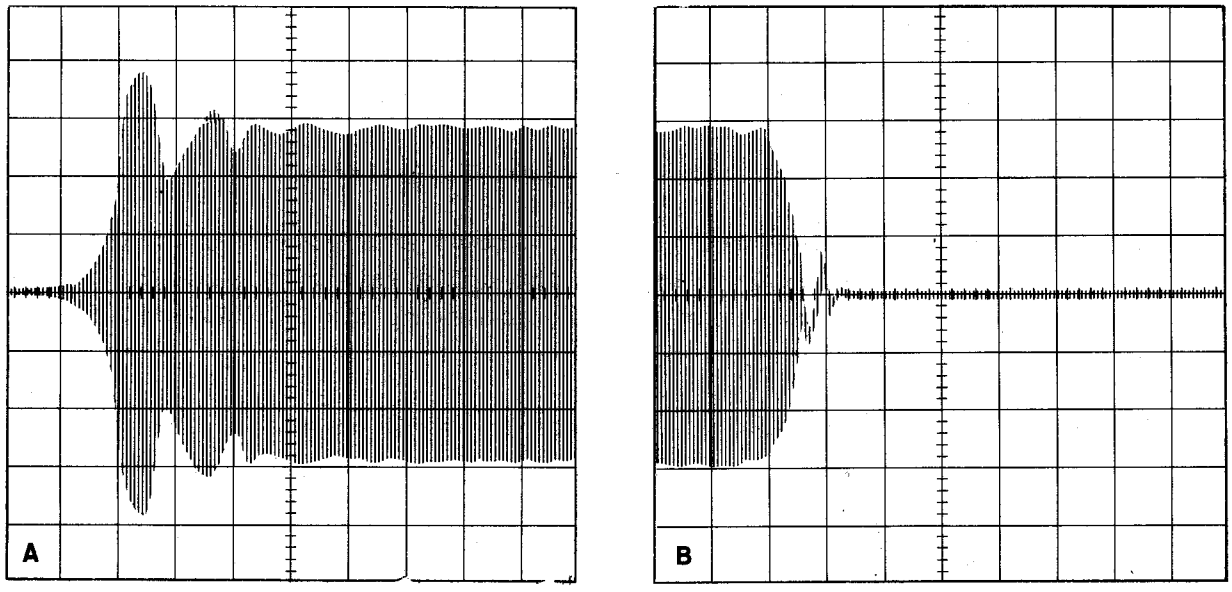


Figure 4-5
Typical Waveforms, Start/Stop Time

4-10. CHECKING START/STOP DISTANCE.

4-11. Start distance is defined as the quantity of tape passing over the read head during the start time; stop distance is defined as the quantity of tape passing over the read head during the stop time. Start and stop distances are specified by tape width and tape speed in the table below. The following equipment is required to measure start and stop distances:

TAPE UNIT	START DISTANCE	STOP DISTANCE
1/2" 150 ips	.155" - .225"	.063" - .113"
1/2" 120 ips	.124" - .180"	.050" - .090"
1/2" 112.5 ips	.120" - .164"	.047" - .084"
1" 120 ips	.124" - .180"	.060" - .120"

1) Pre-recorded test tape as used in start-stop time measurement.

2) Read amplifier capable of developing 2.0 volts peak-to-peak across a 600 ohm load.

3) Counter, Hewlett-Packard 523B or equivalent.

4) Pulse Generator, Tektronix 161 or equivalent.

Step 1: Connect the test equipment as shown in Figure 4-6. The pulse generator is used to trigger the count gate of the counter for the 2.0 milliseconds immediately following the FORWARD START command.

Step 2: Program the tape transport at a convenient rate. The counter reads out the number of recorded ones passing the read head during the 2.0 millisecond start time. Because of the ratio of frequency to tape speed of the test tape, each one passing the read head represents 0.003 inches. Thus the count, multiplied by three, is the forward start distance expressed in thousandths of an inch. This figure should be equal to or less than the value shown in the table above. If this condition is not met, check capstan roller gap. If the tape transport still fails to meet start distance specifications, adjustment of the buffer spring guide around its axis on the left vacuum chamber may be required.

Step 3: Reconnect the counter and pulse generator to the REVERSE START command input. The counter now reads out the number of ones passing the read head during the reverse start time. This figure must also be equal to or less than the value shown in the table above.

Step 4: Reconnect the counter and pulse generator to the FORWARD STOP command input (connection point identical to Step 1, but triggering on negative pulse). The pulse generator is used to trigger the count gate of the counter for the 1.5 milliseconds immediately following the FORWARD STOP command. The count as shown on the counter, multiplied by three, is the forward stop distance expressed in thousandths of an inch. This figure should be equal to or less than the value shown in the table above.

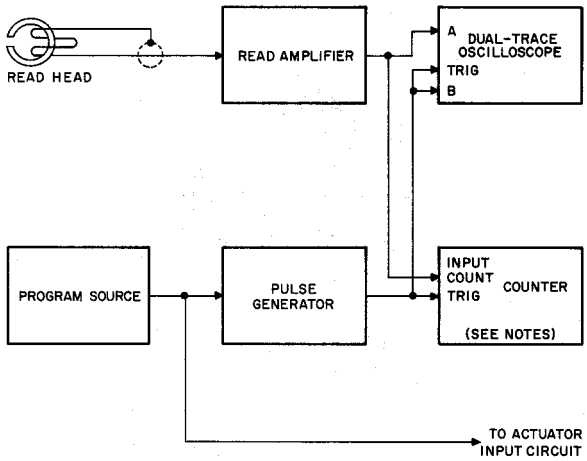
Step 5: Reconnect the counter and pulse generator to the REVERSE STOP command input. The counter now reads out the number of ones passing the read head during the reverse stop time. This figure must also be equal to or less than the value shown in the table above.

4-12. ADJUSTING CAPSTAN ROLLER GAP AND TAPE BRAKE GAP.

4-13. Capstan roller gap and tape brake gap are extremely important factors in the start/stop time of the transport. In addition, the capstan rollers must be adjusted so that tape emerging from between the capstan and capstan roller is smooth and flat, with no bowing or waving. The following equipment is required to adjust capstan roller gap and tape brake gap:

1) Allen wrench, .050 inch across flats

2) Allen wrench, 7/64 inch across flats



NOTES:
1. ADJUST PULSE GENERATOR TO GATE OSCILLOSCOPE DURING POSITIVE PULSE TO MEASURE STOP DISTANCE.
2. GATE TO OPEN FOR 2 MILLISECONDS TO MEASURE START DISTANCE, 1.5 MILLISECONDS TO MEASURE STOP DISTANCE.

Figure 4-6
Test Set-up, Start/Stop Distance Measurement

3) Screwdriver, 1/8 inch flat blade

4) Open end wrench, 5/16 inch across flats

5) Set of feeler gauges, .002 to .015 inch

The adjustment procedure requires that the throw of each actuator be known. This measurement is made at the factory and the result shown on a gummed label attached to each actuator. In the event that this label has been removed or lost, the throw of the actuator may be determined by the following procedure:

Step 1: With the machine off, remove the tape and manually rotate the right hand (forward) capstan roller assembly to its ON position (in contact with the capstan).

Step 2: Referring to Figure 4-7, loosen the two socket head cap screws which clamp the capstan roller yoke to the actuator shaft.

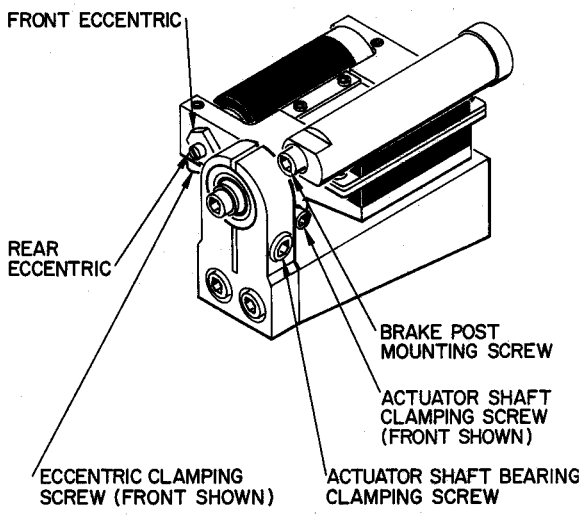


Figure 4-7
Capstan Roller Adjustment Points

Step 3: Rotate the capstan roller yoke on the actuator shaft so that the roller is just in contact with the capstan.

Step 4: Tighten the screws clamping the yoke to the actuator shaft. Check to see that the roller is still in contact with the capstan.

Step 5: Manually rotate the capstan roller assembly to its OFF position.

Step 6: Using a feeler gauge, determine the gap between the capstan and the capstan roller. This figure represents the actuator throw. Mark this figure on the actuator for future reference.

Step 7: Repeat Steps 1 through 6 for the left hand (reverse) capstan roller actuator.

When the actuator throw has been determined, either from a label on the actuator or by the procedure described above, the capstan roller gap may be set as follows:

NOTE

If capstan roller skew is to be adjusted, it is recommended that the two screws which clamp the capstan roller eccentrics in the yoke be loosened and the eccentrics rotated so as to place the roller at its furthest point from the capstan. The screws should then be tightened.

Step 1: Subtract .006 inch from the actuator throw measurement. The remainder will be the proper gap setting for any capstan roller assembly used with the one actuator.

Step 2: Loosen the two socket head cap screws clamping the capstan roller yoke to the actuator shaft.

Step 3: Using a feeler gauge .002 inch or .003 inch smaller than the remainder determined in Step 1, rotate the yoke on the actuator shaft (actuator in OFF position) so that the leaf of the feeler gauge is clamped between the capstan roller and capstan.

Step 4: Tighten the two screws clamping the yoke to the actuator shaft. The effect of this will be to clamp the yoke to the shaft; at the same time, a slight rotation of the yoke on the shaft will consume the .002 inch to .003 inch provided in Step 3.

Step 5: Check the gap with a feeler gauge of the thickness determined by Step 1. The gap should be within ±.001 inch of this figure. If this result is not achieved, repeat Steps 2 through 4 as necessary.

Step 6: Repeat Steps 1 through 5 for the second actuator.

Step 7: Loosen the socket head cap screw for the left hand tape brake post.

Step 8: Place a .010 inch feeler gauge between the brake pad on the capstan roller assembly and the brake post. Using a wrench, rotate the brake post on its eccentric until the leaf of the feeler gauge is held between the post and the pad. Holding the post in this position with the wrench, tighten the brake post mounting screw.

Step 9: Repeat Steps 7 and 8 for the right hand tape brake.

Step 10: Thread the transport with a new roll of tape.

Step 11: Operate the transport in the FORWARD DRIVE mode. Observe the tape as it passes through the right hand capstan roller. If any distortion (bowing, waving, etc.) of the tape is observed, loosen the two socket head cap screws which clamp the eccentrics within the yoke. Manipulate the front and rear eccentrics until parallelism of the capstan and capstan roller is smooth, flat, and straight. Tighten the socket head cap screws.

Step 12: Check capstan roller gap and adjust, as necessary, using the procedure of Steps 2 through 5.

Step 13: Check brake gap and adjust, as necessary, using the procedure of Steps 7 and 8.

Step 14: Operate the transport in the REVERSE DRIVE mode. Repeat Steps 11 through 13 for the left hand capstan roller.

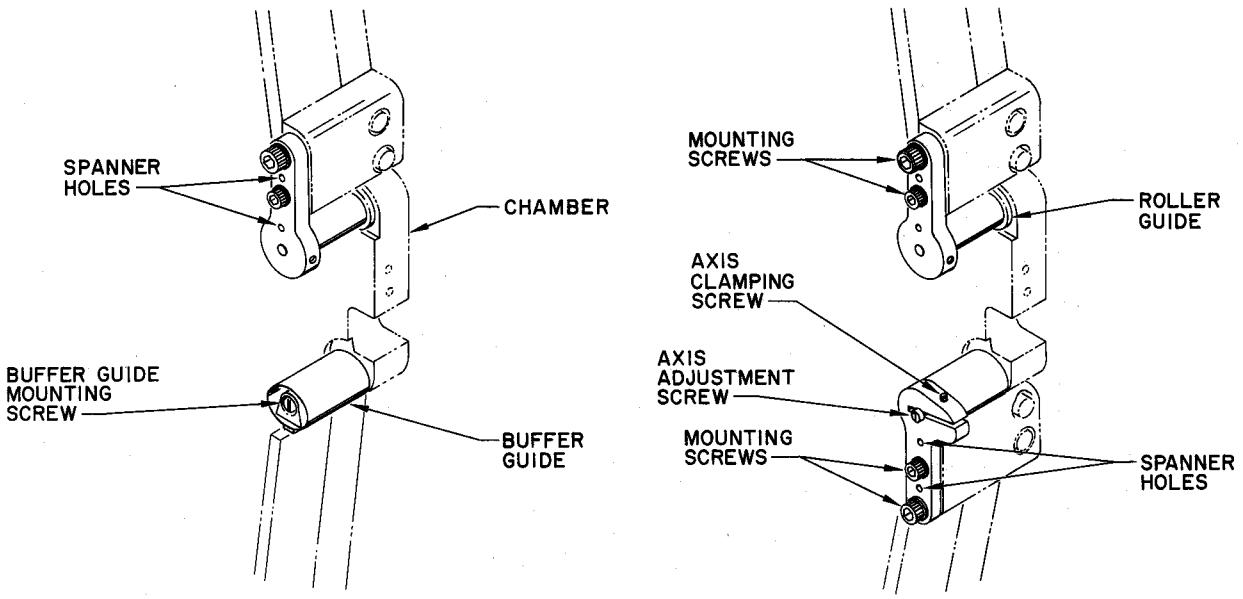
4-14. CHECKING TAPE TRACKING.

4-15. When the capstan rollers have been adjusted as detailed in paragraph 4-13, the balance of the tape path should be checked for proper tape tracking. This is most readily accomplished by cycling the tape transport rapidly between forward and reverse. The operator should observe the tape path between the capstan roller assemblies and the vacuum chambers with the eyes at capstan level. There should be no evidence of skew or tape misguiding; that is, the tape should be perfectly flat with no twist or ripple.

4-16. The buffer spring guides are aligned by loosening the screws which secure the outboard support and manipulating the support with the spanner provided. Earlier buffer guides having no outboard support are adjusted by loosening the single screw passing through the guide and manipulating the guide to achieve proper tape tracking (see Figure 4-8). The buffer guide

may be turned on its axis in extreme cases when problems are encountered with start/stop times. Rotation of this guide on its axis may require re-adjustment of tape tracking.

4-17. The rotary tape guides are aligned by loosening the two screws which secure the outboard bearing support and manipulating the support with the spanner provided until correct tape guiding is achieved.



BUFFER GUIDE WITHOUT OUTBOARD SUPPORT

BUFFER GUIDE WITH OUTBOARD SUPPORT

Figure 4-8
Tape Guide Adjustment Points