CONTROL DATA®
MULTIPLE DISK DRIVE

BM1A5

GENERAL DESCRIPTION
OPERATION
INSTALLATION &
CHECKOUT
MAINTENANCE

CONTROL DATA

CUSTOMER ENGINEERING MANUAL

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PREFACE

All available customer engineering installation, operation, and maintenance information for the CONTROL DATA® BM1A5 Multiple Disk Drive is in three manuals:

Publication No. 70602400	General Description, Operation, Installation and Checkout, Maintenance
Publication No. 70602500	Theory of Operation, Diagrams, Maintenance Aids, Wire List
Publication No. 70601900	Illustrated Parts List

CAUTION

A spindle lock mechanism is actuated when the spindle drawer is opened. A loud ratcheting noise occurs when the drawer of a spinning disk pack is opened. While this action is not recommended, it will not damage the unit.

2. Check that the Operator panel Unit Number indicator is not lighted.

3. Release the front latch (Figure 2-2) on the desired spindle drawer and pull the drawer out to the stop.

CAUTION

During maintenance procedures the read/write heads are sometimes manually positioned. Make certain that the heads are fully retracted.

4. Place the plastic canister over the mounted disk pack so that the post protruding from the center of the disk pack is received into the canister handle.

5. Twist the canister handle counterclockwise until the disk pack is free of the spindle.

CAUTION

Avoid abusive contact between the disk pack and the spindle assembly.

6. Lift the canister and the disk pack clear of the spindle.

7. Install protective cover on spindle cone and close the spindle drawer.

8. Place the bottom dust cover in position on the disk pack and tighten it.

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SECTION 1

GENERAL DESCRIPTION

GENERAL DESCRIPTION

The CONTROL DATA Multiple Disk Drive (consisting of equipment number BM1A5 is a random access data storage device that interfaces with a central processor via a control unit.

The electromechanical multiple disk drive (MDD) positions its read/write heads to discrete positions or tracks over spinning disk surfaces. Data, in the form of magnetized bits or spots, is written on or read from the disk surfaces by the read/write heads.

The MDD consists of independent and individually addressable decks. Each deck uses a spindle-mounted disk pack assembly as its recording medium. The disk pack assemblies used by the decks are mechanically interchangeable and magnetically compatible with any similar Control Data Corporation MDD. Typically, all of the decks are on-line, except for one which is available for use if servicing or maintenance becomes necessary on any of the on-line units.

Decks for the MDD are mounted in cabinets. The BM1A5 cabinet contains two decks and is referred to as a two-by (2X). Each deck consists of a deck assembly, supporting logic and power components, and frame-mounted accessory equipment.

The deck assembly contains the hydraulic access mechanism, the speed and location sensing devices necessary to position the read/write heads, and four Silicon Peripheral Logic (SPL) cards involved in read/write operations. This assembly also includes the mounting and operational facilities required by the disk pack: spindle assembly, spindle drive motor, and shroud. The shroud surrounds the disk pack and thereby minimizes damage to the read/write heads and disk surfaces caused by the ingestion of dust. A hinge-mounted logic chassis assembly is the mounting point for the main complement of the SPL cards used by the deck(s): four cards are mounted on each deck assembly. SPL cards for the cabinet are mounted in two rows (A and B). This assembly also contains a maintenance panel, an I/O connector panel, and three fans to cool the SPL cards. The maintenance panel provides jacks to monitor logic voltages, for each deck in the cabinet, and a switch/lamp combination to analyze the occurrence of an error, and an ON LINE/OFF LINE switch.

A solid-state power supply assembly provides +6, ±20, and +40 vdc outputs. The power supply in a 2X cabinet is shared by the decks of that cabinet. Power to each deck of the 2X cabinet is controlled separately at the power supply control panel (accessible when logic chassis is swung out).

A frame assembly provides the required mounting structure for the previously mentioned assemblies. In addition to the structural elements, this assembly contains the operator controls for the deck(s), a blower assembly, and facilities for input power distribution. Each cabinet contains a circuit breaker that controls the application of input power to the power supply of that cabinet. The output of the blower assembly is ducted to the deck assembly(ies) to provide positive pressurization of the disk and shroud area.

The equipment specifications for the MDD are as follows:

ACCESSING TIME

Maximum Access Time	135 ms
Maximum One-Track Access Time	24.5 ms

RECORDING

Mode	Double frequency
Density (nominal)	1530 bpi (outer track) 2220 bpi (inner track)
Bit Rate (nominal)	2.50 MHz
Data Transfer Rate	416,000 characters/second/deck

DATA ORGANIZATION

Bits/Character	6
Characters/Track	10,085
Tracks/Cylinder	20
Cylinders/Deck	200 + 3 spares
Decks/MDD (8X)	8

DATA CAPACITY - SECTOR ORGANIZATION

Bits/Track	63,250
Bits/Cylinder	1,265,000
Bits/Deck	253,000,000

DISK PACK

Disks/Disk Pack	11
Useable Recording Surfaces/ Disk Pack	20
Disk Surface Diameter	14 inches
Recording Diameters	Track 202 (Inner) 9.068 inch nominal Track 0 (Outer) 13.152 inch nominal
Disk Surface Coating	Magnetic oxide
Disk Pack Velocity	2400 (+36, -96) rpm

READ/WRITE HEADS

Heads/Deck	20
Heads/MDD	180 maximum
Read/Write Track Width	0.0065 inch
Erase Track Width	0.013 inch
Track Spacing	0.010 inch

PHYSICAL - Each Cabinet

Height	67 inches (170.18 cm)
Width	32 inches (81.28 cm)
Depth	40 inches (101.6 cm)
Weight - 2X cabinet	1100 pounds (498.96 kg)

ELECTRICAL

Power Source	380-volt (±10%), 50 (+0.6, -1.2) hertz, 3-phase, 4-wire wye
Operating Current (2X cabinet)	4 amps/phase
Standby Current (2X cabinet)	1.7 amps/phase

INPUT/OUTPUT CONNECTIONS	Three connectors per cabinet located below Logic Chassis Maintenance panel. Pin assignments according to Table 3-1. Connections according to Figure 3-3.

SECTION 2

OPERATION

OPERATION

This section provides instructions and information related to operating the MDD.

CONTROLS AND INDICATORS

The MDD contains a number of panels and indicators. Figure 2-1 locates the panels and the indicator on a typical cabinet of the MDD. Table 2-1 provides panel and indicator complements in terms of the 2X cabinet and the MDD. A functional description of the controls and indicators is given in Table 2-2.

TABLE 2-1. MDD PANELS AND INDICATORS

PANEL OR INDICATOR	NO. PER 2X	TOTAL PER 9X
Operator Panel	2	8
Filter Box Panel	1	4
Logic Chassis Maintenance Panel	1	4
Track Number Indicator	2	8
Power Supply Panel	1	4

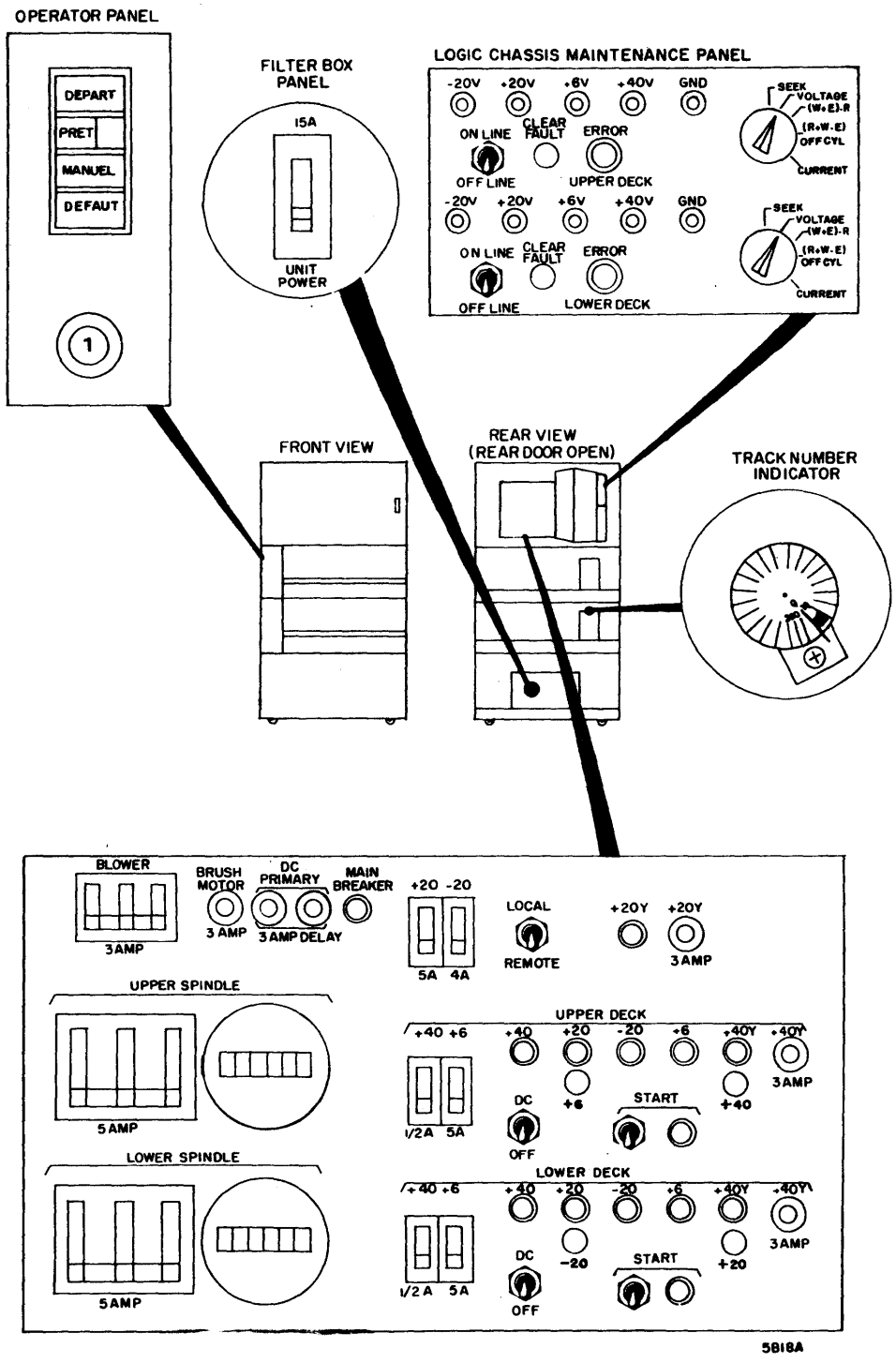


Figure 2-1. Controls and Indicators

TABLE 2-2. CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION
Operator Panel	
DEPART switch/indicator	Switch energizes (when pressed to light) drive motor and begins the First Seek sequence provided the following conditions are met: 1. Disk pack is in place. 2. Deck assembly drawer is closed (closes sector block in place switch. Can be overridden, Figure 2-2). 3. Proper circuit breakers are on. 4. Sequence power available either from control unit (if power supply LOCAL/REMOTE switch is set to REMOTE) or from power supply (if power supply LOCAL/REMOTE is set to LOCAL. Lights when switch is on even if one or more of the above conditions is not met. This allows operator to know which units will sequence on when control unit sequence power becomes available. Switch causes a power off sequence when pressed with the indicator lighted.
NOTE Certain malfunctions can occur in head load mechanism that cause PRET indicator to give a false indication of heads being loaded. If this occurs, the on-line deck is unable to return a Ready signal to controller and hence is unable to respond to controller commands.	

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
PRET/Unit number indicator	PRET segment lights when logic chassis maintenance panel ON LINE/OFF LINE switch is set to the ON LINE position and the read/write heads are loaded. Unit number/segment of the indicator lights when the disk pack velocity exceeds 50 rpm. Significance of Unit Number (0 thru 7) is limited to indicating physical location of a spindle within the MDD.
MANUEL indicator	Lights when related module is not on-line as a result of one of the following conditions: 1. LOCAL/REMOTE switch on power supply set to LOCAL. 2. DC/OFF switch on power supply set to OFF. 3. ON LINE/OFF LINE switch on logic chassis maintenance panel set to OFF LINE.
Defaut switch/indicator	Lights when one or more of the following unwanted conditions occur: 1. More than one head is selected. 2. Read and Write Selects exist at the same time. 3. Read and Erase Selects exist at the same time. 4. Erase is selected with no write driver.

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
DEFAUT switch/indicator (cont'd)	5. Erase is selected with both write drivers. 6. Either one or both write drivers are on with no erase. 7. Read, write, or erase is selected without an On Cylinder signal. 8. Low voltage condition sensed. Pressing the DEFAUT switch clears the Fault FF on the logic chassis and extinguishes the indicator.
Logic Number plug/indicator	Lights when related deck is selected. Each deck contains a plug that responds to a specific binary code from control unit. Lens of plug reflects number that plug recognizes. A deck in which a plug labeled SPARE is installed, is not available to the control unit. Plugs are removable and interchangeable.

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
Filter Box Panel	
UNIT POWER circuit breaker	Controls distribution of main input power to the cabinet power supply.
Logic Chassis Maintenance Panel	
NOTE This panel contains two identical sets of controls: one for each deck assembly in the cabinet.	
-20V, +20V, +6V, +40V, and GND test jacks	Afford a point at which dc voltages in the logic chassis can be measured.
ON LINE/OFF LINE switch	ON LINE position places unit under control of control unit. Setting switch to OFF LINE position causes following: 1. Prevents control unit from initiating seek or read/write operations. 2. Unit Number and Logic Number indicators extinguish. 3. Maintenance indicator lights. 4. Inhibits Unit Ready and Unit Selected signals to controller. 5. Deselects all heads. 6. Inhibits Seek Complete or Seek Error interrupt to controller.

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
Error Select switch and ERROR indicator	A 5-position rotary switch that samples each of the 5-bits of the Error register. Causes the ERROR indicator to light when the bit being sampled is set. Normally, the indicator will light briefly between each position of the switch.
CLEAR FAULT switch	Clears FAULT FF and all bits of the Error register when pressed.
Power Supply Panel	
BLOWER circuit breaker	Controls application of three-phase 208 vac to blower motor. Disables dc power when set to OFF.
BRUSH MOTOR/3 AMP fuse	Protects the 115 vac line to the brush motors and logic chassis and power supply cooling fans.
DC PRIMARY/3 AMP DELAY fuses (2)	Protect the 208 vac lines to the primary winding of the dc supply transformer.
MAIN BREAKER indicator	Provides remote indication of the position of the UNIT POWER circuit breaker located on the cabinet filter box panel.
±20 circuit breaker	Control the application of the ±20 vdc to the logic chassis.
LOCAL/REMOTE switch	Allows the power on sequence to be controlled by either a signal from the controller (when set to REMOTE) or by +20Y

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
LOCAL/REMOTE Switch (cont'd)	vdc from the power supply (when set to LOCAL). MANUEL indicator on operator panel lights when switch is set to LOCAL.
+20Y indicator	Indicates status of +20Y vdc (used to power lamps, relays, etc).
+20Y/3 AMP fuse	Protects the +20Y vdc circuit.
NOTE The following controls and indicators are duplicated on the power supply panel: one set each for the upper and lower units.	
SPINDLE circuit breaker	Controls application of three-phase 208 vac to the spindle drive motor.
SPINDLE elapsed time meter	Indicates cumulative hours of spindle motor operation (pack rotating).
+40 Circuit Breaker	Controls application of +40 vdc to logic chassis.
+6 circuit breaker	Controls application of +6 vdc to logic chassis.
+40 indicator	Provides visual status of +40 circuit breaker.
±20 indicators	Provides visual status of the ±20 circuit breakers.

TABLE 2-2. CONTROLS AND INDICATORS (Cont'd)

CONTROL OR INDICATOR	FUNCTION
+6 indicator	Provides visual status of the +6 circuit breaker.
+40Y indicator	Indicates status of +40Y vdc (used to power deck solenoids and head latch). Lights when disk pack rpm is about 2000 rpm.
+40Y/3 AMP fuse	Protects the +40Y vdc circuit.
CAUTION Before applying dc power to or removing dc power from either deck in a 2X cabinet, the START switch on the remaining deck must be turned to the off (related indicator goes out) position. After dc power is switched, normal operation may be continued on remaining deck.	
DC/OFF switch	Set to the DC position during normal operation. When set to OFF, removes all dc power to deck and logic cards and causes operator panel MANUEL indicator to light.
START switch and indicator	Switch/indicator combination wired in parallel with same items on operator panel. Provide start/stop control from rear of MDD during a maintenance situation.
Deck Assembly	
Track Number Indicator	Calibrated dial read at adjacent index mark. Readout is the current track or cylinder location of the read/write heads. Located on top of carriage immediately above read/write heads.

OPERATING INSTRUCTIONS

MDD POWER APPLICATION

The following procedure prepares the MDD to go on line. The procedure is valid only if the unit was shut down according to the MDD Power Removal paragraph. If power is to be applied to a single deck or spindle and a part of the MDD is already operating on line, refer to Deck or Spindle Power Application paragraph following.

1. Set the Filter Box panel UNIT POWER circuit breaker to ON in each MDD cabinet.
2. Observe each operator panel. Only the spindles to be powered up should have their DEPART indicator lighted. Press any indicators on or off as required.
3. Apply sequence power at the control unit. When a spindle completes its power up sequence, the related PRET indicator will light.
4. When the required PRET indicators are lighted, the MDD is on line.

NOTE

Maximum operational stability is achieved only after the unit has reached thermal stability. The warmup time (spindle rotating) is approximately 45 minutes if the ac power has been removed for longer than 4 hours. It is recommended that this warmup period be allowed prior to a Read or Write operation.

5. The unit is now ready to receive a Read, a Write, or a Seek command.

DECK OR SPINDLE POWER APPLICATION

The following procedure applies power to a deck or spindle so that it can join other on line units of an MDD.

1. Open the rear panel of the cabinet housing the spindle to go on line.
2. Set the Logic Chassis Maintenance panel ON LINE/OFF LINE switch (for applicable deck) to OFF LINE.
3. If one spindle in this cabinet is already on line, go to step 4; otherwise go

to step 7.

4. Position the Power Supply panel switches, related to the spindle to receive power, as follows:

   SPINDLE circuit breaker to ON
   +40 circuit breaker to ON
   +6 circuit breaker to ON
   DC/OFF switch to DC
   START switch to toggle down

5. The following Power Supply panel indicators will light:

   +20
   -20
   +6

6. Proceed to step 9.

7. Position the Power Supply panel switches as follows:

   BLOWER circuit breaker to ON
   +20 circuit breaker to ON
   -20 circuit breaker to ON
   LOCAL/REMOTE switch to REMOTE
   SPINDLE (as applicable) circuit breaker to ON
   +40 (as applicable) circuit breaker to ON
   +6 (as applicable) circuit breaker to ON
   DC/OFF (as applicable) switch to DC
   START (as applicable) switch to toggle down

8. Set the Filter Box panel UNIT POWER circuit breaker to ON. If power supply panel START indicator lights, set related START switch toggle up. The blower motor, the logic chassis fans, and the power supply fans will begin to operate. The following Power Supply panel indicators light:

   MAIN POWER
   +20 Y
   +20
   -20
   +6
   } for the spindle to receive power

9. Set related ON LINE/OFF LINE switch to ON LINE (for applicable deck).
10. Swing the logic chassis into the cabinet and close the cabinet rear panel.

11. Install a disk pack (refer to disk pack installation paragraph following).

12. Press the operator panel DEPART switch/indicator. The switch/indicator lights.

13. When the control unit sequence power becomes available, the First Seek operation begins as indicated by the following operator panel events:

    UNIT Number indicator lights (pack speed is greater than 50 rpm)
    PRET indicator lights (heads have been loaded)

    NOTE

    Maximum operational stability is achieved only after the unit has reached thermal stability. The warmup time (spindle rotating) is approximately 45 minutes if the ac power has been removed for longer than 4 hours. It is recommended that this warmup period be allowed prior to a Read or Write operation.

14. The First Seek operation is complete when the heads are returned to track 00. The unit is now ready to receive a Read, a Write, or a seek command from the control unit.

MDD POWER REMOVAL

The following procedure removes power to the entire MDD.

1. Follow the reverse of the preceding MDD Power Application procedure.
2. Remove sequence power at the control unit.

DISK PACK INSTALLATION

Make certain that the disk pack to be installed has been cleaned and maintained according to the Preventive Maintenance instructions. Do not open spindle drawer if operator panel SPIN indicator is lighted.

1. Release the front latch (Figure 2-2) on the desired spindle drawer and pull the drawer out to the stop.

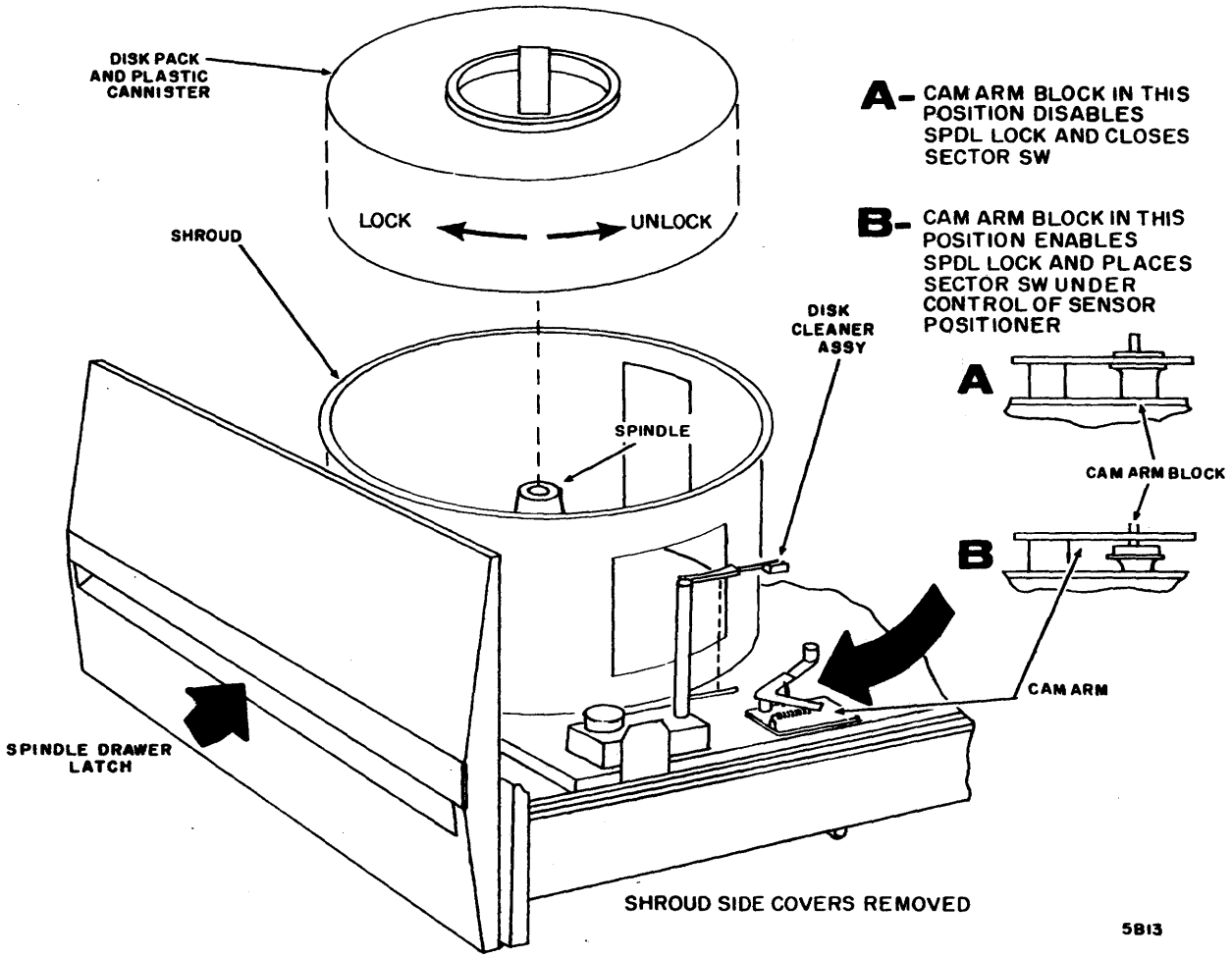


Figure 2-2. Disk Pack Load/Unload Machanics

NOTE

A spindle lock mechanism is actuated when the spindle drawer is opened. The mechanism holds the spindle stationary until the pack loading force exceeds the torque of the slipping clutch.

2. Lift the disk pack by the plastic canister handle.

3. Unscrew the bottom dust cover from the disk pack using the knob in the center of the cover. Set the cover aside. Remove protective cover from spindle and set aside.

CAUTION

Avoid abusive contact between the disk pack and the spindle. During maintenance procedures the read/write heads are sometimes manually positioned. Make certain that the heads are fully retracted.

4. Place the disk pack onto the spindle.

CAUTION

Air blowing into the shroud area could lift away the canister before the disk pack is locked in place.

5. Twist the canister handle clockwise to lock the disk pack in place.

6. Lift the canister clear of the disk pack and set it aside.

NOTE

If a maintenance situation requires the spindle drawer to be open (in either direction) while the spindle rotates, refer to Figure 2-2 and position the cam arm block to disable the spindle lock.

7. Close the spindle drawer.

DISK PACK REMOVAL

1. Press (to extinguish) the operator panel START switch.

SECTION 3

INSTALLATION AND CHECKOUT

INSTALLATION AND CHECKOUT

This section provides the information and procedures necessary to put an MDD into operation.

UNCRATING

During uncrating, care must be used so that any tools being used do not inflict damage to an assembly. As a cabinet is uncrated, inspect it for possible shipping damage. All claims for this type of damage should be filed promptly with the transporter involved. If a claim is filed for damages, save the original crating materials. Most crating materials will be reuseable if reasonable care is used uncrating. Uncrate MDD cabinet as follows:

1. Applicable to air-shipped units only: Cut two vertical steel straps securing unit to skid.
2. Cut two horizontal steel straps securing exterior container.
3. Remove corrugated-paper caps from front and rear of cabinet.
4. Remove corrugated-paper panels covering top and sides of unit.
5. Raise plastic dust cover clear of cabinet.
6. Applicable to air-shipped units only: Using Roll-A-Lifts (placed at cabinet sides) carefully remove cabinet from skid.
7. Open cabinet rear door.
8. Remove two non-metallic straps and wooden block securing logic chassis.
9. Remove cushioning material from top of filter box.
10. Remove tape securing power cable (if present) in bottom of cabinet.
11. Remove tape securing top front door latch and open door. Untape air filter and cushioning material from top of power supply chassis. Separate filter from cushioning material.
12. Remove wedge from between bottom of lower deck drawer and top edge of bottom front door.
13. Open bottom front door. Slide primary filter (unpacket in step 11) into place in base of cabinet (Figure 6-2).

14. Remove cabinet side panels (if installed).

15. Release two non-metallic straps securing both ends of each deck slide to cabinet horizontal frame member above the deck (total of eight straps per 2X cabinet).

16. Release latch in center of drawer front panel and open upper deck drawer.

17. Release non-metallic strap from lower edge of slide on both sides of deck.

18. Remove two wood blocks from between front edge of deck casting and inner surface of drawer front panel.

CAUTION

Do not position read/write heads manually without first referring to Manually Positioning Carriage paragraph, Section 6.

19. Remove nylon cord and CAUTION tag from carriage.

20. Close deck drawer.

21. Repeat steps 16 through 20 for lower deck.

SPACE ALLOCATION

One MDD 2X cabinet requires a floor area of approximately 2.7 x 3.3 feet. In addition, a three foot service access area to the front and a four foot area to the rear of the unit should be provided.

LEVELING AND ALIGNING

Position the MDD cabinets to their operational location and level as follows:

1. Lower jack screws in base of cabinet until casters no longer contact floor.

2. Place a spirit level on main deck so ends of level point toward front and rear of deck.

3. Spirit level should indicate that surface is horizontal to within 3 angular degrees. Adjust jack screws until requirement is met.

4. Place spirit level on main deck so ends of level point toward sides of deck. Repeat step 3.

5. Cabinet is level when spirit level (oriented in both directions) indicates main deck horizontal to within 3 angular degrees and each cabinet caster is clear of floor.

6. Position next cabinet to be leveled alongside previous unit. Repeat steps 1 through 5. In addition to the requirements for being level (step 5), the front frame members and the top surfaces of cabinets must be flush with each other to within ± 1/32 inch.

7. Repeat step 6 for remaining cabinets.

CAUTION

To perform step 8, some cabinet panels must be removed. Make certain that the panels are returned to the same cabinet. Misalignment and/or binding could result from switching panels.

8. Refer to Figure 3-1 and secure each cabinet frame to the adjacent cabinet frame at four places. Tighten each nut to a torque of 175 ± 25 inch-pounds.

9. Do not install cabinet panels removed in step 8.

CABLING AND CONNECTIONS

CABINET INTRACABLING

Inspect the cabling in each cabinet for agreement with Figure 3-2.

INPUT/OUTPUT CABLES

CAUTION

Jackscrews on the logic chassis connecting cables must be alternately tightened or damage could occur.

Refer to Figures 3-3 and 3-4 and install system input/output cables. Table 3-1 provides information relative to the connector pin/signal assignments for these cables.

POWER CABLES

The power cable for each cabinet originates in the cabinet filter box located at the lower rear of the cabinet. Each power cable should exit the respective cabinet under the rear door of the cabinet.

GROUND BOND

To minimize the effect of system generated noise, a ground bond (either a tinned copper braid of 7500 circular mils minimum or a copper strap of 5900 square mils minimum) must be connected between each MDD and controller.

The ground bond is connected to any unused terminal on terminal board TB05 (located on the power supply side panel) and the controller system ground.

The ground bonding scheme may be daisy chained or individually connected between each MDD and controller.

CABINET ACCESSORIES

1. Install operator panel Unit Number lenses as follows:
   a. Remove blank lens by squeezing top and bottom edges together and displacing lens up or down.
   b. Snap appropriate numbered lens into place.
2. Carefully insert appropriate Logic Number plug into hole below operator panel switches and push plug into receptacle.
3. Install cabinet trim as follows:

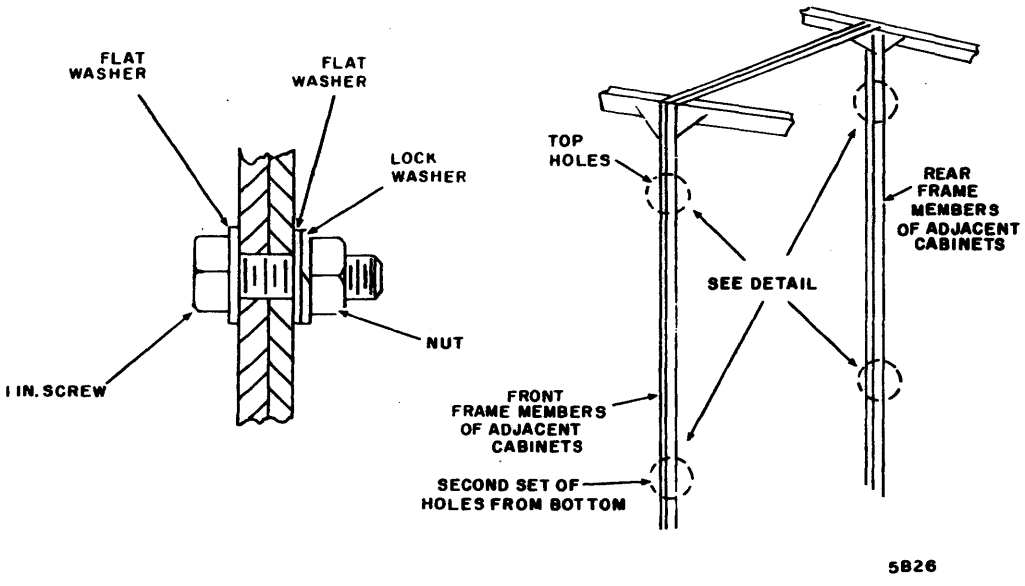


Figure 3-1. Joining Cabinets

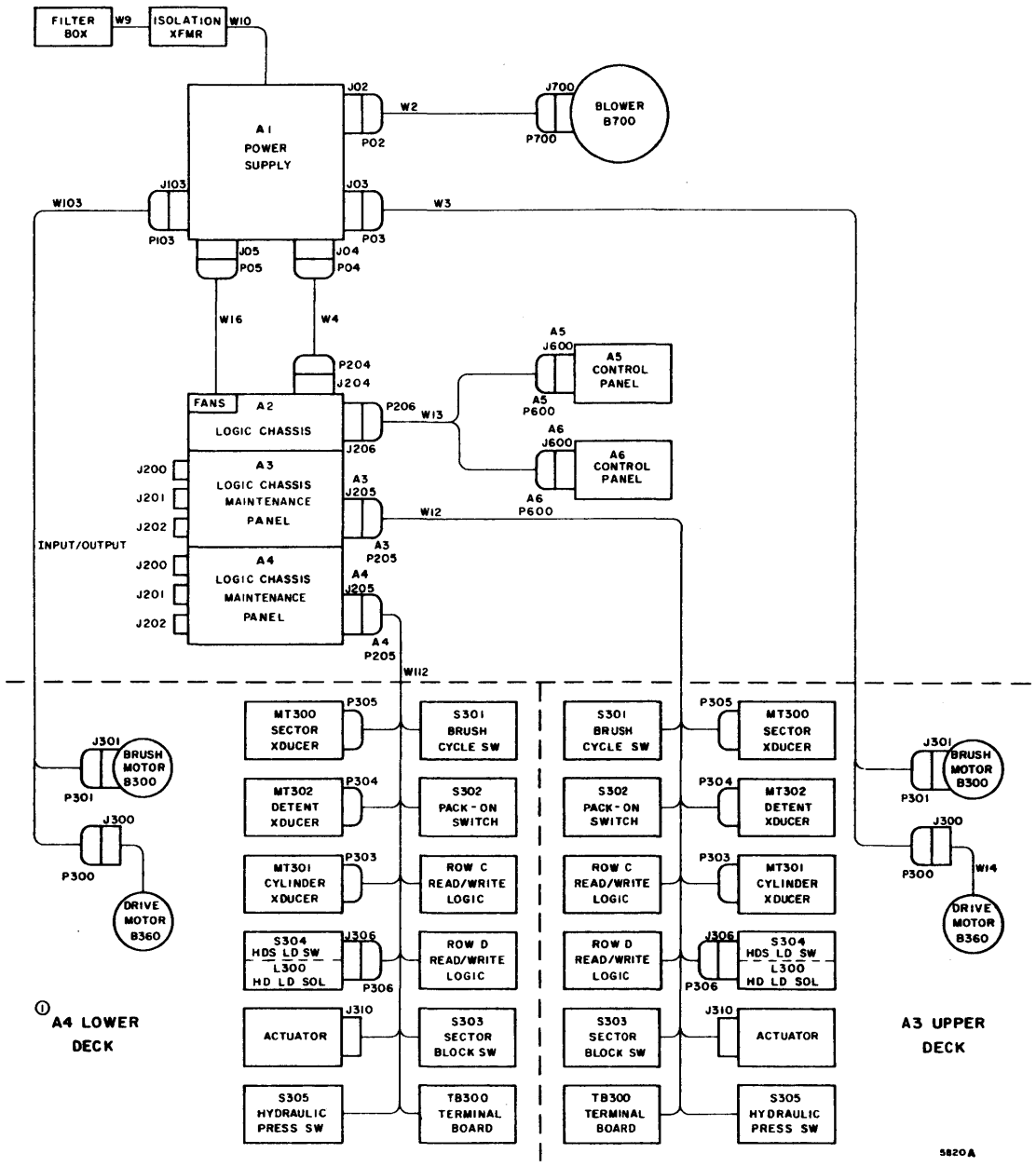


Figure 3-2. Cabinet Intracabling Diagram

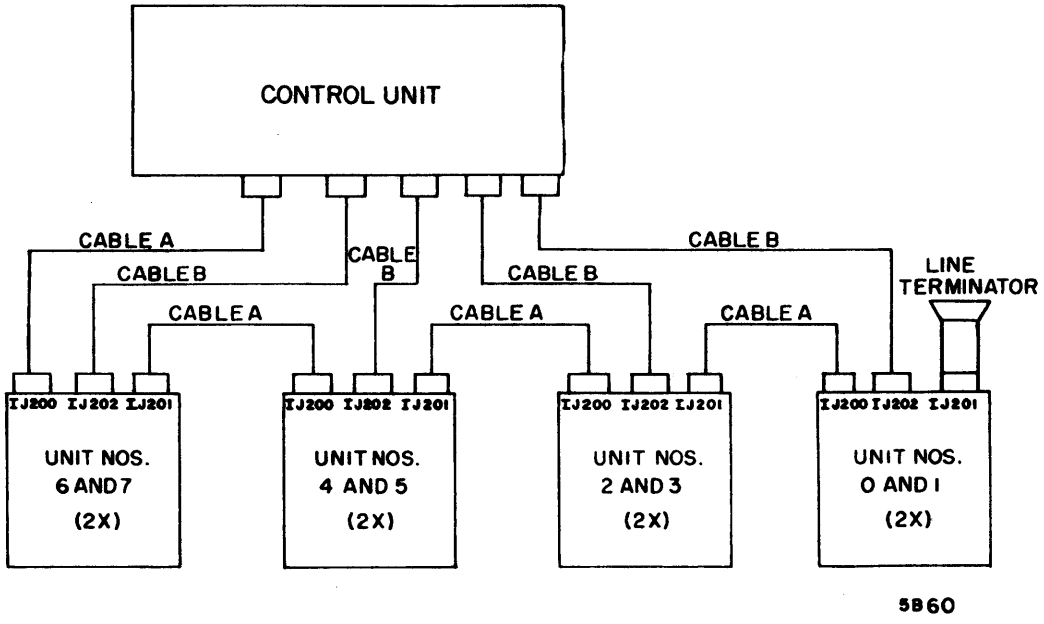


Figure 3-3. System Intercabling

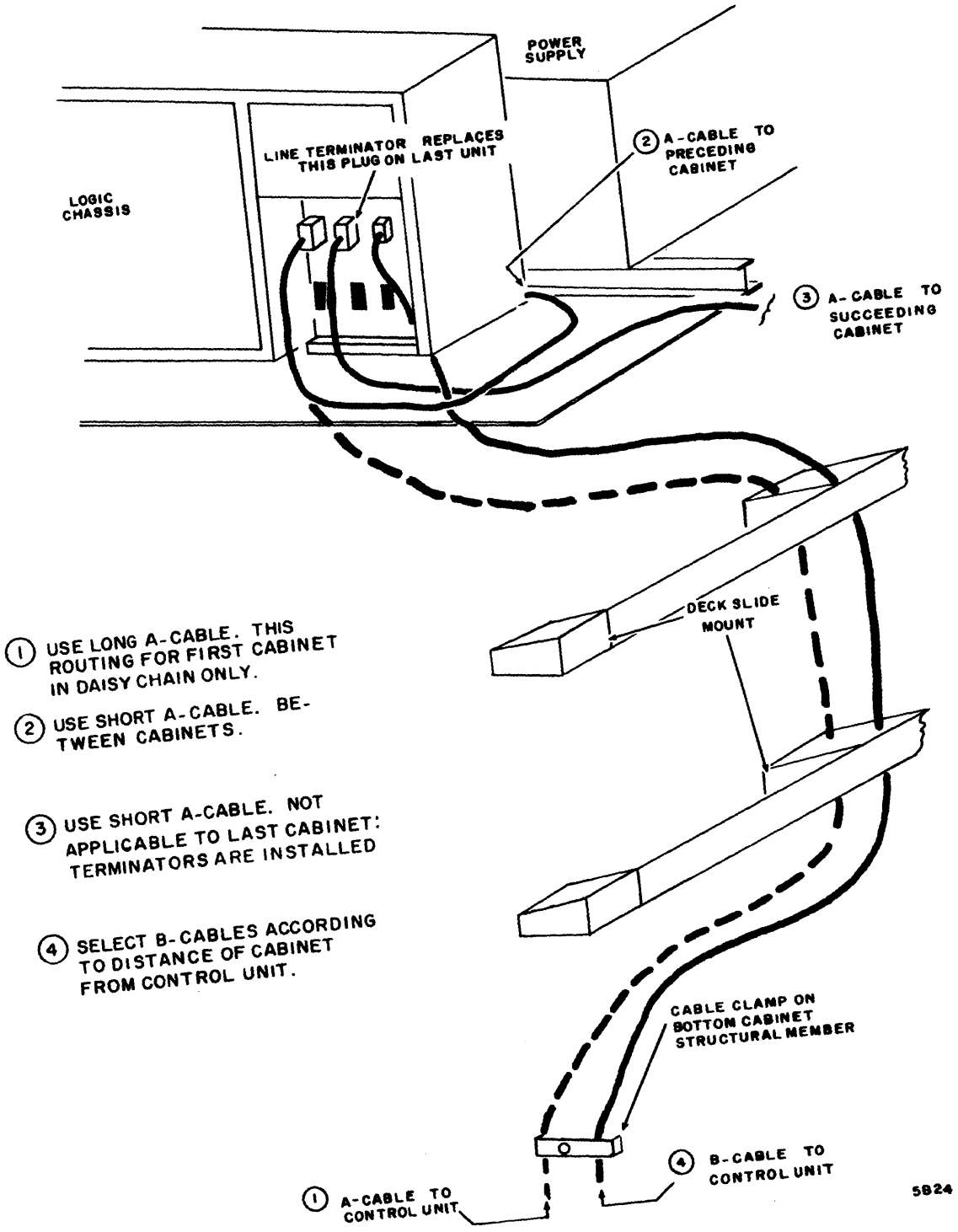


Figure 3-4. Intercabling Routing

TABLE 3-1. INPUT/OUTPUT CONNECTOR PIN ASSIGNEMENTS

CABLE A (J200 AND J201)		CABLE B (J202)	
PINS	FUNCTION	PINS	FUNCTION
1-4	Bidirectional Bus Line 0	A-C	Spare
2-5	Bidirectional Bus Line 1	AA-CC	Spare
3-7	Bidirectional Bus Line 2	B-D	Unit Selected(Upper)
8-12	Bidirectional Bus Line 3	BB-DD	Unit Selected(Lower)
10-13	Bidirectional Bus Line 4	E-H	SeekComplete or SeekError(Upper)
11-14	Bidirectional Bus Line 5	EE-HH	SeekComplete or SeekError(Lower)
15-18	Bidirectional Bus Line 6	L	Spare
16-20	Bidirectional Bus Line 7	N	Termination Power Shield
17-21	Cylinder Select	P	Spare
22-25	Head Select	R	Termination Power Ground**
23-26	Difference Select	S	Spare
24-27	Control Select	T	Sequence Lines Shield
28-31	Read Cylinder Select	U	Sequence Line
29-32	Spare	V	Sequence Line
30-33	Spare	W	Sequence Line
34-37	Pack Unsafe	X	Sequence Line
35-38	Seek Error	Y	Sequence Line
36-39	Pin wired but not used by MDD	Z	Sequence Line
40-43	Logic No. 1 (Bit 0)	F-J	Read Data (Upper)
41-44	Logic No. 2 (Bit 1)	FF-JJ	Read Data (Lower)
42-45	Logic No. 3 (Bit 2)	K-M	Write Data (Upper)
46-49	Logic No. 4 (Bit 3)	KK-MM	Write Data (Lower)
47-50	Unit Select	LL-NN	Spare
48-51	Pin wired but not used by MDD		
52-55	Pin wired but not used by MDD		
53-56	Spare		
54-57	Spare		
58-62	On Cylinder		
59-63	Unit Ready		
60-64	Index		
65-70	Release		

TABLE 3-1. INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS (Cont'd)

CABLE A (J200 AND J201)		CABLE B (J202)	
PINS	FUNCTION	PINS	FUNCTION
66-71	Spare		
67-72	Clear		
73-76	Spare		
74-77	Spare		
75-78	Spare		
79	Spare		
80	Termination Power Ground*		
82	Spare		

* Provides a return path for terminators and does not connect to the lines in cable.

** From control unit

3. Install cabinet trim as follows:

CAUTION

Following procedure removes cabinet panels. Make certain that the panels are returned to the same cabinet. Misalignment and/or binding could result from switching panels.

a. Open all deck drawers to the front. Open front cabinet doors. Remove lower front cabinet panels.

b. Refer to Figure 3-5 and position front trim strip flat against front frame members and behind operator panel. Locate top end of trim strip as shown. Secure strip to frame placing moulding clips as near to top and bottom of strip as possible. Space six remaining clips equally between top and bottom pairs.

c. Refer to Figure 3-5 and secure trim spacer to side trim with five equally spaced moulding clips. Locate top end of side trim as shown. Secure side trim to frame using five moulding clips spaced as in step b.

4. Remove all top panels. Position dust shield over top frame members as shown in Figure 3-5. Install top panels.

5. Install side panels as follows:

a. Refer to Figure 3-6 and assemble side panel hanger and slides and bracket/stud assemblies to cabinet. Do not completely tighten attaching screws at this time.

b. Adjust side panel hanger on lower frame member to dimension shown on Figure 3-6. Tighten screws securing hanger. Tighten screws securing side panel slides to hanger.

c. Put side panel in place on cabinet and secure with quarter-turn fasteners in bracket/stud assemblies.

d. Loosen upper brackets on side panel, establish the 1/2 ± 1/32 inch dimension along top edge (Figure 3-6), and tighten upper brackets on side panel.

CAUTION

Adjustments made in following steps are not complete until seal strip on side panel is compressed along its entire length. Improper adjustment will allow the entry of dust into the cabinet and could cause damage to the unit.

e. Loosen lower brackets on side panel. Move side panel until it is flush with side trim to within ± 1/32 inch (Figure 3-6) and hold it there. Now press side panel toward frame until seal strip along top edge of side panel is compressed at all points. Tighten screws in bracket/stud assemblies.

f. Inspect gap (in which seal strip is compressed) around perimeter of side panel. Seal strip must be compressed at all points and gap must be uniform to within ± 1/16 inch. Make required adjustments by loosening and repositioning side panel hanger or bracket/stud assemblies.

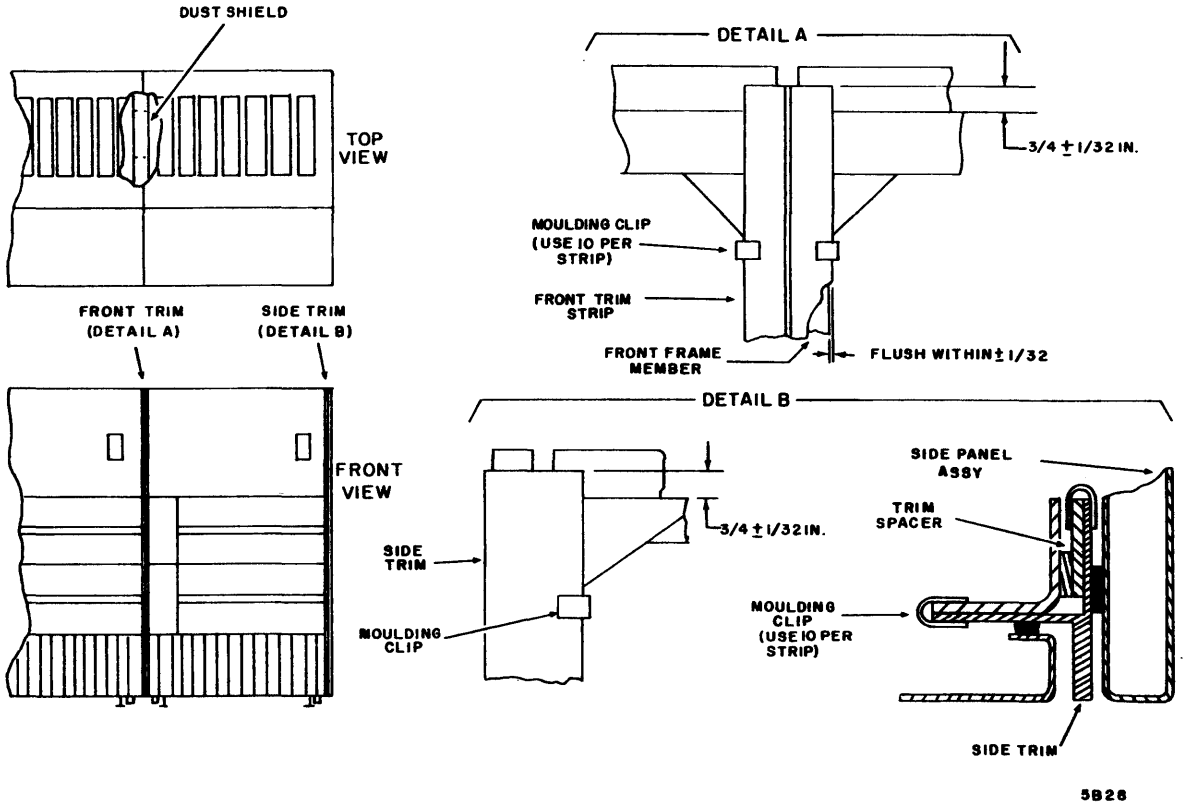


Figure 3-5. Trim and Dust Shield Installation

g. Tighten lower brackets on side panel. Make certain that side panel slides are positioned laterally on side panel hanger so as to maintain side panel alignment.

INPUT POWER REQUIREMENTS

The MDD requires an input power source capable of supplying 380 volt ± 10%, 50 Hz (+1%, -2%) 3-phase, four-wire wye.

The maximum current consumption with this input voltage is as follows:

Operating current (disk packs turning, steady-state)	4 amps/phase/2X cabinet

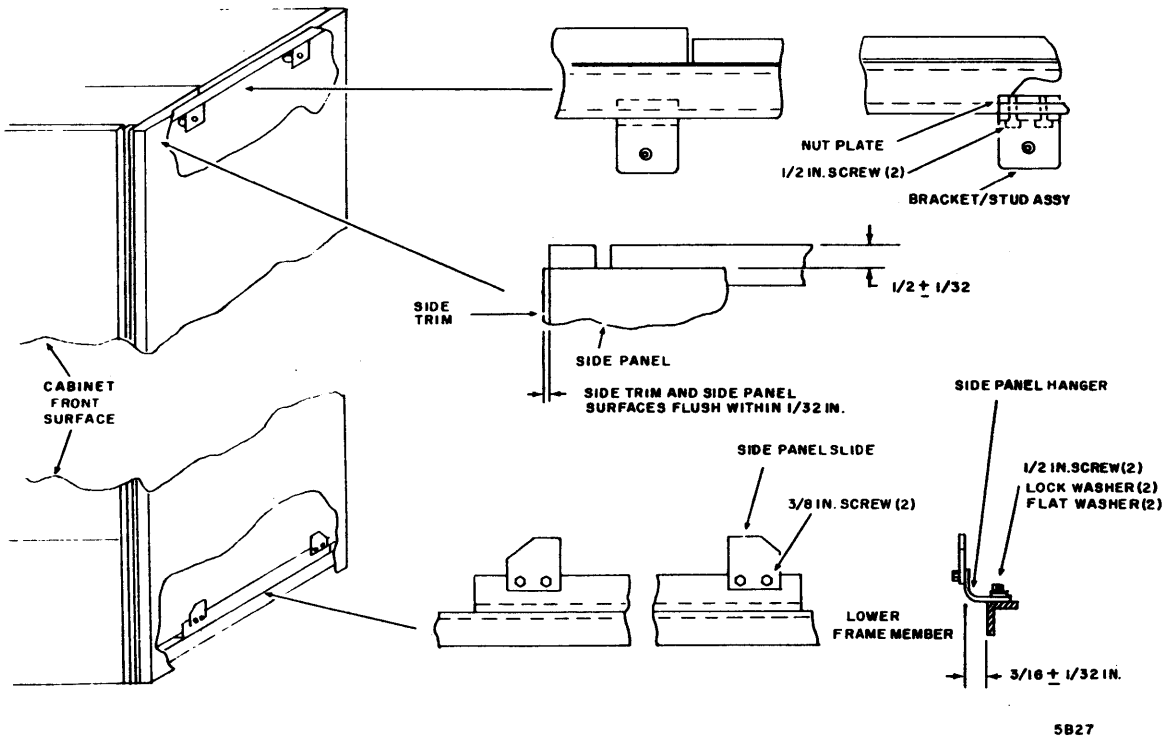


Figure 3-6. Side Panel Installation and Adjustment

Standby current	1.7 amps/phase/2X cabinet
Surge current	15 amps/phase drawn by each spindle motor during start. (Decreases to operational level as motor approaches operating speed. Spindle motors sequenced on, one at a time, during power application)

ENVIRONMENT

Operating and storage environments of the MDD are as follows:

Operating status	60 to 90° F (12° F/hr maximum fluctuation)
	10 to 80% relative humidity (providing there is no condensation)
Non-Operating status	-30 to +150° F
	5 to 95% relative humidity (providing there is no condensation)

INITIAL CHECKOUT AND STARTUP PROCEDURE

This procedure should be used to make the first power application to the MDD. The procedure assumes that the preceding procedures and requirements of this section have been performed and satisfied. Instructions are given for one deck of one cabinet, repeat as required for additional decks and cabinets.

1. Open cabinet rear door. Check that all logic chassis cards are firmly seated in their connectors.
2. Extend deck drawer to rear. Check that the four logic cards adjacent to shroud are seated securely in their connectors.
3. Remove plastic spindle cover.

NOTE

To avoid contamination of spindle assembly, install plastic cover on spindle whenever disk pack is not installed.

4. Grasp and attempt to turn spindle. Spindle should not rotate.
5. Disable spindle lock mechanism (Figure 2-2). Grasp and turn spindle. Spindle should rotate with little resistance.

CAUTION

Bearing damage may occur if alcohol runs into spindle.

6. Wipe spindle surface clean with alcohol-dampened gauze.

CAUTION

Never load read/write heads manually.

7. Unlatch head load cam (see Manually Positioning Carriage, Section 6) and extend read/write heads into shroud area.
8. Inspect and clean read/write heads (see Preventive Maintenance Index, Section 6).
9. Disengage detent pawl and retract carriage to stop.
10. Enable spindle lock mechanism (Figure 2-2).
11. Make certain that sector sensor and pack cleaning brushes are rotated back from shroud openings.
12. Install a disk pack (see Section 2).
13. Inspect and clean disk pack (see Preventive Maintenance Index, Section 6).
14. Remove disk pack from spindle (see Section 2).
15. Use a vacuum cleaner to remove any dust or dirt from interior of shroud and cabinet.

16. Set Filter Box panel UNIT POWER circuit breaker to OFF.

17. Make certain that cabinet power cable is connected to correct external ac power source. (Nominal voltage and frequency requirements are specified on identification plate located on top horizontal structural member at rear of cabinet.)

18. If external ac power to MDD is protected by circuit breaker, set circuit breaker to ON.

19. Set Logic Chassis Maintenance panel ON LINE/OFF LINE switch to OFF LINE.

20. Set Power Supply panel switches as follows:

    BLOWER circuit breaker to OFF
    +20 Circuit breaker to OFF
    -20 circuit breaker to OFF
    LOCAL/REMOTE switch to LOCAL
    SPINDLE (as applicable) circuit breaker to OFF
    +40 (as applicable) circuit breaker to OFF
    +6 (as applicable) circuit breaker to OFF
    DC/OFF (as applicable) switch to DC
    START (as applicable) switch to toggle down

21. Set Filter box panel UNIT POWER circuit breaker to ON. Power supply MAIN BREAKER and +20Y indicators light. Logic chassis and power supply fans begin to operate.

22. Set power supply BLOWER circuit breaker to ON. Cabinet blower begins to operate.

23. Extend deck drawer to rear. Place hand over air baffle surrounding spindle in bottom of shroud. Blower should be exhausting air into shroud. If blower is drawing air from shroud, reverse the connection of any two phase leadwires of the unit input power.

24. Install disk pack. Close deck drawer. If power supply START and Operator panel DEPART indicators light, set power supply START (as applicable) switch to toggle up.

25. Set power supply +20 and -20 circuit breakers to ON.

26. Set power supply +40 and +6 (as applicable) circuit breakers to ON.

27. Set power supply SPINDLE (as applicable) circuit breaker to ON and set related ON LINE/OFF LINE switch to ON LINE.

28. Set power supply START switch to toggle down.

29. Set power supply LOCAL/REMOTE switch to REMOTE.

30. Press Operator panel DEPART switch/indicator. Operator panel DEPART and power supply START indicators light.

31. Make sequence power available from controller.

NOTE

When more than one deck is being powered up, power is sequenced to the next deck in line when the spindle of the preceding deck reaches the correct speed. Following events do not occur simultaneously in each deck to be powered up.

32. Power supply +6, +20, and -20 indicators light and SPINDLE (as applicable) time meter starts. On the deck the spindle drive motor and disk cleaner (brush motor) start. Operator panel SPIN indicator lights indicating a disk pack rpm of more than 50.

33. When disk pack has achieved operational speed, power supply +40 and +40Y indicators light and actuator moves to hydraulic home position. At this point sequence power is passed to next deck (if any) to be powered up.

NOTE

Further activity ceases until brush motor finishes driving the cleaning brushes over disk pack surfaces.

34. When brushes are returned to a position clear of disk pack, the hydraulic actuator drives carriage forward to load read/write heads.

35. When heads are loaded, Operator panel PRET indicator lights and hydraulic actuator returns read/write heads to track zero.

36. Perform Head/Arm Adjustment procedure (see Preventive Maintenance Index).

37. Perform Index to Burst Check and Adjustment (see Corrective Maintenance).

38. To stop spindle motor, press Operator panel DEPART switch/indicator (indicator will extinguish). To remove power to unit, set ON LINE/OFF LINE switch to OFF LINE (for each spindle) and set Filter Box panel UNIT POWER circuit breaker to OFF.

CAUTION

Unit Number indicator goes out immediately if UNIT POWER circuit breaker is set to OFF.

39. Allow Unit Number indicator to go out before opening deck drawer.

Information for these sections is included in
BM1A5 Multiple Disk Drive
Pub. No. 70602500

SECTION 4

THEORY OF OPERATION

SECTION 5

DIAGRAMS

SECTION 6

MAINTENANCE

MAINTENANCE

This section contains the instructions required to maintain a MDD. The information is provided in the form of preventive maintenance, corrective maintenance and troubleshooting.

MAINTENANCE TOOLS

The special tools required to maintain a MDD are listed below:

Tool	Control Data Part Number
AC/DC Volt/Ohmmeter, Ballantine Labs Inc, Model 345 (or equivalent)	
CE Disk Pack	12211935 or 89259100
Card Extender	86416700
Card Puller	84146900
Carriage Alignment Tool	84251900
Current Probe, Tektronix P-6019 with passive terminator (or equivalent)	
Feeler Gages	
Head Adapter Cable	86053800
Head Adjustment Tool	84264200 or 87256300
Multimeter, Simpson 260 (or equivalent)	
Oil Injector Syringe	12209303
Oscilloscope, dual-trace, Tektronix 546 with Type CA preamplifier (or equivalent)	
Push-Pull Gage	12210797
Seal Inserting Tool	70808200

Tool	Control Data Part Number
Stone, Abrasive	
Syringe	
Tachometer	84264100
Tester Card	40072100

MAINTENANCE MATERIALS

The materials used in the procedures of this section are listed below:

Material	Source
Number 1 Tube gauze	Control Data 12209713
Hydraulic Fluid (bulk, fluid only)	Control Data 45583801
Hydraulic Fluid (2-quart container)	Control Data 70957000
Hydraulic Fluid (5-gallon container)	Control Data 46836301
Isopropyl Alcohol	Control Data 12210956
Loctite, Grade C	Loctite Corporation
Loctite Primer, Grade N	Loctite Corporation
Molykote, Type G	Dow Corning Corporation
Oil (bulk oil only)	Control Data 95020400
Oil (1/2-pint container)	Control Data 12208888
Plastic Spatulas (or tongue depressors)	Commercially available
Tape, Adhesive	Commercially available
Tape, Thread Lock, Teflon 1/4	Control Data 94195700

D1775

PREVENTIVE MAINTENANCE

GENERAL

Performance of the MDD is dependent upon the proper and timely execution of a preventive maintenance routine. Such a routine is provided by the Preventive Maintenance Index following.

The index consists of five levels based on a calendar period or hours of operation (whichever comes first). The power supply SPINDLE elapsed time meter keeps a cumulative record of hours of operation. Perform preventive maintenance in accordance with the indication of this meter. The Preventive Maintenance Procedure column lists the title of the paragraph containing the required instructions.

PREVENTIVE MAINTENANCE INDEX

*LEVEL	PREVENTIVE MAINTENANCE PROCEDURE
3	Inspect and clean read/write heads
3	Inspect and clean disk pack
3	Change primary filter
4	Clean shroud and spindle
4	Check pack cleaning brushes
4	Lubricate detent pawl
4	Lubricate detent gear
4	Replace hydraulic fluid
4	Lubricate rack and pinion gears
4	Lubricate carriage rollerways
4	Lubricate head load latch
4	Clean and lubricate lockshaft
4	Lubricate head load linkage
5	Check hydraulic fluid level
5	Replace absolute filter
5	Check head/arm adjustment

*Level 1 - Weekly or 150 hours (no preventive maintenance scheduled)

Level 2 - Monthly or 500 hours

Level 3 - Quarterly or 1, 500 hours

Level 4 - Semiannually or 3,000 hours

Level 5 - Annually or 6, 000 hours

INSPECT AND CLEAN READ/WRITE HEADS

1. Stop spindle motor.
2. Extend deck drawer to rear.

NOTE

Use of a suitably bright and directional light during following steps is recommended.

3. Inspect heads as follows:

CAUTION

Use extreme care not to damage heads with dental mirror.

   a. Use dental mirror to inspect face of each head for reddish-brown oxide deposits. Clean head (instruction follow) if required.

   b. Use dental mirror to inspect face of each head for scratches and burrs. If scratches or burrs are found, refer to Preface of this manual to determine publication number of manual containing Maintenance Aids section for this equipment. Refer to that section for head replacement criteria.

4. Clean heads as follows:

   a. Wrap a piece of lint-free gauze around a plastic spatula (or a tongue depressor). Dampen gauze (do not soak) with isopropyl alcohol.

CAUTION

Do not touch the head face with fingers. Do not leave residue or lint on the head surface after cleaning. Residue or particles trapped between the heads and a disk surface cause scoring of the disk and the head, resulting in loss of the head and of the scored disk area. Do not breathe on the heads or the disk. Moisture in the breath condenses on the surface and causes dust to accumulate.

b. Thoroughly wipe the face of each head with the dampened gauze.

c. Thoroughly wipe the face of each head with dry gauze.

d. Repeat step 3a.

INSPECT AND CLEAN DISK PACK

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Install disk pack to be cleaned on spindle.
4. Release four half-turn fasteners securing right-hand (as viewed from front of MDD) shroud side cover.

CAUTION

The spindle lock mechanism must be enabled before the disk pack is removed.

5. Disable spindle lock mechanism (Figure 2-2).

NOTE

Use of a suitably bright and directional light during following steps is recommended.

6. Slowly revolve disk pack while observing each disk surface. If severe scratches (oxide coating removed from disk surface to point of baring substrate) are found, refer to Preface of this manual to determine publication

number of manual containing Maintenance Aids section for this equipment. Refer to that section for disk pack replacement criteria.

7. Wrap a piece of lint-free gauze around a plastic spatula (or a tongue depressor) and dampen (do not soak) with isopropyl alcohol.

8. Insert the spatula through pack cleaning brushes port in side of shroud until tip contacts hub of disk pack.

NOTE

Apply moderate and constant pressure to disk surface with spatula during following step.

9. Slowly rotate disk pack while very slowly withdrawing tip of spatula. Continue withdrawing spatula until tip is clear of disk pack circumference.

10. Repeat steps 7, 8, and 9 for a disk surface until gauze comes away clean from disk surface.

11. Wrap a clean, dry piece of gauze on spatula and repeat steps 8 and 9 to remove residue released by alcohol.

12. Repeat steps 7 through 11 for each remaining recording surface of disk pack.

13. Dampen a piece of gauze with isopropyl alcohol and wipe clean the exposed top surface of disk pack. Dry the surface.

14. Use alcohol dampened gauze to clean both pieces of disk pack container. Dry the container.

15. Enable spindle lock mechanism (Figure 2-2).

16. Remove disk pack from spindle (do not install bottom half of container). Invert container and inspect nylon mesh filter surrounding lower hub of disk pack. If filter is discolored (normally white), replace as follows:

    a. Release O-ring securing lower rim of filter.

    b. Remove dirty filter.

    c. Insert new filter (Control Data p/n 40050500) in cavity and secure with original O-ring.

17. Install bottom of disk pack container. Set pack and container aside.

CAUTION

Bearing damage may occur if alcohol runs into spindle.

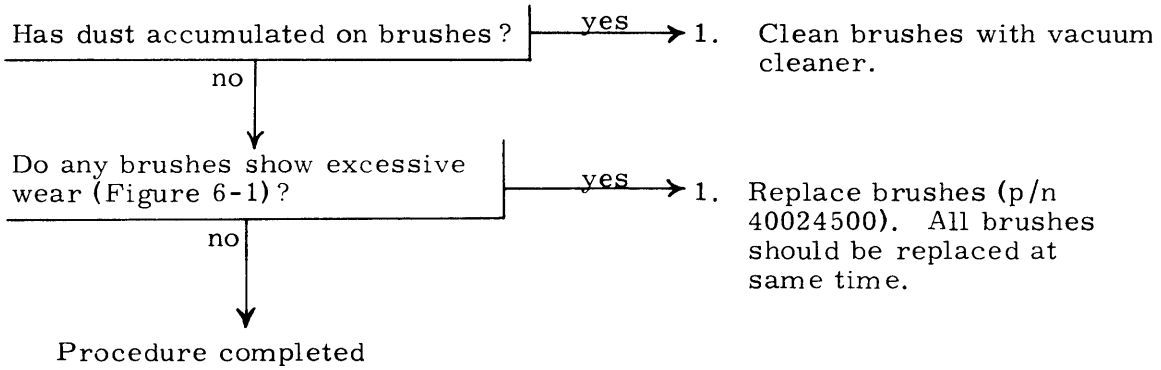
18. Clean spindle cone of MDD thoroughly with alcohol dampened gauze.

CLEAN SHROUD AND SPINDLE

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Remove disk pack.
4. Clean shroud with a lint-free gauze that is slightly dampened with isopropyl alcohol. Wipe shroud to remove all dirt and smudges. Thoroughly wipe spindle surface.
5. After cleaning shroud, use a wad of adhesive-type tape and pick up any particles that were not picked up with gauze. Make certain that all particles are removed from interior of shroud.

CHECK PACK CLEANING BRUSHES

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Check brushes for presence of dust or excessive wear.



CHANGE PRIMARY FILTER

1. Set filter box UNIT POWER circuit breaker to OFF.
2. Open hinged lower front panel of cabinet.
3. Remove primary filter (Figure 6-2).
4. Install replacement filter (p/n 92682019).

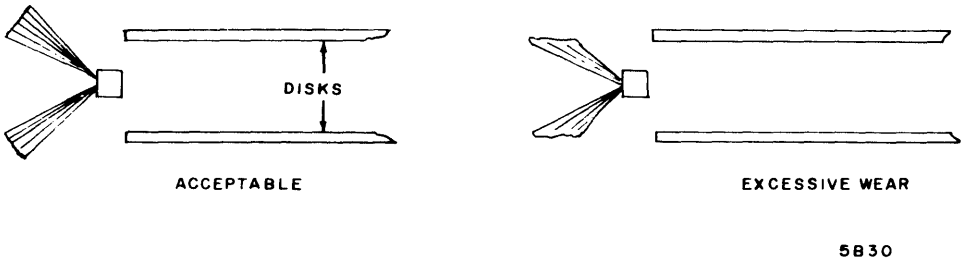


Figure 6-1. Pack Cleaning Brushes

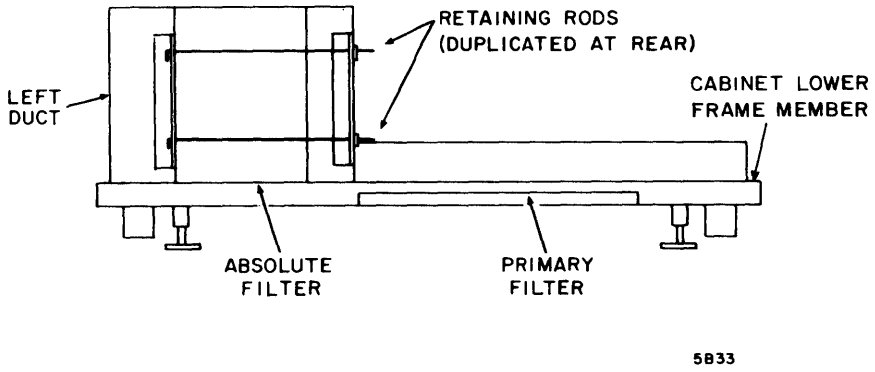


Figure 6-2. Cabinet Filters

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LUBRICATE DETENT PAWL

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Use lint-free gauze to wipe excessive or old lubricant from pawl.
4. Apply a light coat of Molykote, Type G at pawl pivot point (Figure 6-3).

LUBRICATE DETENT GEAR

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Release four half-turn fasteners securing each shroud side cover. Set both covers aside.
4. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear of deck and set aside.

CAUTION

Never manually position the carriage past hydraulic home position without disabling head loading mechanism.

5. Unlatch head load cam (Manually Positioning Carriage paragraph).
6. Use lint-free gauze to wipe old lubricant from detent gear (Figure 6-3). Be sure to remove accumulations between gear teeth.
7. Apply a thin coat of oil (p/n 95020400) on gear. Check that no lubricant has accumulated on notched cylinder disk. Make certain that no lubricant is left in notches.
8. Continue to next procedure. Shroud will be installed later.

REPLACE HYDRAULIC FLUID

Refer to Hydraulic Fluid Removal and Replacement paragraph (Corrective Maintenance) and replace hydraulic fluid.

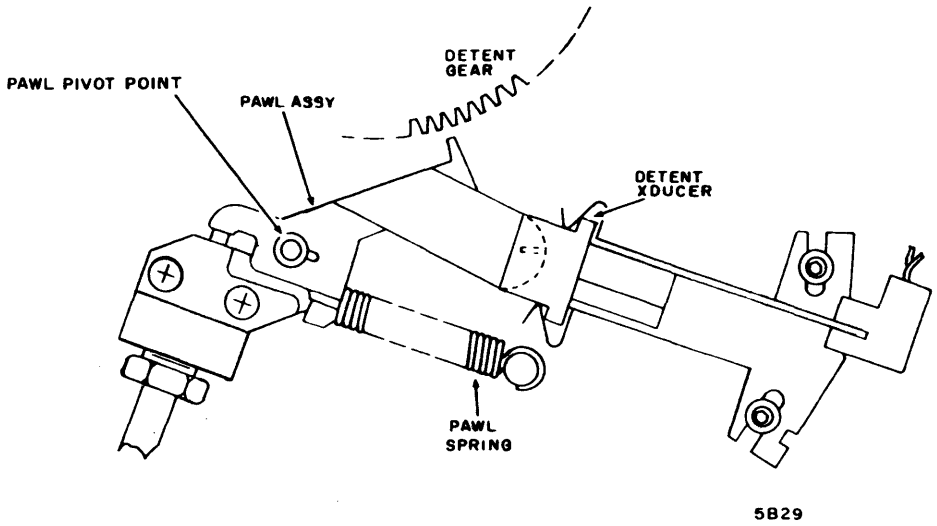


Figure 6-3. Detent Pawl and Gear Lubrication

LUBRICATE RACK AND PINION GEARS

NOTE

It is assumed that this procedure is being performed immediately after lubrication of the detent gear.

1. Saturate felt pads on front end of carriage (Figure 6-4) with oil (p/n 95020400).
2. Use lint-free gauze to clean rack and pinion gears (Figure 6-4).
3. Apply a light coat of oil (p/n 95020400) to both gears.

LUBRICATE CARRIAGE ROLLERWAYS

NOTE

It is assumed that this procedure is being performed immediately after lubrication of the rack and pinion gears.

1. Use lint-free gauze to wipe the carriage rollerways (Figure 6-4) clean.
2. Apply a light coat of oil (p/n 95020400) to carriage rollerway surfaces.

3. Return carriage to fully retracted position.
4. Replace shroud.
5. Perform Shroud Adjustment procedure (see CORRECTIVE MAINTENANCE).
6. Install shroud side covers.

LUBRICATE HEAD LOAD LATCH

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Apply a light coat of Molykote, Type G to the latch cam surface (Figure 6-5).
4. Apply Molykote, Type G to the pawl pivot point (Figure 6-5).

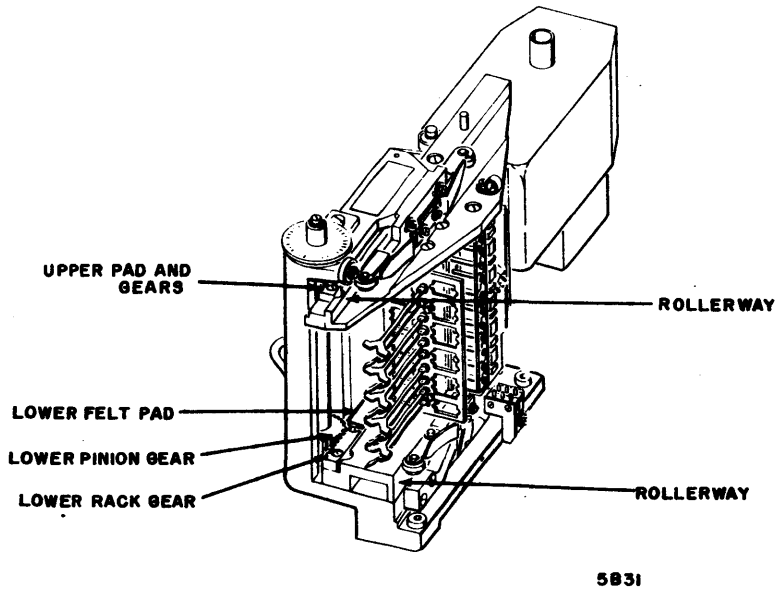


Figure 6-4. Carriage Lubrication

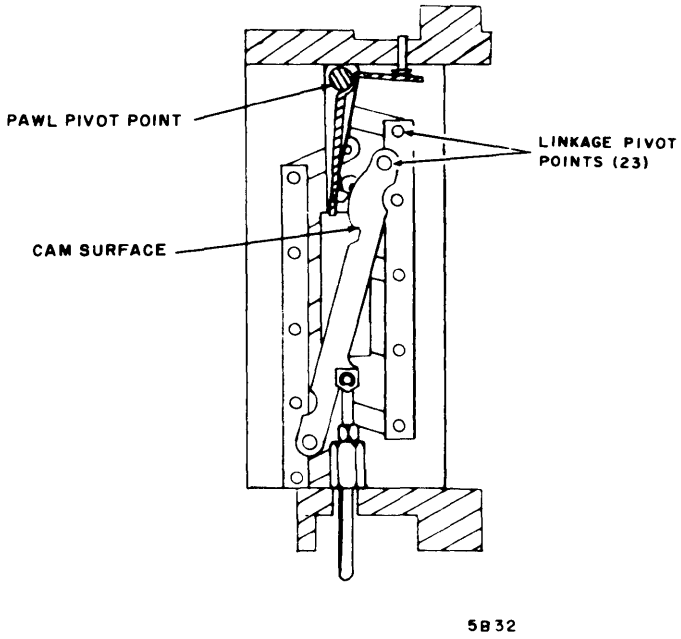


Figure 6-5. Head Latch Lubrication

REPLACE ABSOLUTE FILTER

1. Set filter box UNIT POWER circuit breaker to OFF.
2. Open hinged lower front panel.
3. Refer to Figure 6-2 and remove two front retaining rods securing filter. Loosen two retaining rods at rear of filter.
4. Move left duct slightly to left enough to allow removal of filter.
5. Install replacement filter (p/n 94301102).
6. Make certain that all seams (gasket foam) are tight and will not allow air to bypass filter.

CLEAN AND LUBRICATE LOCKSHAFT

1. Stop spindle motor.

2. Remove disk pack.
3. Extend deck drawer to rear.
4. Use lint-free gauze and a brush or sharp instrument to clean lockshaft threads on top end of spindle.
5. Apply a thin coat of oil (p/n 95020400) to threads.

LUBRICATE HEAD LOAD LINKAGE

1. Stop spindle motor.
2. Extend deck drawer to rear.

CAUTION

Never manually position carriage past hydraulic home position without disabling the head loading mechanism.

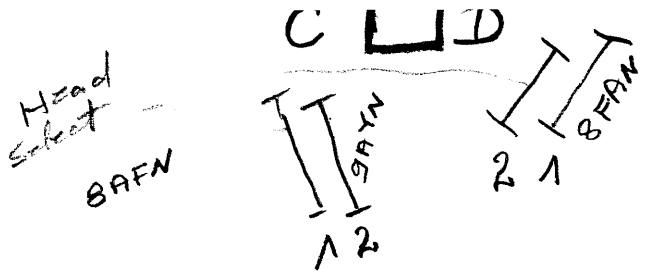
3. Unlatch head load cam (Manually Positioning Carriage paragraph).
4. Apply a small amount of Molykote, Type G to each pivot point in head loading linkage (Figure 6-5).
5. Apply a light coat of Molykote, Type G to bearing surfaces and pivot points of head loading mechanism located at bottom of carriage mount (head load cam and head load cam latch, Figure 6-12).

CORRECTIVE MAINTENANCE

The maintenance procedures for the MDD are provided on the basis of the Subassemblies of the unit. Detailed procedures (Check, Adjustment, Removal and/or Replacement) are provided as subparagraphs to the Subassembly heading.

Procedures are written for one deck and are applicable to both decks of a 2X cabinet. When test points are used, the row or deck location of the test point is given and related to the deck being maintained.

It is recommended that maintenance personnel read the entire procedure prior to performing the instructions of the procedure.



CHECK HEAD/ARM ADJUSTMENT

1. Stop spindle motor. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
2. Extend deck drawer to rear.
3. Remove SPL card at location C02 of open drawer.
4. Remove SPL card at location A17 (for upper deck) or B17 (for lower deck).

CAUTION

The CE disk pack contains specially recorded tracks of data. Extreme care must be taken so that this data is not modified.

5. Install CE disk pack (p/n 89259100).
6. Set DC/OFF switch to DC.

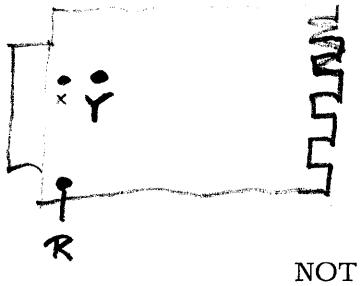
CAUTION

The MDD and disk pack must be temperature stabilized. To stabilize an MDD, extend drawer, install disk pack, close drawer, start spindle motor, load heads, and allow unit to operate for one hour. If MDD is turned off for less than 30 minutes after stabilizing, an additional ten-minute running period is required to restabilize. If MDD is turned off for 30 minutes or more, a one hour running period is required to stabilize. Any disk pack that is at room temperature, or warmer, requires only a ten-minute running period to stabilize.

7. Start spindle motor.

NOTE

In following procedure it is necessary to position heads to a specific track location. This command may be derived by either suitable software and the central processor or the tester card (p/n 40072100) if available. (Install tester card at location A03 for upper deck or B03 for lower deck).



OFF Line

NOTE

If heads on other decks are to be checked when this deck is completed, time can be saved by starting the temperature stabilization of those decks at this time. Use standard disk pack for initial warmup (if CE disk packs are not available). When the check of this deck is complete, transfer CE disk pack to next deck, allow a ten-minute running period for stabilizing, and proceed with check from step 8.

8. Position carriage to track 73 and make certain that detent pawl is properly engaged.

9. Connect oscilloscope external trigger to test point C (Index) of SPL card at location A11 (for upper deck) or B11 (for lower deck).

10. Connect oscilloscope channels A and B to test points G and F of SPL card at location D01 of open drawer. Ground oscilloscope at test point A of same card.

11. Select desired (Figure 6-6) head by grounding (at test point Y or R of same card) similarly numbered test point located as follows:

Head/Test Point No.	Card Location	Head/Test Point No.	Card Location
0, 3, 4, 7, 8, 11, 12, 15, 16, and 19	D02	1, 2, 5, 6, 9, 10, 13, 14, 17, and 18	C01

12. Adjust oscilloscope sweep so that three cross-over points (nulls) span exactly 10 centimeters (Figure 6-7).

NOTE

Since one revolution of the pack equals 25 msec, in order to achieve the waveforms shown, the oscilloscope horizontal time base must be placed in the uncalibrated position.

13. Record position of center cross-over point relative to center vertical graticule line. The center cross-over must be within 1.5 cm.

14. If adjustment is required, the center cross-over must be adjusted within ±.8 cm of the center graticule.

NOTE

Insure proper CE pack stabilization prior to any head adjustment.

15. If requirement is not met, loosen screws through head/arm clamp assembly immediately above and below head to be adjusted.

16. Refer to Figure 6-8 and place slot in end of head adjustment tool (p/n 84264200 or 87256300) over head/arm assembly so that tips of tool enter carriage groove and bottom of tool slot engages head/arm notch.

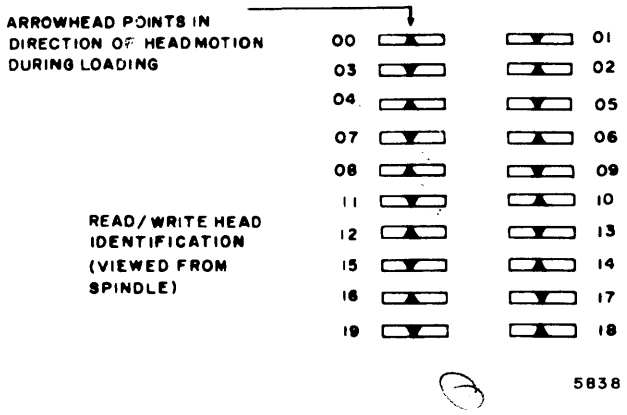


Figure 6-6. Head Identification

NOTE

Very little tool motion is required to make following adjustment.

17. Moving tool laterally (parallel to head/arm length), reposition head/arm until center cross-over point displayed on oscilloscope is within ±0.8 cm (± 2 ms) of center vertical graticule.

18. Remove adjustment tool and carefully tighten screws above and below adjusted head. Position established in step 17 must remain in-tolerance when screws are tight. Readjust if required.

19. Repeat steps 11 through 18 for read/write heads immediately above and below head just adjusted.

20. Repeat steps 11 through 19 for any other head requiring adjustment.

21. Stop spindle motor. Remove CE disk pack.

22. Disconnect oscilloscope.

23. Set associated DC/OFF switch to [redacted]. Install SPL cards removed in steps 3 and 4.

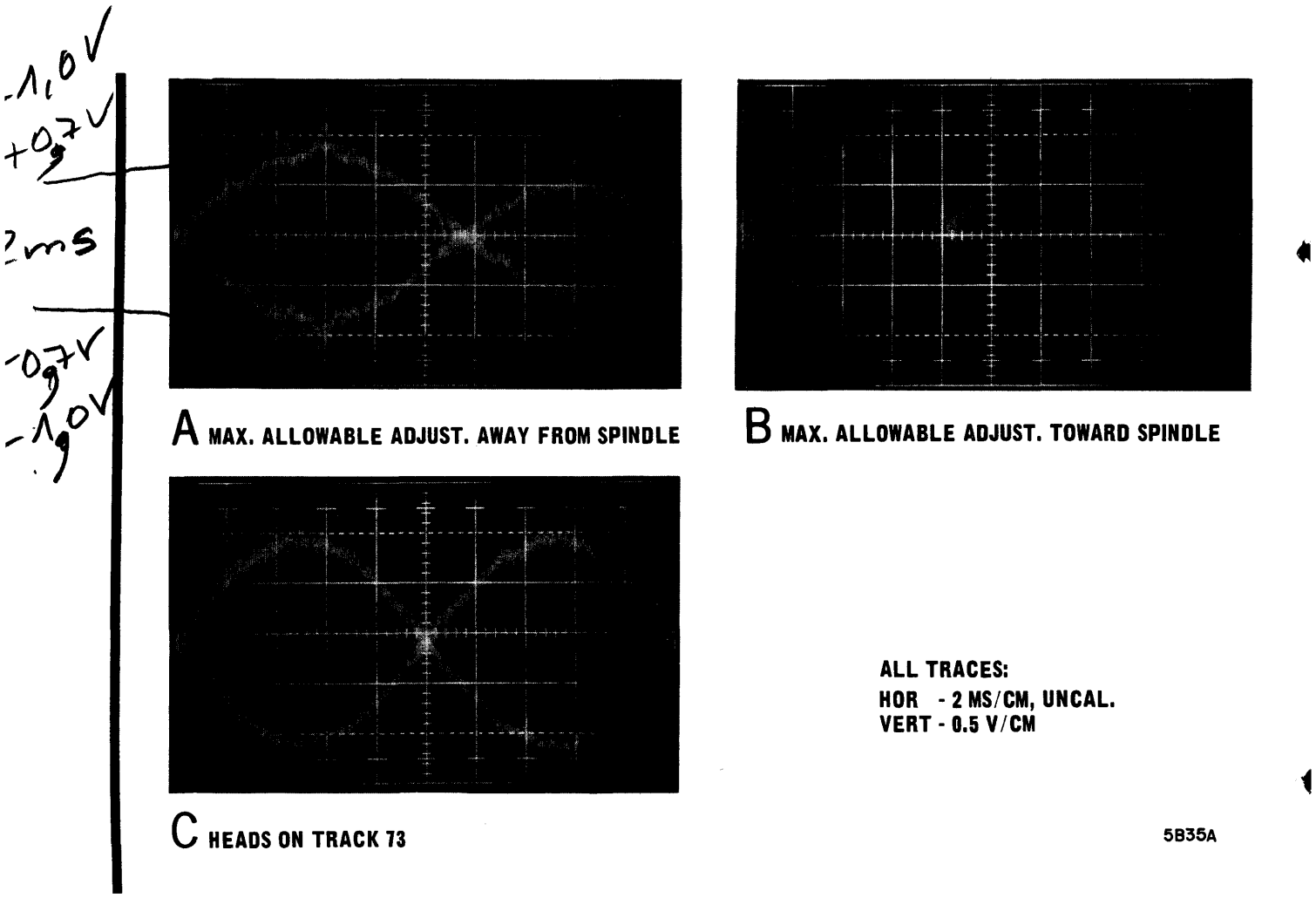


Figure 6-7. Head Adjustment Trace

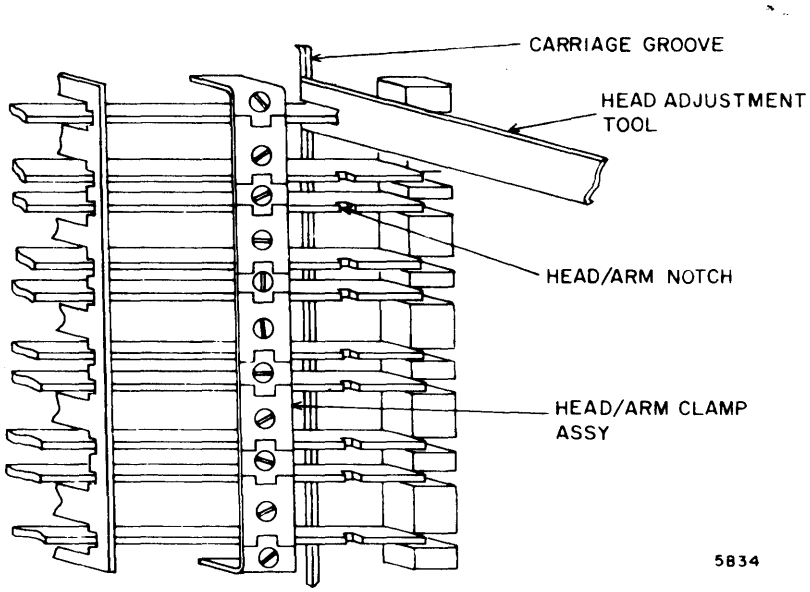


Figure 6-8. Head/Arm Assembly Adjustment

DRIVE BELT

Check (Figure 6-9)

1. Extend applicable deck drawer to rear.
2. Remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
3. Drive belt tension is correct when length of idler spring is 4(+0.25, -0.0) inches. Perform adjustment procedure if required.

Adjustment (Figure 6-9)

1. Loosen three screws securing drive motor assembly to underside of main deck.
2. Reposition drive motor assembly until idler spring length is 4(+0.25, -0.0) inches.
3. Securely tighten these screws.

Removal and Replacement (Figure 6-9)

1. Move free end of idler arm toward drive motor pulley and pull belt clear of idler arm pulley.
2. Disable spindle lock by engaging cam arm block and cam arm, Figure 2-2.
3. Place replacement drive belt close at hand.
4. Disconnect leadwires to pack-on switch and ground spring.

CAUTION

Support the spindle lock and switch assembly and manipulate the drive belt in following steps so that pack-on switch, ground spring, or spindle lock linkage is not damaged.

5. Remove three screws and lock washers securing spindle lock and switch assembly to spindle legs.
6. Carefully lower assembly until old belt can be removed.
7. Install smooth side of replacement belt against spindle drive pulley.

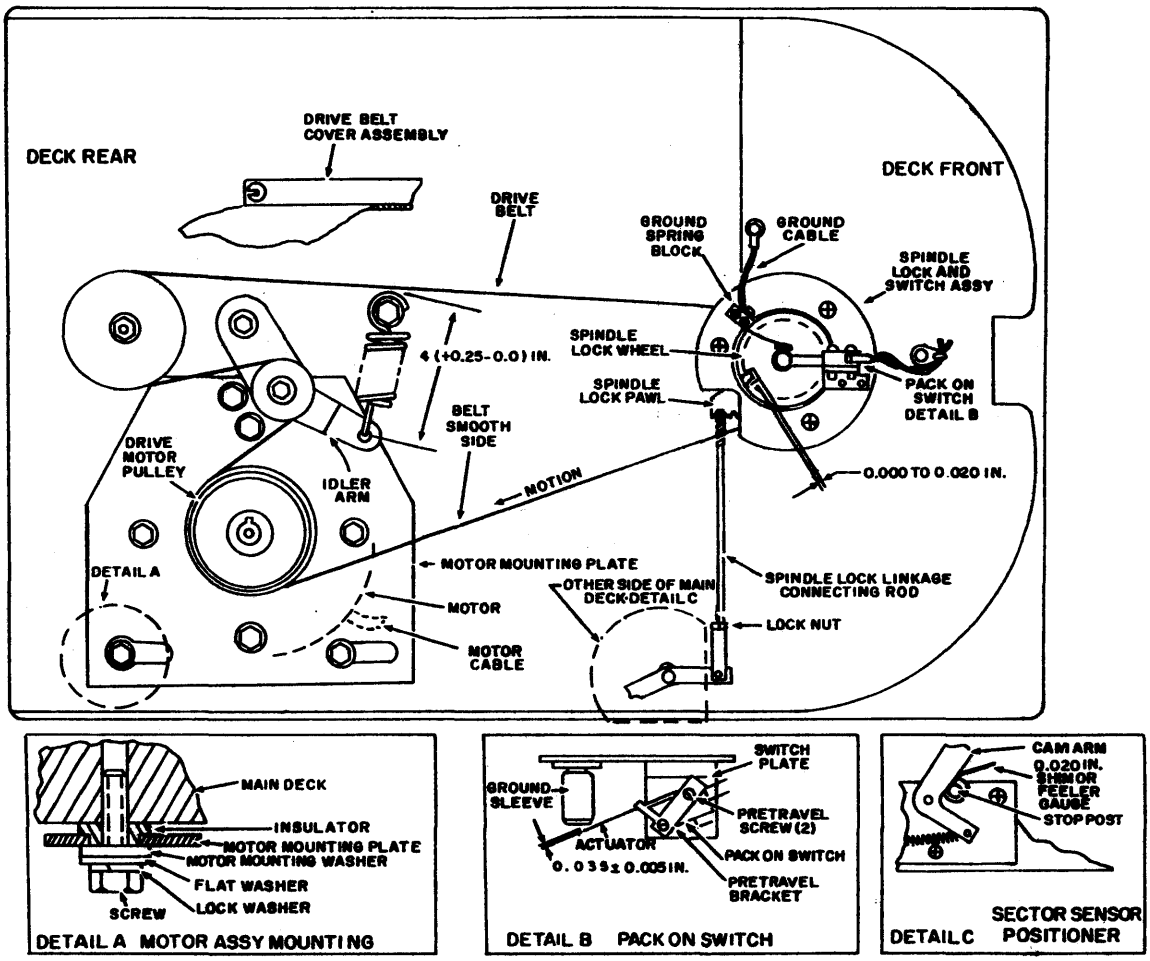


Figure 6-9. Main Deck Underside

8. Carefully secure spindle lock and switch assembly to spindle legs. Ground spring and pack-on switch actuating arm should be contacting spindle ground sleeve.
9. Restore electrical connections of step 4.
10. Thread drive belt according to Figure 6-9.
11. Perform Drive Belt Check procedure.

DRIVE MOTOR PULLEY

Check (Figure 6-9)

1. Extend applicable deck drawer to rear.
2. Remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
3. Adjacent surfaces of drive motor pulley and motor mounting plate should be separated by 19/32 ± 1/32 inch. Perform adjustment procedure if required.

Adjustment (Figure 6-9)

1. Loosen setscrew in hub of pulley.
2. Reposition pulley along motor shaft until dimension between adjacent surfaces of pulley and motor mounting plate is 19/32 ± 1/32 inch.
3. Tighten setscrew and recheck dimension.

Removal and Replacement (Figure 6-9)

1. Remove setscrew securing pulley to motor shaft.
2. Slide pulley off shaft.
3. Align pulley slot with shaft key and slide pulley on shaft.
4. Loosely secure pulley to shaft with setscrew.
5. Perform Drive Motor Pulley Adjustment procedure.
6. Check drive belt threading according to Figure 6-9.

DRIVE MOTOR REMOVAL AND REPLACEMENT (Figure 6-9)

The drive motor is not field repairable. If trouble is experienced, replace and return faulty unit to factory.

1. Set power supply SPINDLE circuit breaker to OFF.
2. Extend applicable deck drawer to rear.

3. Remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
4. Move free end of idler arm toward drive motor pulley and pull belt clear of idler arm pulley.
5. Disconnect drive motor cable plug.
6. Support drive motor assembly form below main deck and remove three screws securing assembly to deck.
7. Lower assembly clear of main deck.
8. Loosen setscrew and remove drive pulley from faulty motor.
9. Remove four screws and washers and separate motor from motor mounting plate.
10. Align motor cable exit with motor mounting plate, Figure 6-9. Secure plate to replacement motor.
11. Refer to detail A of Figure 6-9 and loosely secure motor assembly to main deck.
12. Check drive belt threading according to Figure 6-9.
13. Connect drive motor cable plug.
14. Perform Drive Belt Adjustment procedure.

SPINDLE AND LOCKSHAFT ASSEMBLY

Field repair of this assembly is limited to replacing the lockshaft. If the trouble being experienced cannot be remedied by replacing the lockshaft, replace the entire spindle and lockshaft assembly. Return the faulty assembly to the factory.

Lockshaft Removal and Replacement

1. Extend applicable deck drawer to front.
2. Refer to Figure 6-9 and remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
3. Disconnect ground cable (Figure 6-9) from underside of deck.

4. Observe leadwire connection scheme to pack on switch (Figure 6-9) and then disconnect each wire at switch.

5. Remove nut and lockwasher from pivot screw so that spindle lock pawl (Figure 6-9) will come free of mounting plate during next step. Pawl need not be disconnected from spindle lock linkage.

6. Remove three screws and lockwashers securing spindle lock and switch assembly to spindle legs. Lower assembly clear of spindle.

7. Remove ground sleeve nut and lockwashers from lower end of lockshaft.

8. Remove lower lockshaft assembly by turning assembly counter-clockwise.

9. Carefully raise lockshaft out of top of spindle assembly.

10. Remove E-ring from near center of faulty lockshaft and install E-ring on replacement lockshaft.

11. Lower replacement lockshaft into top of spindle assembly.

12. Install CE disk pack.

13. Thread the lower lockshaft assembly onto the bottom of the replacement lockshaft until finger tight. Using suitable wrench tighten washer assembly three full revolutions.

14. Reassemble remaining components to spindle by reversing steps 3 through 7.

15. Perform Spindle Lock Pawl Check procedure.

16. Perform Pack On Switch Check procedure.

17. Perform Ground Spring Check and Adjustment procedure.

18. Install drive belt cover assembly using two screws and washers. Secure four half-turn fasteners.

Spindle and Lockshaft Assembly Removal and Replacement

1. Extend applicable deck drawer to rear.

2. Release four half-turn fasteners securing each shroud side cover. Set both covers aside.

3. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear of deck and set aside.

4. Remove four shroud standoffs.

5. Remove both SPL cards from C-row of logic on deck.

6. Remove three screws and six washers securing C-row card chassis to deck.

7. Disconnect plug to sector sensor.

8. Thread plug through circular cutout in C-row card chassis. Move C-row chassis clear of sector sensor.

9. Remove sector preamplifier card from transducer.

10. Install CE disk pack (p/n 89259100) on spindle.

11. Pivot sensor toward disk pack until stop is encountered. Pull up on cam arm block to hold sector sensor in position.

CAUTION

When measuring dimension A of Figure 6-21 accuracy is most essential, reference of this dimension will be needed to align the sector sensor assembly after installation of the replacement spindle assembly.

12. Rotate disk pack until notch in sector disk begins to enter sensor transducer. Using a feeler gage measure and record distance between the bottom of the disk pack sector disk and the transducer bottom notch. (Dimension A of Figure 6-21).

13. Release cam arm block to disengage sector sensor assembly.

14. Remove CE disk pack.

15. Remove four screws and lock washers securing air baffle to main deck.

16. Refer to Figure 6-9 and remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.

17. Remove retaining ring that secures spindle lock linkage to spindle lock pawl. Check that pawl is clear of spindle lockwheel.

18. Disconnect leadwires to pack-on switch and ground spring block. Observe leadwire connections.

19. Remove three screws and lock washers securing spindle lock and switch assembly to spindle legs.

20. Move idler arm to put slack in drive belt and pull belt from spindle drive pulley.

21. Remove three screws and lock washers securing spindle and lockshaft assembly to main deck.

22. Lift faulty spindle and lockshaft assembly off main deck.

23. Install replacement spindle and lockshaft assembly in reverse order of removal (Steps 15 through 21).

24. Install CE disk pack.

25. Pivot sector sensor toward disk pack until stop is encountered. Pull up on cam arm block to hold sector sensor in position.

26. Rotate disk pack until notch in sector disk begins to enter sector sensor transducer.

27. Measure distance between bottom of disk pack sector disk and the transducer bottom notch (Dimension A of Figure 6-21).

28. Add or remove shims under sector sensor mount to obtain same dimension measured in step 12.

29. Reassemble components removed in steps 5 through 9 in reverse order.

30. Install drive belt cover assembly using two screws and washers. Secure four half-turn fasteners.

31. Install shroud using four screws and eight washers. Install four shroud stand offs.

32. Install shroud side covers by securing half-turn fasteners.

33. Perform Carriage and Carriage Mount Adjustment procedure.

34. Perform Spindle Lock Pawl Check procedure.

35. Perform Ground Spring Check and Adjustment procedure.

36. Perform Pack-on Switch Check procedure.

37. Perform Head/Arm Adjustment procedure (see Preventive Maintenance Index).

38. Perform Switch and Stop Check and Adjustment procedure.

39. Perform Index to Burst Check and Adjustment procedure.

40. Perform Shroud Adjustment procedure.

41. Perform Drive Belt Adjustment procedure.

SHROUD ADJUSTMENT

1. Make certain that four screws in bottom of shroud are loose enough to allow shroud to be positioned laterally.

2. Install disk pack.

3. Visually inspect clearance between entire circumference of disk pack sector disk and adjacent interior surface of shroud.

4. If clearance is uniform, remove disk pack from spindle. Tighten four screws in bottom of shroud. Make certain shroud does not shift from established position.

5. If clearance is not uniform, adjust as follows:

   a. Position shroud laterally to meet requirement of step 3.

   b. Remove disk pack from spindle.

   c. Tighten four screws in bottom of shroud making certain that shroud does not shift from original position.

SPINDLE LOCK PAWL

Check (Figure 6-9)

1. Extend applicable deck drawer to rear.

2. Remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.

3. A gap of between 0.000 and 0.020 inch must exist between tip of spindle lock pawl and bottom of notch in spindle lock wheel. Spindle lock linkage connecting rod must move pawl before traveling 1/64-inch maximum. Perform adjustment procedure if required.

Adjustment (Figure 6-9)

1. Loosen lock nut on spindle lock linkage connecting rod.

2. Turn connecting rod until gap of between 0.000 and 0.020 inch exists between tip of spindle lock pawl and bottom of notch in spindle lock wheel.

3. Tighten lock nut.

PACK-ON SWITCH

Check (Figure 6-9)

1. Extend applicable deck drawer to rear.
2. Remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
3. Disconnect pack-on switch electrical connections. Use multimeter (set to Rx1) to monitor pack-on switch status.
4. Install a disk pack. Multimeter must indicate zero ohms. The pretravel bracket must limit any further upward travel of the actuator to absolute minimum.
5. If multimeter does not indicate zero ohms, pretravel bracket may not be allowing switch to function.
6. Check that 0.035 ± 0.005 inch gap exists between switch actuator and spindle ground sleeve, see detail B, Figure 6-9.
7. Remove disk pack from spindle.
8. Multimeter must indicate infinity.
9. Perform adjustment procedure if required.
10. Restore electrical connections to switch.

Adjustment (Figure 6-9)

1. If pretravel bracket does not satisfactorily limit travel, loosen pretravel screws and adjust bracket downward.
2. If multimeter failed to indicate zero ohms when ground sleeve was raised, loosen pretravel screws and adjust bracket upward. If multimeter still fails to indicate zero ohms, replace pack-on switch.

3. If gap between actuator and ground sleeve is incorrect, loosen two screws on opposite side of switch from pretravel screws. Reposition switch on mounting bracket until requirement is met.

Removal and Replacement (Figure 6-9)

1. Disconnect electrical connections to switch.
2. Remove two screws and four washers securing switch assembly to mounting bracket.
3. Remove two screws and four washers securing pretravel bracket and switch to switch plate.
4. Install replacement switch in reverse order of removal.
5. Perform Pack-on Switch Check procedure.

GROUND SPRING CHECK AND ADJUSTMENT

1. Extend applicable deck drawer to rear.
2. Refer to Figure 6-9 and remove two screws and washers and release four half-turn fasteners securing drive belt cover assembly. Set cover aside.
3. Hook a push-pull gage (12210797) to extreme free end of ground spring.

NOTE

Multimeter provides most accurate indication of physical separation.

4. Force (applied perpendicular to spring) required to separate ground spring from ground sleeve should be between 3.53 and 5.30 ounces.
5. If requirement is not met, reform the spring or replace it.

DISK CLEANER ASSEMBLY

Check (Figure 6-10)

1. Extend applicable deck drawer to front.
2. Release four half-turn fasteners securing right-hand shroud side cover.
3. Using feeler gage, make certain that dimensions A and B (Figure 6-10) are a minimum of 0.010 inch as brushes reach limits of their travel.
4. Using multimeter, check that continuity (zero ohms on meter) exists between brush switch (S301) posts 2 and 3 with brushes retracted. Meter must indicate infinity between posts 1 and 3 with brushes in this position.
5. With brushes extended, continuity must exist between switch posts 1 and 3.
6. Perform adjustment procedure if required.

Adjustment (Figure 6-10)

Unless otherwise specified, brushes must follow linkage movement (brush detenting mechanism engaged). Units S/N 1012 and below detent by use of ball plungers located in the brush arm assembly (Figure 6-10, part B). Units S/N 1013 and above detent by use of a cam brush link and grooved brush linkage (Figure 6-10, part C).

1. Make certain brush assembly detent mechanism is engaged (brushes follow movement of linkage).

NOTE

Units with ball plunger detent mechanism, do not attempt to adjust ball plungers.

2. Loosen four setscrews securing linkage to motor shaft and brush arm shaft or two setscrews securing linkage to motor shaft and two setscrews securing cam brush link to brush arm shaft, as applicable.
3. Set brush holder against brush stop with detent mechanism engaged. Align linkage according to part A of Figure 6-10. Tighten four setscrews (adjust cam brush link according to part C of Figure 6-10. Tighten cam link setscrews).

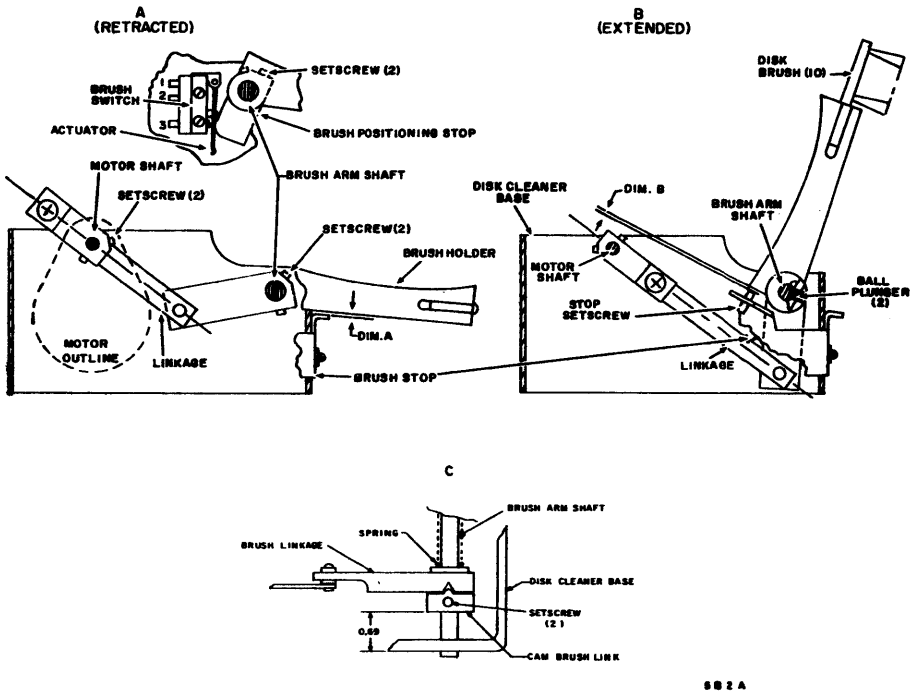


Figure 6-10. Disk Cleaner Adjustment

4. Loosen two screws securing brush stop. Place 0.020 inch thick shim or feeler gage between lower brush holder and brush stop (Dimension A, Figure 6-10). Remove slack in linkage by pressing brush stop toward brush holder and tighten two screws securing brush stop.

5. Align linkage according to part B of Figure 6-10. Using a shim or feeler gage, turn the stop setscrew to establish a 0.020 inch gap (Dimension B, Figure 6-10) between stop setscrew and brush holder.

6. Align linkage according to part A of Figure 6-10. Loosen two setscrews securing brush positioning stop. Rotate brush positioning stop against brush switch actuator until switch clicks. Rotate brush positioning stop an additional 2 or 3 degrees and tighten both setscrews.

Removal and Replacement (Figure 6-10)

No special instructions are required for removal and replacement except, when replacing motor or switch, use two drops of Grade C Loctite on the threads of each securing screw. Perform check procedure following any replacement.

DETENT ACTUATOR

Check (Figure 6-11)

Extend applicable deck drawer to rear and inspect entire detent actuator assembly for indications of hydraulic fluid leaks. Tightening hydraulic fluid fitting or four screws that secure head to block may stop leaks, in those areas. If not, replace actuator assembly. Replace actuator diaphragm to correct leaks around plunger.

Actuator Assembly Removal (Figure 6-11)

1. Disconnect pawl spring.
2. Remove retaining ring, spring, and washers (2) securing pawl.

NOTE

Use care to control hydraulic fluid spillage during following steps.

3. Disconnect hydraulic fluid fitting at actuator head.
4. Remove two screws and washers securing actuator assembly.
5. Raise assembly clear. If shims are present on base, keep them for use during replacement.

Actuator Assembly Replacement (Figure 6-11)

1. Check replacement assembly for a separation between bottom surfaces of head and block of between 0.001 and 0.010 inch (Dim. B, Figure 6-11). If dimension is incorrect, loosen four screws securing head to block, establish separation, and tighten screws.
2. Install replacement assembly by reversing removal steps 1 through 5. Prior to installing pawl, fill well at base of pawl pivot with Molykote, Type G and apply a light coat of Molykote to both pawl surfaces around pivot hole.

Actuator Assembly Adjustment (Figure 6-11)

1. Check dimension between top surfaces of pawl and detent gear (Dim. A, Figure 6-11).

2. Top surface of pawl should be from 0.001 inch above to 0.007 inch below top surface of detent gear.

3. Add or remove shims under detent actuator to gain proper dimension.

4. Tag and then disconnect leadwire from terminal 1 (forward solenoid) at rear of hydraulic actuator.

5. Install a disk pack on spindle.

6. Start spindle motor. Loosen detent actuator hydraulic fluid fitting very slowly until fluid begins to come out around threads. Tighten fitting.

7. Carriage is now stopped at hydraulic home position. Use feeler gage to make certain that pawl tip is located between 0.001 and 0.003 inch from tops of the detent gear teeth.

8. If requirement is not met, loosen two screws securing detent actuator assembly. Rotate assembly until dimension is achieved and tighten two screws. Recheck dimension.

9. Stop spindle motor. Connect leadwire at rear of hydraulic actuator.

10. Wipe up any spilled fluid and check for fluid leaks.

CAUTION

Utmost care must be used so as not to introduce any dust or dirt into sump.

11. Remove two screws securing sump cover to top of hydraulic actuator. Check that fluid level passes between solenoid terminal (rear of actuator) pins 2 and 1. If fluid is required use part no. 45583801. Replace sump cover.

Actuator Diaphragm Replacement (Figure 6-11)

1. Disconnect pawl spring.

NOTE

Use care to control hydraulic fluid spillage during following steps.

2. Disconnect hydraulic fluid fitting at actuator head.

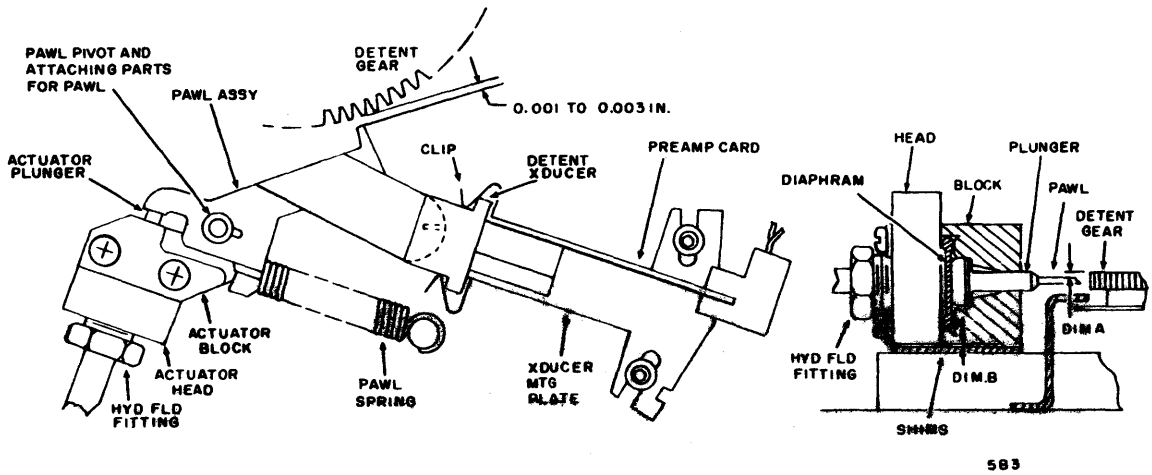


Figure 6-11. Detent Mechanism

3. Remove four screws and eight washers securing actuator head to actuator block. (Do not loosen screws in actuator block). Set head aside.
4. Remove faulty diaphragm from block and discard.
5. Slide plunger from block. Apply a light coat of Molykote, Type G to plunger shaft and install in block.
6. Apply a light coat of Molykote, Type G to replacement diaphragm. Install diaphragm in recess of block so that higher bead faces outward and away from head of plunger (Figure 6-11). Make certain that diaphragm fits smoothly into block and is completely inserted into recess.
7. Carefully place actuator head in position and secure evenly with four screws and washers (units with socket head screws, torque each screw to 9.5 $\pm$ 0.7 inch pounds).
8. Connect hydraulic fluid fitting to head.
9. Start spindle motor (LOCAL/REMOTE switch to LOCAL, bypass sector switch, Figure 2-2, and bypass pack-on switch with jumper if disk pack is not installed). Loosen hydraulic fluid fitting very slowly until fluid begins to come out around threads. Tighten fitting when all air is purged from actuator and pipe.
10. Wipe up any spilled fluid and check for fluid leaks.

CAUTION

Utmost care must be used so as not to introduce any dust or dirt into sump.

11. Remove two screws securing sump cover to top of hydraulic actuator. Check that fluid level passes between solenoid terminal (rear of actuator) pins 2 and 1. If fluid is required use part no. 45583801. Replace sump cover.

MANUALLY POSITIONING CARRIAGE

Special care must be used whenever carriage is manually positioned.

CAUTION

Never load read/write heads manually unless specifically instructed by procedure (instruction will include use of pads. Never allow heads to load unless disk pack is installed and up to speed.

1. Extend applicable deck drawer to rear. Manually disengage detent pawl from detent gear and move the carriage to approximately track 10.
2. Insert tip of small screwdriver through opening in lower roller assembly (Figure 6-12) and move head load cam latch to left. This will unlatch the head load cam and cause the right end of the cam to move upward and away from the actuators of the head load switches.

CAUTION

Inserting any instrument between detent actuator plunger and detent pawl may rupture the actuator diaphragm.

3. Carriage may now be positioned manually to any track within its range (when detent pawl is disengaged from detent gear) without danger of loading heads.
4. Head load cam will relatch automatically when carriage is returned to retracted position and heads will load on next access stroke.

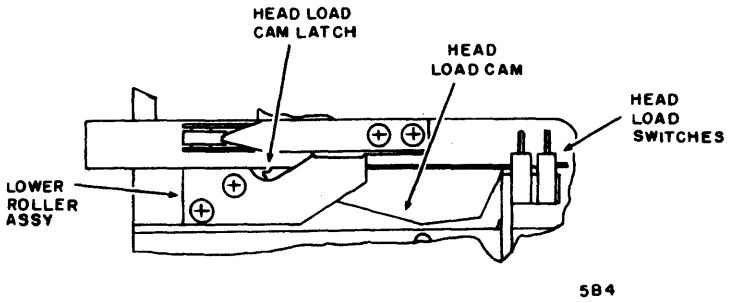


Figure 6-12. Automatic Head Loading Override

HYDRAULIC FLUID REMOVAL AND REPLACEMENT

1. Remove disk pack from spindle.
2. Refer to Manually Positioning Carriage paragraph and move carriage to track 202 without loading heads.

CAUTION

Utmost care must be used so as not to introduce any dust or dirt into sump.

3. Remove two screws securing sump cover to top of hydraulic actuator. Set cover aside.

CAUTION

Shield inside hydraulic actuator deflects fluid streams that occur when power is applied to spindle motor. This shield should remain in place.

4. Withdraw hydraulic fluid from hydraulic actuator with syringe.

CAUTION

Any hydraulic fluid added to actuator should be new.

5. Add new hydraulic fluid (p/n 45583801) to actuator until fluid level passes between solenoid terminal (rear of actuator) pins 2 and 1.

6. Set sump cover in place and start spindle motor.

CAUTION

Do not over tighten hydraulic fittings. If fluid leakage persists, refer to Repair of Hydraulic Fluid Leakage procedure.

7. Loosen hydraulic fluid fitting on detent actuator (Figure 6-11) very slowly until fluid begins to come out around threads. Tighten fitting when all air is purged from actuator and pipe.

8. Wipe up any spilled fluid and check for leaks.

9. Check that fluid level is still correct (step 5). Secure sump cover.

HYDRAULIC PUMP OR PUMP DRIVE REMOVAL AND REPLACEMENT (Figure 6-13)

1. Refer to Hydraulic Fluid paragraph and remove fluid from unit.

CAUTION

Use extreme care during following steps so as not to introduce any dust or dirt into pump or disconnected fittings.

2. Disconnect pipe at pump by removing pipe nut from bushing.

3. Go to step 4 to replace pump or step 5 to replace pump drive.

4. Replace pump as follows:
   a. Disconnect hose at pump by removing nut/collar.
   b. Remove two screws, two nuts, and four washers securing pump. Tag leadwires to pressure switch and disconnect them.
   c. Raise pump clear of pump drive.
   d. Remove pressure switch and two bushings from faulty pump and install on replacement unit.
   e. Place coupling on pump drive shaft. Position pump on top of pump drive so that pump shaft is received by coupling.
   f. Carefully remove collar and nut from end of hose. Slide new nut and collar (supplied with new pump) on end of hose according to original installation. Connect hose to pump.
   g. Connect leadwires to pressure switch.
   h. Go to step 6.

5. Replace pump drive as follows:

   a. Remove two screws, two nuts, and four washers securing pump.

   b. Raise pump clear of pump drive and set it on main deck.

   c. On underside of main deck remove nut and washers securing pulley to pump drive shaft. Remove pulley.

   d. Raise pump drive from main deck. Remove coupling and key from opposite ends of pump drive shaft.

   e. Lower replacement drive through main deck. Install key and pulley with two washers and nut.

   f. Place drive belt on pulley and check belt threading according to Figure 6-9.

   g. Place coupling on pump drive shaft. Position pump on top of pump drive so that pump shaft is received by coupling.

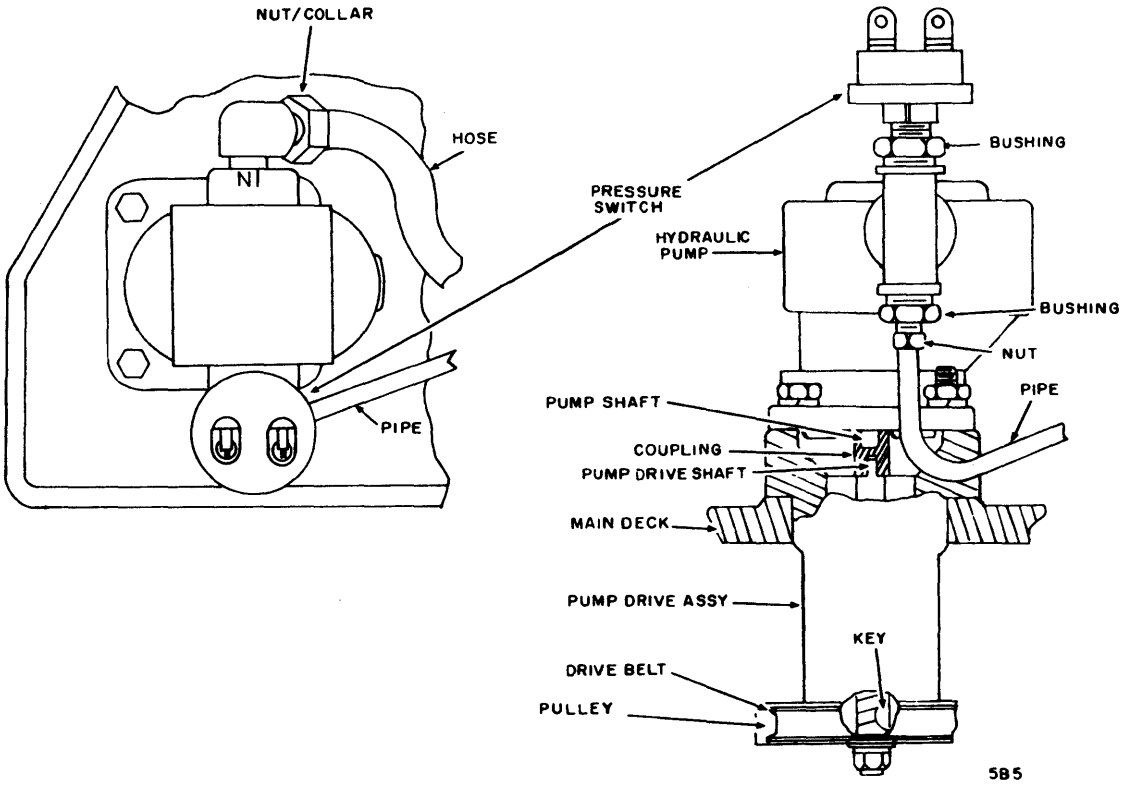


Figure 6-13. Hydraulic Pump and Pump Drive.

6. Secure pump with two screws, two nuts, and four washers. Tighten nuts and screws evenly.

CAUTION

Do not over tighten hydraulic fittings. If fluid leakage persists, refer to Repair of Hydraulic Fluid Leakage procedure.

7. Connect pipe to pump. If difficulty is encountered when starting threads, loosen pipe at hydraulic actuator, start threads, and tighten both ends.

8. Refer to Hydraulic Fluid paragraph and replace fluid.

HYDRAULIC ACTUATOR ASSEMBLY

Leak Check (Figure 6-14)

1. Extend applicable deck drawer to rear.

2. Inspect entire hydraulic actuator for presence of hydraulic fluid. Pay particular attention to rear cylinder cap, screws in valve block, drive piston seal, and fluid supply lines.

3. Most leaks detected at actuator can be remedied by performing Repair of Hydraulic Fluid Leakage procedure or performing a procedure in O-ring and Seal Replacement paragraph. However, if leakage is caused by damage to hydraulic actuator, replace actuator (below).

Removal and Replacement (Figure 6-14)

1. Refer to Hydraulic Fluid paragraph and remove fluid from unit.

CAUTION

Use extreme care during following steps so as not to introduce dust or dirt into disconnected fittings or replacement actuator.

2. Disconnect three hydraulic fittings at hydraulic actuator.

3. Tag each leadwire connected to solenoid terminal pins. Disconnect leadwires.

4. Unlatch head load cam (Manually Positioning Carriage paragraph) and move carriage until access is gained to actuator clamp (links drive rod ball tip to carriage). Remove three screws and six washers from actuator clamp.

5. Remove screw and two washers securing hydraulic actuator to carriage mount.

6. Remove three screws and washers securing hydraulic actuator to main deck. Raise actuator clear of deck.

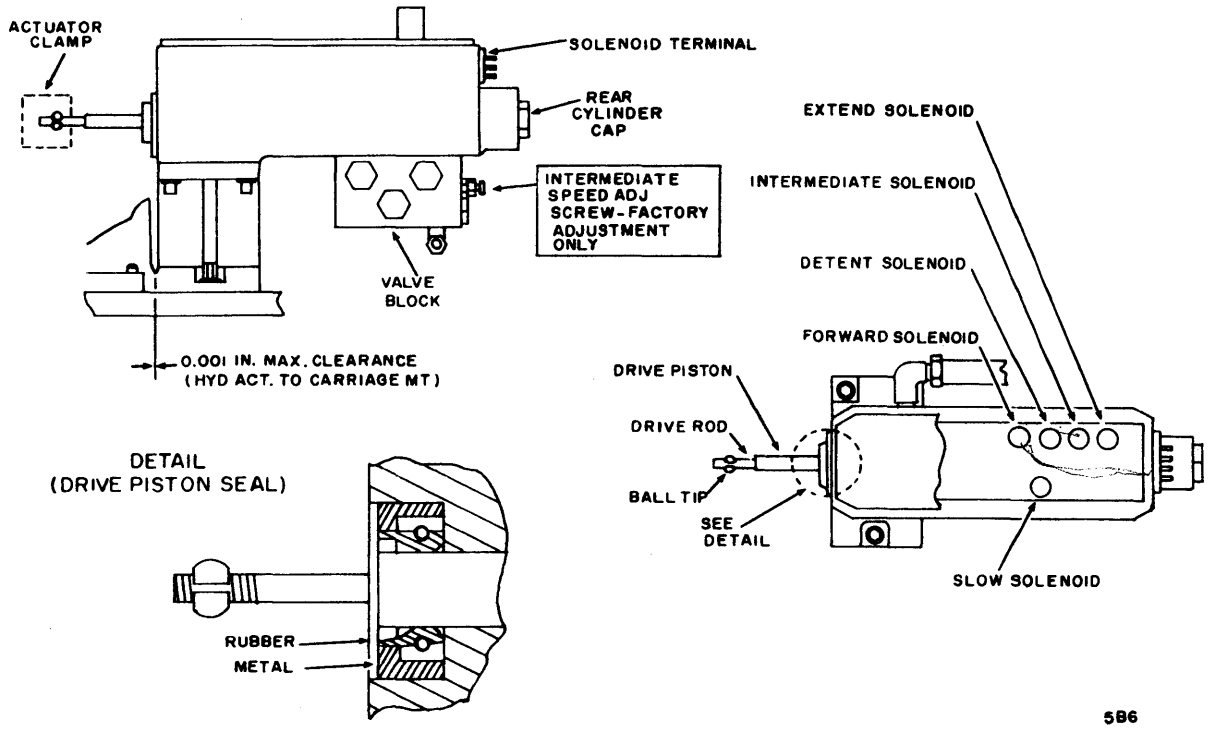


Figure 6-14. Hydraulic Actuator

7. Install replacement unit by reversing steps 1 through 6. Adjacent edges of hydraulic actuator and carriage mount must be flush to within 0.001 inch maximum (Figure 6-14).

8. Perform Hydraulic Home Check and Adjustment procedure.

9. Perform Head/Arm Adjustment procedure (see Preventive Maintenance Index).

O-RING AND SEAL REPLACEMENT

CAUTION

Use extreme care during any following procedures so as not to introduce dust or dirt into actuator or valve block.

Rear Cylinder Cap O-Ring (Figure 6-14)

1. Place cloth below rear cylinder cap (to catch small amount of hydraulic fluid during next step).
2. Remove rear cylinder cap.
3. Remove faulty O-ring from cap.
4. Lubricate replacement O-ring (p/n 92074123) and cap with hydraulic fluid.
5. Carefully install O-ring on cap. O-ring must not be twisted or damaged when in place in cap groove.
6. Apply light coat of hydraulic fluid to O-ring and install cap in actuator.
7. Check hydraulic fluid level (see Hydraulic Fluid paragraph).

Valve Block O-Rings (Figure 6-14)

Replace any leaking valve block O-ring as follows:

1. Refer to Hydraulic Fluid paragraph and remove fluid from actuator.
2. Carefully remove plug and defective O-ring.
3. Lubricate replacement O-ring (p/n 92074119) with hydraulic fluid.

CAUTION

Use care not to lose any shims (plug or spring shims) that may be present.

4. Carefully mount O-ring so that it is not twisted or damaged.
5. Lubricate O-ring with hydraulic fluid and carefully install in valve block.
6. Install new hydraulic fluid (see Hydraulic Fluid paragraph).

Drive Piston Seal (Figure 6-14)

1. Refer to Hydraulic Fluid paragraph and remove fluid from actuator.
2. Unlatch head load cam (Manually Positioning Carriage paragraph) and move carriage until access is gained to actuator clamp (links drive rod ball tip to carriage). Remove three screws and six washers from actuator clamp.
3. Push drive piston to retracted position (leave carriage where it is).

CAUTION

Do not scratch seal cavity or drive piston with screwdriver.

4. Use small screwdriver to remove drive piston seal (force screwdriver tip through rubber to behind metal and carefully pry seal out).
5. Lubricate inner and outer dimeters of replacement seal (p/n 94302801) with hydraulic fluid.
6. Place seal over drive piston so that lip faces actuator. Place seal inserting tool (70808200) over piston so that one end engages metal face of seal. Carefully tap seal inserting tool with plastic mallet until seal is positioned at rear of actuator cavity.
7. Extend drive piston toward carriage and install actuator clamp.
8. Install new hydraulic fluid (see Hydraulic Fluid paragraph).
9. Perform Hydraulic Home Check and Adjustment procedure.

Extend Piston Seal

1. Refer to Hydraulic Fluid paragraph and remove fluid from actuator.
2. Remove rear cylinder cap.
3. Remove extend piston by hooking its exposed small diameter and pulling it clear of actuator.
4. Remove faulty seal from piston.
5. Lubricate replacement seal (p/n 94249335) with hydraulic fluid and install on piston.
6. Carefully insert piston in actuator and position it forward of hole at end of housing threads.
7. Replace O-ring on rear cylinder cap (see related paragraph).
8. Install cap on actuator.
9. Install new hydraulic fluid (see Hydraulic Fluid paragraph).
10. Perform Hydraulic Home Check and Adjustment procedure.

SOLENOID REMOVAL AND REPLACEMENT

CAUTION

Use extreme care during the following procedure so as not to introduce dust or dirt into actuator. If more than one solenoid is to be replaced, use care not to get the solenoid plungers and shims (if present) in incorrect holes.

1. Disconnect taper pins of faulty solenoid at inner pins of solenoid terminal (Figure 6-14).
2. Using a close fitting screwdriver (prevents burring of slot), remove defective solenoid and shims (if present) from actuator.
3. Install solenoid plunger and plunger shim (if present) in replacement solenoid (p/n 94249318).

CAUTION

Excess screwdriver torque may cause internal damage to solenoid.

4. Use screwdriver to thread solenoid into proper casting hole. Stop turning screwdriver when solenoid is seated securely.
5. Connect taper pins of replacement solenoid at solenoid terminal.

HEAD LOADING MECHANICS

Linkage Check and Adjustment (Figure 6-15)

CAUTION

This procedure requires that heads be loaded. To prevent damage to heads, pads must be used.

1. Remove disk pack from spindle.
2. Carefully place pads of 6 to 8 thicknesses of clean, dry, lint-free gauze between surfaces of read/write heads that approach each other as heads are loaded.
3. Extend applicable deck drawer to rear. Disconnect chassis harness plug P306 from J306 (to head latch magnet).

CAUTION

In next step, do not jumper +40 volts from logic chassis maintenance panel jack of an on-line unit. Voltage at jack is used by read/write circuit and errors may be caused.

4. Use jumper wires to apply +40 volts to J306 pins 2(+40V) and 3 (ground).

5. Manually disengage detent pawl from detent gear and position carriage to track 193 (heads will load, pads will provide required protection).

6. Head load pawl tip must fully engage latch slot in head load latch. Head load pawl must be pulled securely against both pole faces of head latch magnet. Adjust as follows:

   a. Loosen three screws securing head latch magnet.

   b. Reposition magnet until requirements are met and tighten screws.

   c. Recheck requirements.

   d. Disengage detent pawl and retract carriage.

7. Disengage detent pawl and slowly move carriage forward while observing vertical position of rod assembly. Stop moving carriage when rod reaches highest point.

8. Referring to Figure 6-15, measure gap between tip of head load pawl and adjacent edge of latch slot. If required adjust as follows:

   a. Disengage detent pawl and retract carriage. Remove push rod retaining ring and push rod.

   b. Loosen rod assembly locknut. Twist larger nut to change effective length of assembly. Tighten locknut.

   c. Install push rod (without retaining ring) and repeat step 7.

   d. When requirement is met replace retaining ring.

9. Disengage detent pawl.

10. Retract carriage while observing knock off pin.

11. Upper roller must contact knock off pin (can be felt and observed) causing heads to unlatch when carriage is positioned at some point between tracks -07 and -12.

    Adjust as follows:

    a. If roller assembly contacts pin too early or too late, loosen two screws securing upper roller assembly. Reposition roller assembly as required and tighten screws.

b. If roller assembly passes over pin without contacting or just brushes pin, reform head load pawl so that pin is held higher. If pawl is reformed, this procedure must be repeated from step 4.

c. If roller assembly contacts pin securely, but does not unlatch heads, check for burrs on head load pawl tip or in latch slot. Use a stone to carefully remove burrs. Check for binding at linkage bearing points. Lubricate with a small amount of Molykote, Type G as required.

12. Check that gauze pads are still in place on read/write heads.

13. Disengage detent pawl.

14. Move carriage forward to load and latch heads.

15. Disconnect jumper wires (+40v) connected to head latch magnet. Heads must unlatch and unload. Remedy fault as follows:

a. Check for burrs on head load pawl tip or in latch slot. Use a stone to carefully remove burrs.

b. Check for binding at linkage bearing points. Lubricate with a small amount of Molykote, Type G as required.

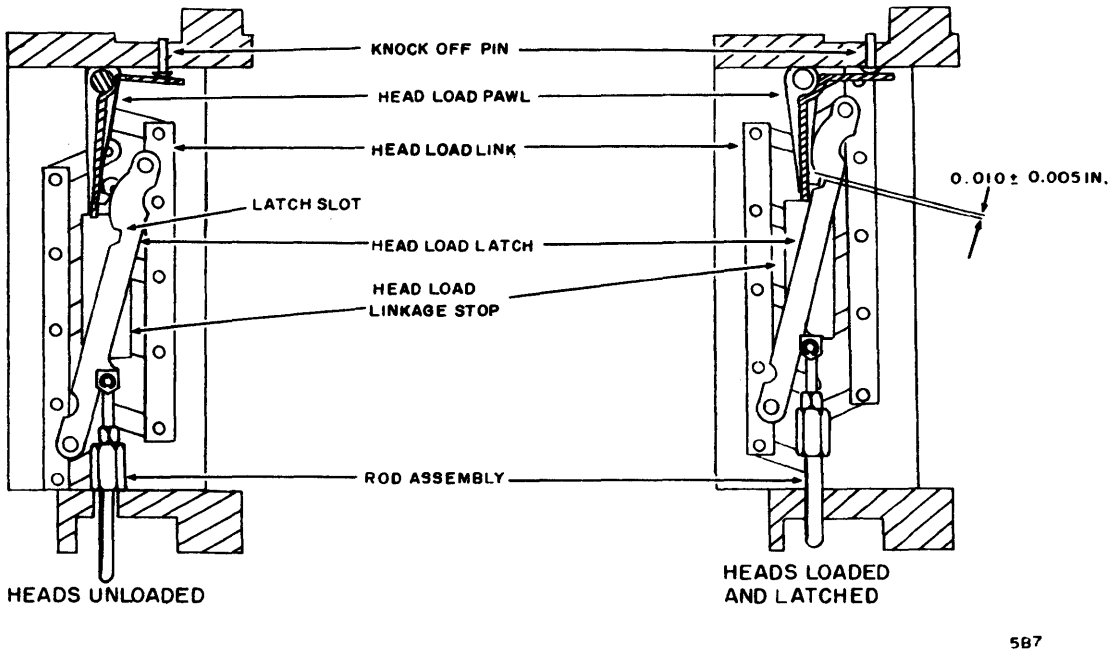


Figure 6-15. Head Load Linkage

Head Latch Switch Check and Adjustment (Figure 6-16)

CAUTION

This procedure requires that heads be loaded. To prevent damage to heads, pads must be used.

1. Remove disk pack from spindle.
2. Carefully place pads of 6 to 8 thicknesses of clean, dry, lint-free gauze between surfaces of read/write heads that approach each other as heads are loaded.
3. Extend applicable deck drawer to rear. Disconnect chassis harness plug P306 and J306 (to head latch magnet).

CAUTION

In next step, do not jumper +40 volts from logic chassis maintenance panel jack of an on-line unit. Voltage at jack is used by read/write circuit and errors may be caused.

4. Use jumper wires to apply +40 volts to J306 pins 2(+40v) and 3 (ground).
5. Manually disengage detent pawl from detent gear and position carriage forward until heads load (pads will provide required protection). Return carriage to track -05.
6. Refer to Figure 6-16 and disconnect leadwires to head latch switch.
7. Connect multimeter to head latch switch terminals. Multimeter should indicate continuity.
8. Insert a 0.010 inch feeler gage between switch actuator and head load pawl (keep feeler gage flat against pawl). Multimeter should indicate continuity.
9. Insert an additional 0.020 inch feeler gage (total of 0.030 inch) between switch actuator and head load pawl. Multimeter should now indicate an open circuit.
10. Remove only the 0.020 inch feeler gage. Multimeter should now indicate continuity.
11. If any of requirements in steps 7, 8, 9, or 10 are not met, loosen two screws (opposite side of nut plate) securing switch, reposition switch, and repeat check steps.

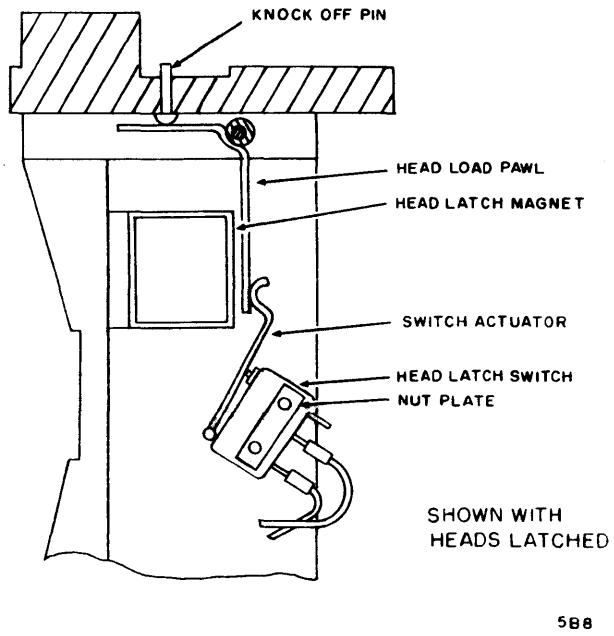


Figure 6-16. Head Latch Switch (S304) Adjustment (Shown without TB204)

Heads Loaded Switches

1. Remove power to spindle.
2. Make certain that head load cam is latched (Figure 6-12).

CAUTION

Do not load read/write heads.

3. Manually disengage detent pawl and position carriage to track -01.

NOTE

Transfer point is indicated by an audible click by switch.

4. Lift switch actuator from switch spring until switch transfers. Dimension between actuator and spring (Figure 6-17) must not exceed 1/16-inch.
5. Raise actuator to highest point and then lower it. Switch must transfer when actuator and spring are separated by not more than 1/16-inch.

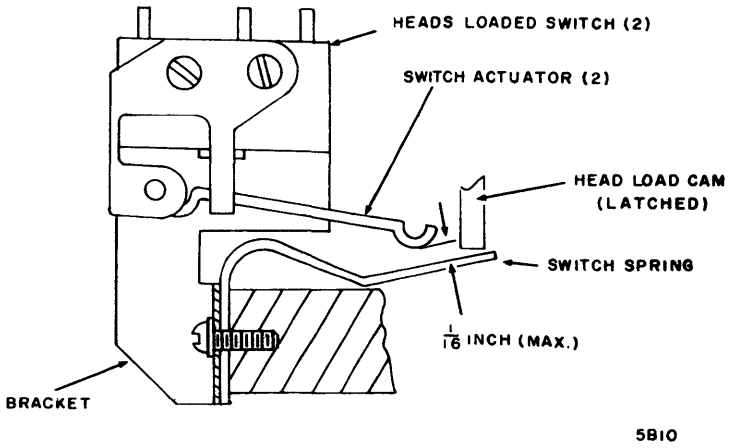


Figure 6-17. Heads Loaded Switch (S300A/S300B) Adjustment (Shown without TB302/TB303)

6. If either requirement is not met, adjust using clearance in switch mounting holes and/or bracket mounting holes, or reform switch actuator.

7. Repeat steps 4 through 6 for adjacent switch.

CARRIAGE AND CARRIAGE MOUNT

Removal and Replacement

Damage to carriage rack gear or detent gear requires replacement of carriage and carriage mount assembly.

1. Remove disk pack from spindle.

CAUTION

Do not touch face of read/write heads. Skin acids may etch and damage head.

2. Disconnect read/write head cable plugs. Loosen head/arm clamps and remove each head/arm assembly.

3. Disconnect all electrical connections to carriage and carriage mount.

4. Unlatch head load cam (Manually Positioning Carriage paragraph) and move carriage until access is gained to actuator clamp (links hydraulic actuator drive rod ball tip to carriage).

5. Remove three screws and six washers from actuator clamp. Move drive rod to retracted position.

6. Remove screws securing cylinder and detent transducer assemblies. Move assemblies clear of carriage mount.

7. Remove two screws securing detent actuator. Move it clear of carriage mount by gently bending the tubing attached to it.

8. Remove screw securing hydraulic actuator to carriage mount. Remove three screws and washers securing hydraulic actuator to main deck. Move actuator clear.

9. Remove four screws securing carriage and carriage mount to main deck (fourth screw is under detent mechanism).

10. Raise assembly vertically (until free of dowel pin in main deck) and move it clear of deck area.

11. Position replacement carriage and carriage mount on main deck dowel pin.

12. Perform Carriage and Carriage Mount Adjustment procedure.

13. Perform Head/Arm Replacement procedure.

14. Install hydraulic actuator with three screws and washers. Adjacent edges of actuator and carriage mount must be flush to within 0.001 inch maximum clearance (Figure 6-14).

15. Secure hydraulic actuator to carriage mount with one screw.

16. Install actuator clamp with 3 screws and six washers.

17. Reposition (approximately) and loosely secure detent actuator.

18. Perform Carriage and Carriage Mount Adjustment procedure.

19. Use a feeler gage to check gap between top surface of detent flag and bottom surface of transducer receiving slot (Figure 6-18). Add or remove shims between transducer to meet requirement. Secure transducer to deck and recheck gap.

20. Repeat step 19 for cylinder transducer and track position disk.

21. Perform Detent Actuator Adjustment procedure.

22. Perform Detent Transducer Check and Adjustment procedure.

23. Perform Hydraulic Home Check and Adjustment procedure.

24. Perform Cylinder Transducer Check and Adjustment procedure.

25. Perform Head/Arm Adjustment procedure (see Preventive Maintenance Index).

Adjustment

A carriage and carriage mount assembly is properly aligned when carriage motion is along a radial line to the spindle center. Following adjustment is required whenever carriage and carriage mount assembly is loosened from main deck or replaced.

1. Remove head/arm assembly 06 or 09 (Figure 6-19).

NOTE

Carriage Alignment tool (84251900) consists of a replacement arm tool and a replacement ring tool.

2. Install replacement arm tool in place of head removed in step 1 and tighten in place.

3. Install replacement ring tool on spindle.

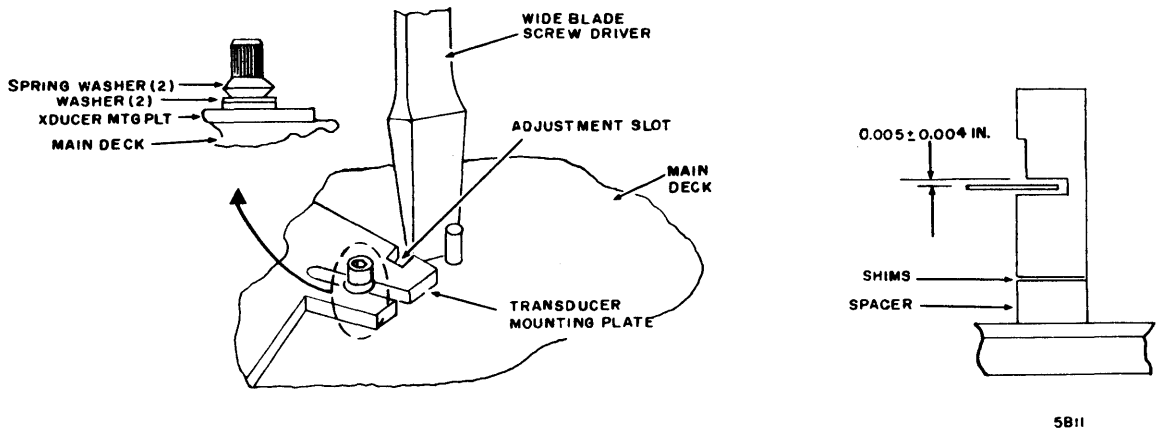


Figure 6-18. Transducer Adjustment

4. Unlatch head load cam (Manually Positioning Carriage paragraph) to disable head load mechanism. Disengage detent pawl and move carriage forward until replacement arm and ring tools are aligned approximately as shown in Figure 6-19.

NOTE

Threads of screws securing carriage mount to main deck contain thin coat of Loctite, Grade C and Loctite primer, Grade N. This coating should adequately lock threads for five installation and removal cycles. Reapply above compounds every fifth cycle according to manufacturer's instructions on container label.

5. Pivot carriage mount on main deck until required dimension (0.000 to 0.004 inch) is achieved. Carefully and evenly tighten four screws securing mount to deck.

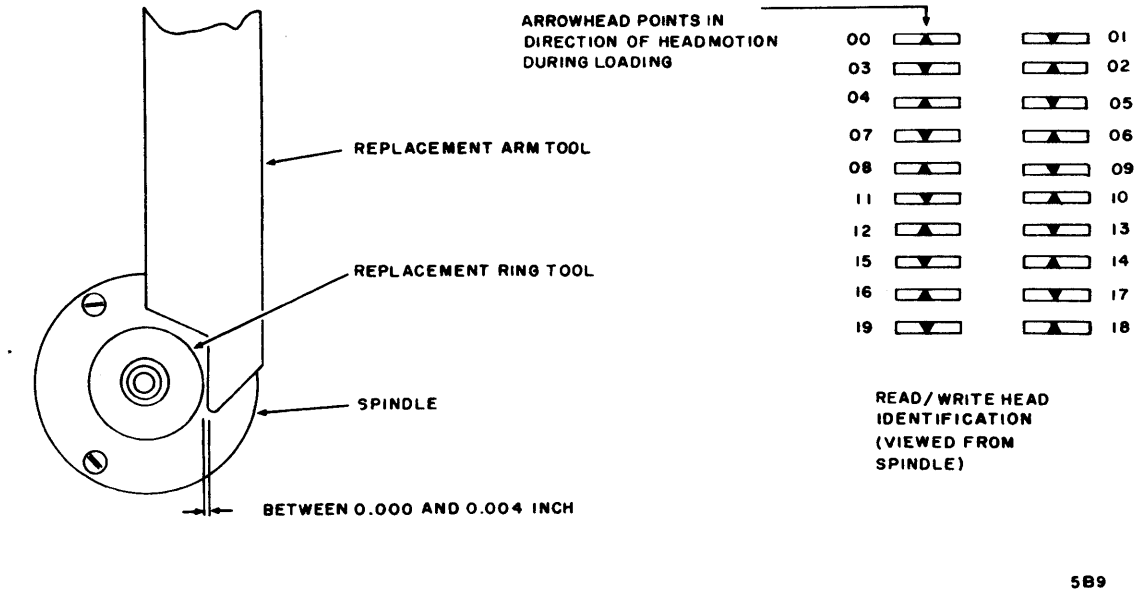


Figure 6-19. Carriage/Carriage Mount Alignment

HYDRAULIC HOME CHECK AND ADJUSTMENT

1. Stop spindle motor and remove disk pack.
2. Unlatch head load cam (Manually Positioning Carriage paragraph).

CAUTION

If misalignment is discovered in next step do not attempt to remedy by rotating dial. Misalignment beyond field remedy may result.

3. Manually disengage detent pawl and position carriage to track 00 and then track 73. Track number indicator and adjacent index mark should be aligned as close as possible at track 00 and within ±0.5 of a division (track) at track 73. If adjustment is required, loosen screw in index plate and reposition as required.
4. Return carriage to fully retracted position. Disconnect leadwire from terminal 1 (forward solenoid) at rear of hydraulic actuator.
5. Install a disk pack and start spindle motor (LOCAL/REMOTE switch to LOCAL, bypass sector switch, Figure 2-2).
6. Use feeler gage to check that pawl tip is located between 0.001 and 0.003 inch from tops of detent gear teeth (Figure 6-11). If requirement is not met, adjust as follows:
   a. Loosen two screws securing detent actuator assembly.
   b. Rotate assembly until dimension is correct. Hydraulic fluid tubing will require some slight bending to attain new position.
   c. Tighten two screws and recheck dimension.
7. Visually check that track number indicator reading is between track -01 and -01.5. If this requirement is met, check is complete. If requirement is not met, adjust as follows:
   a. Stop spindle motor. Unlatch head load cam.
   b. Position carriage to track 200.
   c. Loosen three screws in actuator clamp (Figure 6-14) only enough so that carriage drive piston and rod can be rotated, but not enough to allow axial motion on ball tip.

d. Return carriage to fully retracted position.

e. Start spindle motor.

NOTE

One-third of a revolution of drive rod changes track number indicator reading (and hydraulic home position) one full track. Rotating the drive rod CCW (as view from spindle) decreases a positive track number indicator reading and makes a negative reading more negative.

f. When carriage motion (to hydraulic home) stops, rotate drive rod until track number indicator reading is between -01 and -01.5.

g. Unlatch head load cam. Move carriage to track 200. Tighten three screws in actuator clamp.

DETENT TRANSDUCER

Check and Adjustment

NOTE

Transducer output is temperature sensitive. Unit must be operated with heads loaded and spindle rotating for a period of one hour immediately preceding performance of this procedure.

1. Stop spindle motor.
2. Connect oscilloscope probe to test point J (detent transducer preamplifier) of card at logic chassis location A11 (upper deck) or B11 (lower deck). Ground oscilloscope at test point A or Z of same card to which probe is connected.
3. Extend applicable deck drawer to rear. Manually disengage detent pawl and position carriage to track 00.
4. With detent engaged, oscilloscope must display a signal amplitude that is -1.5 ± 0.2 volts. If adjustment is required proceed as follows:

NOTE

Spring washers, used to mount transducer, allow movement of assembly without loosening screws.

a. Refer to Figure 6-18 and place screwdriver in adjustment slot and against dowel in main deck.

b. Pivot screwdriver on dowel pin and move detent transducer mounting plate as far as possible toward cylinder transducer.

c. Carefully move detent transducer mounting plate away from cylinder transducer until signal amplitude decreases to -1.5 volts.

5. Disconnect leadwire from terminal 1 (forward solenoid) at rear of hydraulic actuator.

6. Start spindle motor. Carriage will move to hydraulic home when jack reaches speed.

7. Oscilloscope should indicate a minimum amplitude of +1.5 volts. If this requirement is not met, correct the situation according to one of the following steps.

   a. Use feeler gage to check that pawl tip is located between 0.001 and 0.003 inch from tops of detent gear teeth (Figure 6-11). If adjustment is required, loosen two screws securing detent actuator assembly. Rotate assembly until dimension is correct. Tighten screws and recheck dimension.

   b. Perform Oscillator Check procedure. Replace oscillator if required.

   c. Check power supply ±20 volt outputs (Check Power Supply Outputs procedure, see Preventive Maintenance). Adjust outputs as required.

   d. Replace transducer preamplifier card.

   e. Replace transducer.

8. Stop spindle motor. Connect forward solenoid leadwire at rear of hydraulic actuator.

Transducer or Preamplifier Card Removal and Replacement (Figures 6-11 and 6-18)

1. To replace detent transducer proceed to step 2. Go to step 3 to replace detent preamplifier card.
2. Replace detent transducer as follows:
   a. Remove two screws, four spring washers, and four flat washers securing transducer mounting plate.
   b. Unclip preamplifier card from transducer.
   c. Release two screws securing transducer to mounting plate. Save spacer and shims.
   d. Assemble replacement transducer, spacer, and shims to mounting plate with two screws.
   e. Use feeler gage to check gap between top surface of detent flag and bottom surface of transducer receiving slot (Figure 6-18). Add or remove shims between transducer and spacer to meet requirement.
   f. Go to step 4.
3. Replace detent preamplifier card as follows:
   a. Disconnect plug at rear edge of preamplifier card.
   b. Unclip preamplifier card from transducer.
   c. Position replacement card at rear of transducer and clip in place.
   d. Connect plug to rear of card.
4. Perform Detent Transducer Check and Adjustment procedure.

CYLINDER TRANSDUCER

Check and Adjustment

NOTE

Transducer output is temperature sensitive. Unit must be operated with heads loaded and spindle rotating for a period of one hour immediately preceding performance of this procedure.

1. Stop spindle motor.
2. Connect oscilloscope probe to test point F (cylinder transducer preamplifier) of card at logic chassis location A11 (upper deck) or B11 (lower deck). Ground oscilloscope at test point A or Z of same card to which probe is connected.
3. Connect oscilloscope external trigger to test point B (I510, Any Seek) of card at location A08 (upper deck) or B08 (lower deck).
4. Start spindle motor.

NOTE

Following procedure requires MDD to perform seek operations. Commands controlling seek operations may be derived via a Tester Card (40072100) installed in logic chassis (position A03 for upper spindle or position B03 for lower spindle) or suitable software and the computer.

5. Make oscilloscope settings according to Figure 6-20.
6. Command MDD to perform 1-track forward sequential seek to track 202. Seek timing should allow adequate time to observe oscilloscope between each move.
7. Signal during each one track seek must meet requirement of Figure 6-20, Part A. Part B shows transducer/tachometer traces during 1-track reverse seek. These traces will occur when Part A is achieved. If requirement is not met, return to track with smallest peak-to-peak voltage.
   a. Refer to Figure 6-18 and place screwdriver in adjustment slot and against dowel pin in main deck.
   b. Pivot screwdriver on dowel pin and move cylinder transducer mounting plate as far as possible away from detent transducer.
   c. Carefully move cylinder transducer mounting plate toward the detent transducer while observing oscilloscope. (Signal will go to minimum and begin to increase.) Stop moving mounting plate when signal reaches maximum. Note amplitude of this signal.
   d. Reverse motion of step c and move cylinder transducer carefully away from detent transducer. Stop moving mounting plate when signal amplitude is 80 ± 10 percent of that of that noted in step c and +3.0 volts minimum.

e. If requirement of step d can be achieved, go to step 8. If not, correct correct situation according to one of the following steps.

f. Perform Oscillator Check Procedure. Replace oscillator if required.

g. Check power supply ±20 volt outputs. Adjust outputs as required.

h. Replace transducer preamplifier card.

i. Replace transducer.

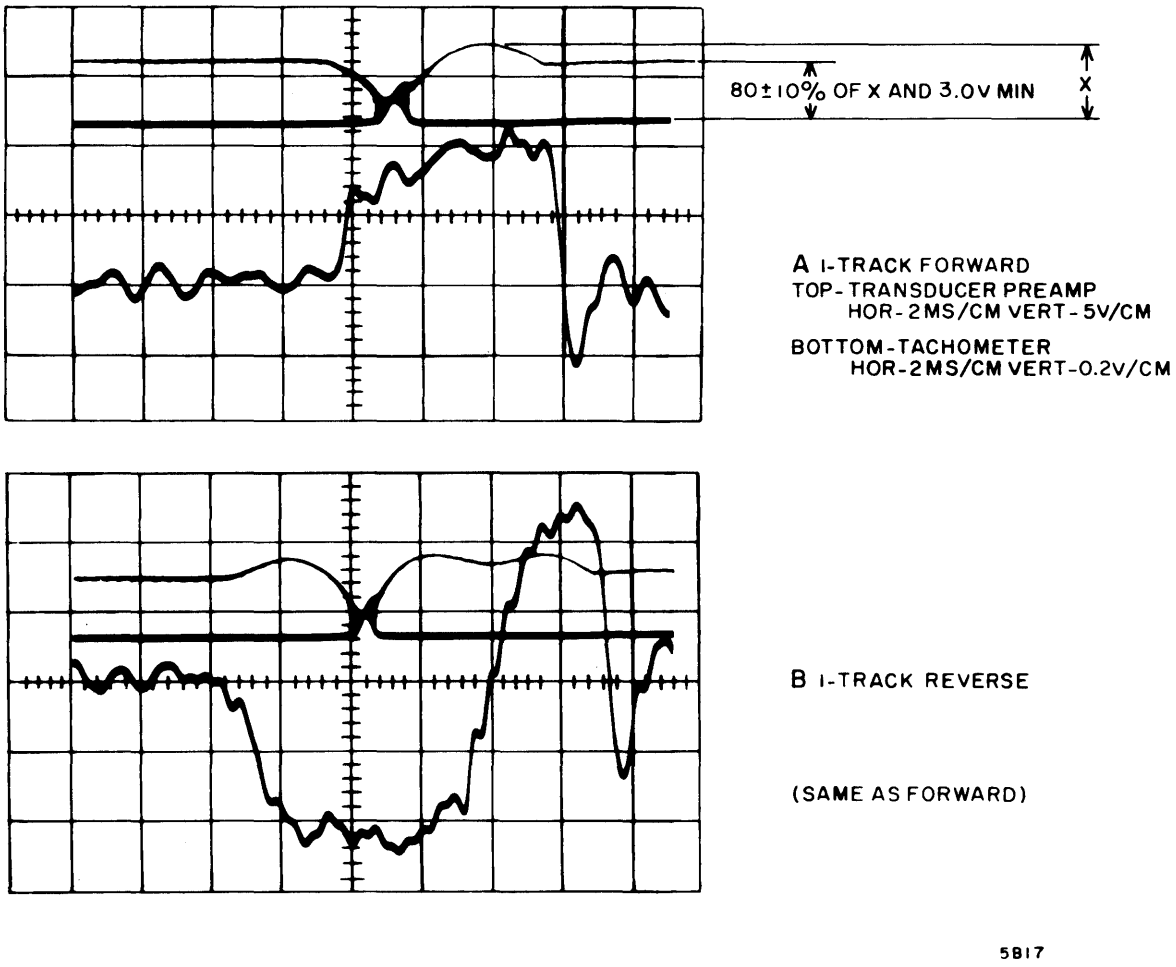


Figure 6-20. Cylinder Transducer Trace

8. Return carriage to track 00. Observe trace amplitude and manually apply a moderate, forward force to rear of carriage. Amplitude should decrease slightly. If signal amplitude increases, return to track with smallest peak-to-peak voltage and perform steps 7a through 7d.

Transducer or Preamplifier Card Removal and Replacement (Figure 6-18)

1. Release four half-turn fasteners securing shroud side covers. Set covers aside.
2. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear and set aside.
3. To replace cylinder transducer proceed to step 4. Go to step 5 to replace cylinder preamplifier card.
4. Replace cylinder transducer as follows:
   a. Remove two screws, four spring washers, and four flat washers securing transducer mounting plate.
   b. Unclip preamplifier card from transducer.
   c. Release two screws securing transducer to mounting plate. Save spacer and shims.
   d. Assemble replacement transducer, spacer, and shims to mounting plate with two screws.
   e. Use feeler gage to check gap between top surface of track position disk and bottom surface of transducer receiving slot (Figure 6-18). Add or remove shims between transducer and spacer to meet requirement.
   f. Go to step 6.
5. Replace cylinder preamplifier card as follows:
   a. Disconnect plug at rear edge of preamplifier card.
   b. Unclip preamplifier card from transducer.
   c. Position replacement card at rear of transducer and clip in place.
   d. Connect plug to rear of card.
   e. Go to step 7.

6. Perform Cylinder Transducer Check and Adjustment procedure.

7. Install shroud and side covers.

8. Perform Shroud Adjustment procedure.

SECTOR SENSOR ASSEMBLY

Switch and Stop Check and Adjustment

1. Stop spindle motor. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
2. Extend deck drawer to rear.
3. Remove disk pack from spindle.
4. Release four half-turn fasteners securing each shroud side cover. Set covers aside.
5. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear of deck and set aside.
6. Install CE disk pack (p/n 12211935) on spindle.
7. Pivot sensor toward disk pack until stop is encountered. Hold sensor in this position while rotating disk pack. Stop rotation when edge of disk surfaces 17 and 18 are nearest to top vertical notch in sensor.
8. Use feeler gage to measure vertical gap between sensor notch and edge of disk. Dimension must meet requirement of Figure 6-21. Adjust as follows:
   a. Remove both SPL cards from C-row of logic on deck.
   b. Remove three screws and six washers securing C-row card chassis to deck.
   c. Disconnect plug to sector sensor preamplifier card.
   d. Thread plug through circular cutout in C-row card chassis.
   e. Move C-row chassis clear of sector sensor.
   f. Remove two screws and washers securing positioning arm to transducer (Figure 6-21).
   g. Loosen locknut on stop adjust screw.

h. Pivot sensor toward disk pack until stop is encountered. Rotate stop adjust screw until required gap between sensor notch and edge of disk is achieved (Figure 6-21).

i. Tighten locknut and recheck dimension. Readjust if required. Continue to next step and adjust switch. Do not perform reassembly at this time.

NOTE

Switch transfer is checked in following steps. Transfer may be monitored either by observing a multimeter (continuity) or by listening for the audible click of the switch.

9. Refer to Figure 6-21 and place a 0.015-inch shim flat against the surface of the stop that is encountered by the stop adjust screw.

10. Pivot sensor toward disk pack until tip of stop adjust screw contacts feeler gage. Switch must transfer. Hold sensor firmly in this position.

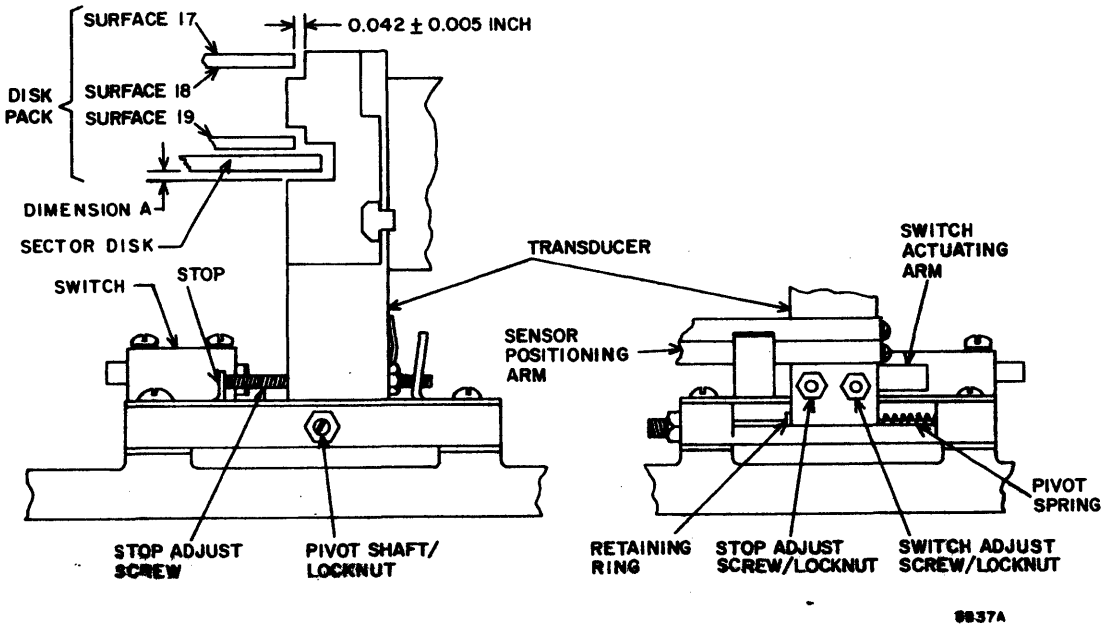


Figure 6-21. Sector Sensor

11. Slide a 0.010-inch feeler gage between first gage and the stop (total of 0.025-inch now between stop and tip of stop adjust screw). Switch must transfer.

12. Slide only the 0.010-inch feeler gage from between the stop and the screw. Switch must transfer. Release sensor.

13. If any of the above requirements (steps 10, 11, or 12) is not met, readjust as follows:

    a. If C-row logic cards are installed, perform steps 8a through 8f (above) and remove them.

    b. Loosen lock nut on switch adjust screw. Back switch adjust screw out until it no longer contacts switch actuating arm.

    c. Pivot sensor toward disk pack until stop is firmly encountered.

    d. Thread switch adjust screw into sensor until switch transfers (clicks). Rotate switch adjust screw clockwise an additional 1/2 to 3/4 turn. Tighten locknut.

    e. Install C-row logic cards by reversing steps 8a through 8f (above).

14. Remove CE disk pack from spindle.

15. Install shroud and perform Shroud Adjustment procedure.

16. Install shroud side covers.

Index to Burst Check and Adjustment

1. Stop spindle motor.

2. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.

3. Extend deck drawer to rear.

4. Remove SPL card at location C02 of open drawer.

5. Remove SPL card at logic chassis location A17 (for upper deck) or B17 (for lower deck).

CAUTION

The CE disk pack contains specially recorded tracks of data. Extreme care must be taken so that this data is not modified.

6. Install CE disk pack (p/n 89259100). Check hub of disk pack for presence of label specifying index to data period. If label is found, make a note of value specified.

7. Set DC/OFF switch to DC.

8. Start spindle motor.

NOTE

The CE disk pack sector disk does not allow MDD logic to provide a speed signal. The jumper used in next step allows signal to occur. Jumper is installed after spindle motor starts. If motor is stopped, remove jumper before a restart is attempted.

9. Connect a jumper wire between test points F and A (ground) of SPL card at logic location A08 (for upper deck) or B08 (for lower deck).

NOTE

In following procedure it is necessary to position heads to a specific track location. This command may be derived by either suitable software and the central processor or the tester card (p/n 40072100) installed in logic chassis (location A03 for upper spindle or B03 for lower spindle).

10. Position carriage to track 118.

11. Connect oscilloscope external trigger to test point C (Index) of SPL card at location A11 (for upper deck) or B11 (for lower deck).

12. Connect oscilloscope channels A and B to test points G and F of SPL card at location D01 of open drawer. Ground oscilloscope at test point A of same card.

13. Select head 9 by connecting a jumper wire between test points 9 and Y (ground) of SPL card at location C01 of open drawer.

NOTE

The CE disk pack (p/n 89259100) has a pulse on track 9 and 10 located 3 usec from the leading edge of the Index pulse. The remaining 18 tracks have a pulse located 10 usec from the leading edge of the Index pulse. In the following step, 7 usec must be added to the readings taken on heads 9 and 10.

NOTE

Following oscilloscope trace tends to be unstable. Instability or jitter results as oscillator phases itself. Include jitter in period measurement.

14. Refer to Figure 6-22 for oscilloscope settings. Compare traces. Period between leading edge of Index pulse and leading edge of the first Data pulse must be 10 $\pm$ 5 usec (including jitter). If requirement is not met, adjust as follows:

    a. Loosen locknut on sector sensor pivot shaft (Figure 6-21).

    b. If period is too short, use screwdriver to turn pivot shaft clockwise until requirement is met, and then go to step 15. If period is too long, use screwdriver to turn pivot shaft counterclockwise. Push sensor along shaft toward pivot spring. When displayed period is too short, turn pivot shaft clockwise until requirement is met.

NOTE

If head 10 is not readable after setting head 9 at 3.0 usec, set head 10 at 3.0 usec.

15. Disconnect oscilloscope external trigger. Set triggering to internal.

16. Disconnect channel probes.

17. Connect channel A probe to test point C (Index) of SPL card at location A11 (for upper deck) or B11 (for lower deck).

18. Trace must indicate a logic "1" (+3 vdc) pulse with a width of 55.0 $\pm$ 7.5 usec. If requirement is not met, a failure has occurred in term Y509.

19. Disconnect oscilloscope.

20. Stop spindle motor and remove CE disk pack.

21. Install SPL cards removed in steps 4 and 5.

22. Remove jumper wire installed in step 9

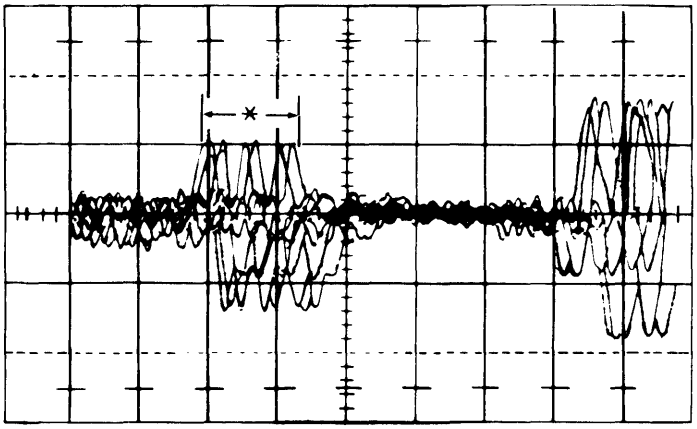


Figure 6-22. Index to Burst Period

Transducer Removal and Replacement

1. Stop spindle motor.
2. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
3. Extend deck drawer to rear. Remove disk pack from spindle.
4. Release four half-turn fasteners securing each shroud side cover. Set covers aside.
5. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear of deck and set aside.
6. Remove both SPL cards from C-row logic chassis.
7. Remove three screws and six washers securing C-row logic chassis to deck.
8. Disconnect plug to sector sensor preamplifier card. Thread plug through circular cutout in C-row card chassis.
9. Unclip sector preamplifier card from transducer.
10. Install CE disk pack (p/n 89259100) on spindle.
11. Pivot sector sensor toward disk pack until stop post is encountered. Hold sector sensor in position by engaging cam arm block.
12. Rotate disk pack until notch in sector disk begins to enter transducer.

13. Using feeler gage measure and record distance between the disk pack sector disk bottom and the transducer bottom notch (Dim. A of Figure 6-21).

14. Disengage sector sensor assembly and remove disk pack.

15. Tag and then disconnect leadwires to sector switch.

16. Remove three screws and washers securing sensor assembly to deck. Raise assembly and stop adjust bracket clear of deck. Retain shims and stop bracket for use during reassembly.

17. Refer to Figure 6-21 and remove retaining ring from pivot shaft.

18. Remove locknut securing pivot shaft.

19. Turn pivot shaft clockwise until pivot shaft exits threaded hole in mounting block.

NOTE

Observe mounting position of pivot spring. Spring is double acting, provides tension and compression to transducer.

20. Slide pivot shaft through transducer, pivot spring, and free of mounting block.

21. Remove sensor positioning arm and two adjusting screw/locknuts from faulty transducer. Install these items on replacement transducer.

22. Position replacement transducer in sensor mount plate. Slide threaded end of pivot shaft through mount plate, transducer pivot spring and mount plate. (Install pivot spring to provide both tension and compression to transducer).

23. Install retaining ring in groove of pivot shaft.

24. Using original shims, three screws, and three washers, secure stop adjustment bracket and sector sensor assembly to deck.

25. Install CE disk pack used in step 10 on spindle.

26. Pivot sector sensor toward disk pack until stop post is encountered. Hold sensor in position.

27. Rotate disk pack until notch in sector disk begins to enter sensor transducer.

28. Using feeler gage measure distance between the disk pack sector disk bottom and the transducer bottom notch (Dim. A of Figure 6-9. 1). Add or remove shims to sensor assembly to obtain same dimension recorded in step 13.

29. Disengage sector transducer from disk pack.
30. Connect leadwires to sector switch.
31. Perform steps 7 through 13 of Sector Sensor Assembly Switch and Stop Adjustment procedure (ignore disassembly and reassembly steps).
32. Remove CE disk pack.
33. Install C-row logic cards by reversing steps 8a through 8d of this procedure.
34. Install shroud and perform Shroud Adjustment procedure.
35. Install shroud side covers.
36. Perform Sector Sensor Transducer/Preamplifier Output Check procedure.
37. Perform Index to Burst Check and Adjustment.

Preamplifier Card Removal and Replacement

1. Extend deck drawer to rear.
2. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
3. Remove disk pack from spindle.
4. Release four half-turn fasteners securing each shroud side cover. Set covers aside.
5. Remove four screws and eight washers on inner bottom of shroud. Raise shroud clear of deck and set aside.
6. Disengage plug to preamplifier card.
7. Unclip preamplifier card from transducer.
8. Position replacement card at rear of transducer and clip in place. Connect plug to replacement preamplifier card.
9. Install shroud and perform Shroud Adjustment procedure.
10. Install shroud side covers.
11. Perform Sector Sensor Transducer/Preamplifier Output Check procedure.
12. Perform Index to Burst Check and Adjustment procedure.

Transducer/Preamplifier Output Check

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Set associated ON LINE/OFF LINE switch to OFF LINE.
4. Set associated DC/OFF switch to OFF.
5. Remove SPL card at location A11 (for upper deck) or B11 (for lower deck). Install card extender (p/n 86416700) at vacated position and replace the card.
6. Install a disk pack.
7. Set DC/OFF switch to DC.
8. Start spindle motor.
9. Connect oscilloscope channels A and B to pins 24 and 25 (card extender) of SPL card at location A11 (for upper deck) or B11 (for lower deck). Ground oscilloscope at test point A of same card.
10. Trigger oscilloscope positive at test point F of card at location A18 (for upper deck) or B18 (for lower deck).
11. Set oscilloscope mode controls to add and invert channel B. Set horizontal to 50 usec/cm and vertical to 1v/cm.
12. Oscilloscope trace amplitude must be 3.75 ± 1.5 volts peak to peak. If the requirement is not met, refer to remedies in steps 14a, b, c.
13. Connect oscilloscope channels A and B to test point C and pin 24 (card extender) of SPL card at location A11 (for upper deck) or B11 (for lower deck).
14. Refer to Figure 6-23 for oscilloscope settings. Compare traces. Leading edge of 50 usec pulses (test point C) must occur during positive going period of voltage pulses (pin 24). If requirement is not met, correct situation according to one of following:
    a. Perform Oscillator Check procedure. Repair oscillator if required.
    b. Replace transducer preamplifier card.
    c. Replace transducer.
15. Disconnect oscilloscope probe from pin 24 and connect at pin 25. Requirement of step 14 must be met. Disconnect channel probes.

16. Connect oscilloscope channel B probe to test point F (Index) of SPL card at location A18 (for upper deck) or B18 (for lower deck).

NOTE

Collector of transistor Q05 is biased at approximately +20 volts dc.

17. Connect oscilloscope channel A probe to collector of transistor Q05 (Figure 6-24) of SPL card at location A11 (for upper deck) or B11 (for lower deck).

18. Refer to Figure 6-24 for oscilloscope settings. Compare traces. First pulse should be a 10.75 $\pm$ 1.5 volt negative transition from the bias voltage. Second pulse should occur approximately 100 usec after trigger and should be a negative voltage transition with an amplitude of at least 80 percent of the first pulse. If these requirements are not met, correct situation according to one of following:

    a. Check power supply $\pm$20 volt outputs.

    b. Replace transducer preamplifier card.

    c. Replace transducer.

    d. Troubleshoot logic term Y509.

19. Disconnect oscilloscope.

20. Stop spindle motor and remove CE disk pack.

21. Set DC/OFF switch to OFF.

22. Install SPL card removed in step 5.

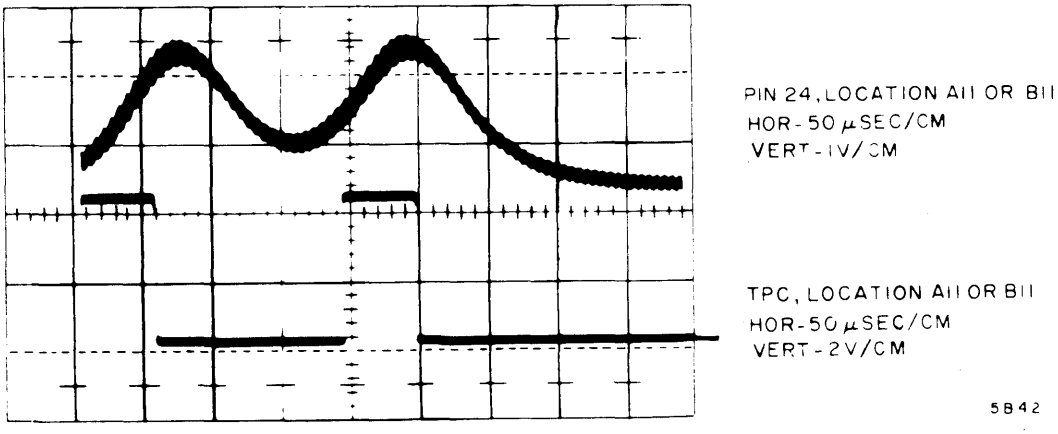


Figure 6-23. Sector Transducer Trace

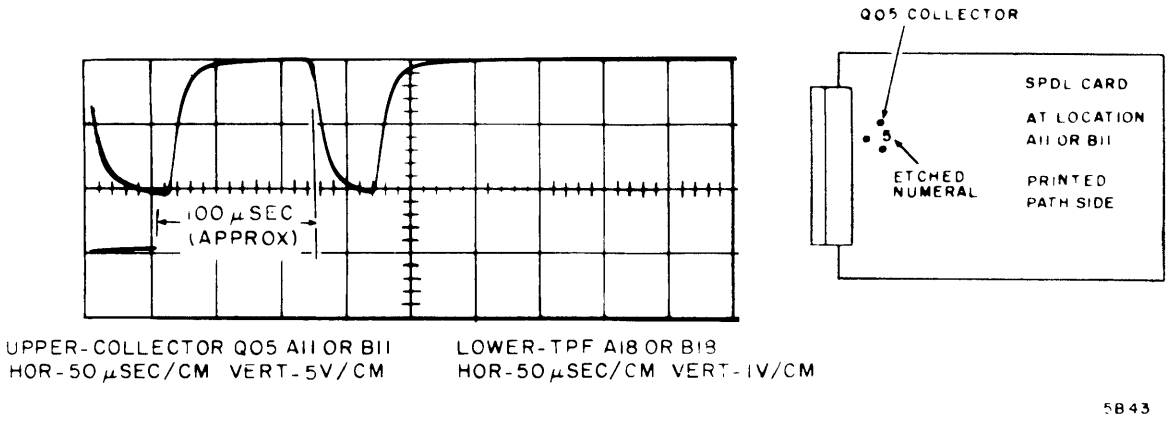


Figure 6-24. Detector Trace

Sector Sensor Positioner Check and Adjustment

1. Stop spindle motor.
2. Extend deck drawer forward.
3. Release four half-turn fasteners securing right-hand shroud side cover. Set cover aside.
4. Refer to Figure 6-25 and rotate cam arm toward shroud.
5. Pull upward on cam arm block and release cam arm so that it engages the 5/8-inch diameter of cam arm block.
6. Measure deflection of tip of transducer arm (distance tip of arm is displaced after sector sensor stop screw first contacts stop). Deflection must be between 3/32 and 4/32 inch. If requirement is not met, adjust as follows:
   a. Loosen three screws securing sensor positioner plate to deck.
   b. Reposition plate until requirement is met. Tighten screws.
7. Install shroud side cover.

OSCILLATOR CHECK

1. Connect oscilloscope probe to test point B of SPL card at location A11 (for upper deck) or B11 (for lower deck).
2. Oscillator output voltage must be 11.8 ± 1.2 volts peak-to-peak.
3. Period of one complete sine wave must be between 4.88 and 5.93 usec (187 kHz nominal).

READ / WRITE HEADS

Head/Arm Removal and Replacement

1. Stop spindle motor.
2. Set associated **ON LINE/OFF LINE** switch to **OFF LINE** and set related **DC/OFF** switch to **OFF**.
3. Extend deck drawer to rear.

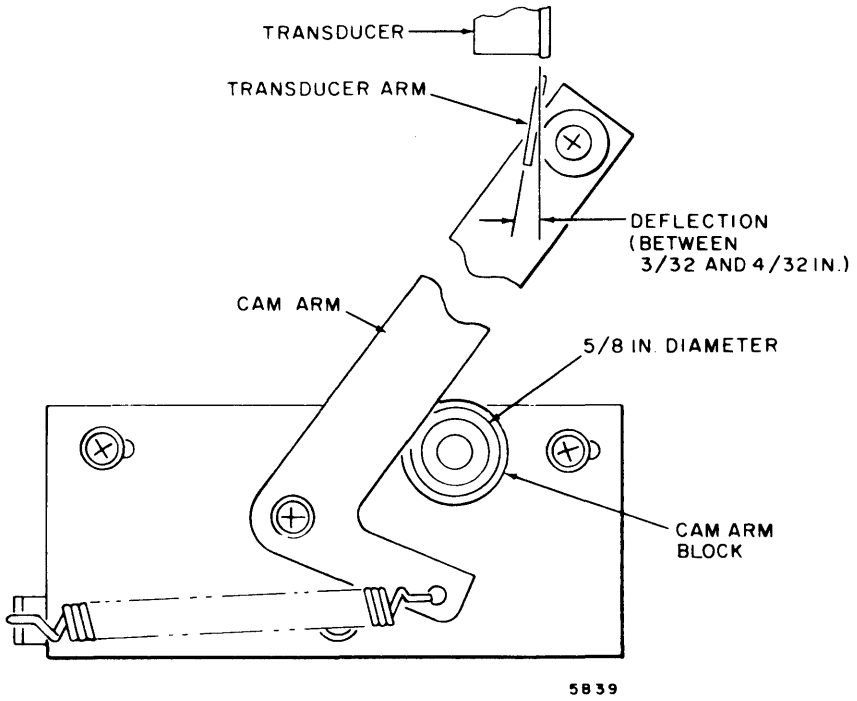


Figure 6-25. Sector Sensor Positioner

4. Remove disk pack.
5. Refer to Figure 6-26 to determine location of faulty head/arm assembly.
6. Disconnect head plug at card C01 or D02.
7. Loosen head/arm clamp assembly screws immediately above and below faulty head.

CAUTION

Do not touch the face of any head. Avoid contacting any head but the one being replaced.

8. Pull head/arm slowly toward spindle and clear of head/arm clamps and guide plate. Use care not to damage torsion rod.
9. Determine part number of replacement head by referring to Table 6-1. Orient face (up or down) of replacement head/arm according to Figure 6-26. Slide assembly through head/arm guide plate until the approximate original position is reached. Do not jam torsion rod with head/arm.
10. Connect head plug at card C01 or D02 (as applicable).
11. Inspect the replaced head/arm assembly. Torsion rod must engage head on raised load button. Make certain that head cable is oriented similarly to other adjacent cables.
12. Perform Head/Arm Adjustment procedure (see Preventive Maintenance Index).
13. Perform Adjacent Track Erase Check procedure.

TABLE 6-1. READ/WRITE HEAD REPLACEMENT DATA

READ/WRITE HEAD IDENTIFICATION NO. (SEE FIGURE 6-26)	READ/WRITE HEAD REPLACEMENT PART NO.
02, 06, 10, 14, 18	40040000
01, 05, 09, 13, 17	40040001
00, 04, 08, 12, 16	40040002
03, 07, 11, 15, 19	40040003

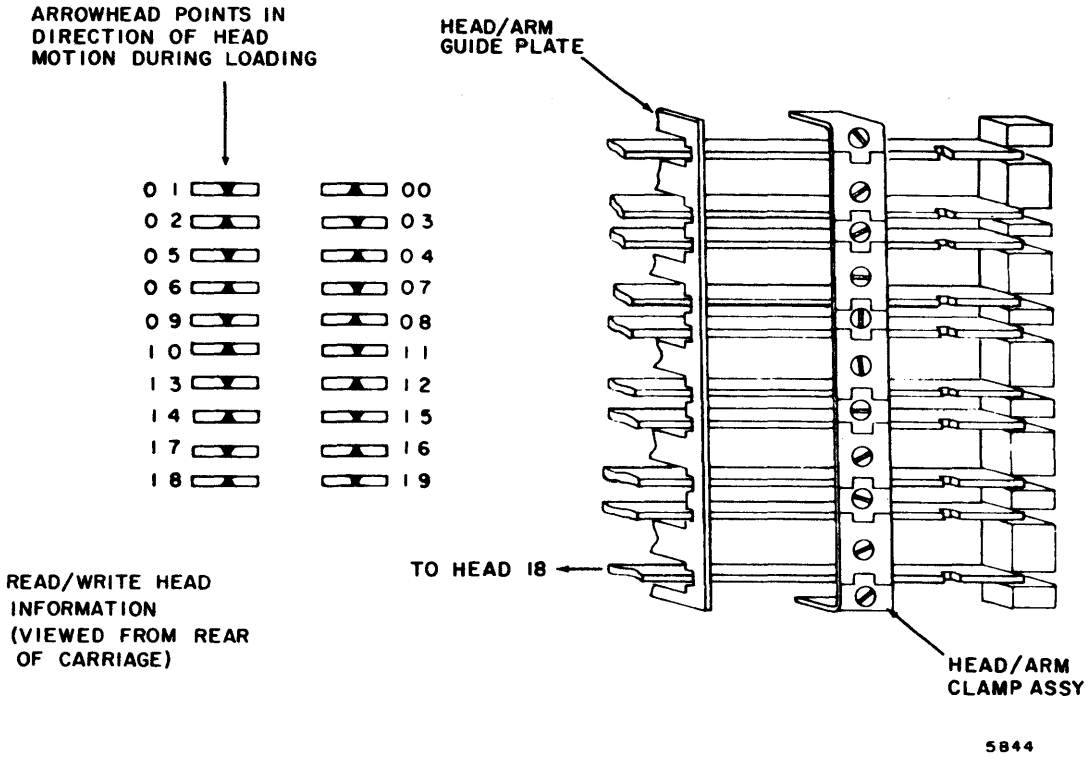


Figure 6-26. Head/Arm Replacement

Write And Erase Current Amplitude Check

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
4. Identify head (Figure 6-26) to be checked and disconnect related head plug at card C01 or D02 as applicable.
5. Install a head adapter cable (p/n 86053800) between the head plug and card C01 or D02.
6. Set DC/OFF switch to DC.
7. Start spindle motor.
8. Connect oscilloscope external trigger to test point F (Index) of SPL card at location A18 (for upper deck) or B18 (for lower deck).
9. Connect a current probe to the oscilloscope. Clamp current probe around the thicker of the two loops on the head adapter cable.

NOTE

The following procedure requires that data be written on a disk pack. Write operation may be performed via MDD exerciser or the central processor.

10. Select head connected to oscilloscope. Write a pattern of all zeroes while observing oscilloscope.
11. Oscilloscope should display write current trace with a minimum amplitude of 80 ma peak-to-peak. Record minimum current amplitude.
12. Select head connected to oscilloscope. Write a pattern of all ones while observing oscilloscope.
13. Oscilloscope should display write current trace that has a minimum amplitude of 90 percent of that recorded in step 11.
14. Clamp current probe around the other (thinner) loop on the head adapter cable.
15. Select head connected to oscilloscope and perform a write operation.
16. Oscilloscope should display erase current trace with a minimum amplitude of 37.5 ma. Rise time (from 10 to 90 percent of amplitude) of observed trace must be a minimum of 5 usec.

Signal Amplitude Check

NOTE

In following procedure it is necessary to position heads to specific track locations. These commands may be derived by either suitable software and the central processor or the tester card (p/n 40072100) installed in logic chassis (location A03 for upper spindle or B03 for lower spindle). The procedure also requires that data be written on a disk pack. Write operation may be performed via MDD exerciser or the central processor.

1. Position the carriage to track 201.
2. Write a data pattern of all ones with each head.
3. Extend deck drawer to rear.
4. Connect channels of oscilloscope (to add and invert channel B) to test points S and T of SPL card at location C01 of open drawer. Ground oscilloscope at test point R or Y of same card.
5. Connect oscilloscope external trigger to test point F (Index) of SPL card at logic chassis location A18 (upper deck) or B18 (lower deck).
6. Select head number 1 for a read operation. Observe oscilloscope trace amplitude. Amplitude must be a minimum of 32 millivolts. Record head number and amplitude.
7. Repeat step 6 for read/write heads 2, 5, 6, 9, 10, 13, 14, 17, and 18.
8. Connect channels of oscilloscope (to add and invert channel B) to test points S and T of SPL card at location D02 of open drawer. Ground oscilloscope at test point R or Y of same card.
9. Repeat step 6 for read/write head 0, 3, 4, 7, 8, 11, 12, 15, 16, and 19.
10. Replace any read/write head that fails the above requirement.

Adjacent Track Erase Check

It is necessary to perform this check only on a read/write head that has been replaced.

NOTE

In following procedure it is necessary to position heads to specific track locations. These commands may be derived by either suitable software and the central processor or the tester card (p/n 40072100) installed in logic chassis (location A03 for upper spindle or B03 for lower spindle). The procedure also requires that data be written on a disk pack. Write operation may be performed via MDD exerciser or the central processor.

1. Position the carriage to track 201.
2. Write data pattern of all ones with the read/write head that was replaced.
3. Extend deck drawer to rear.
4. Connect channels of oscilloscope (to add and invert channel B) to test points S and T of SPL card at location C01 (for heads 1, 2, 5, 6, 9, 10, 13, 14, 17, or 18) or D02 (for all other heads) of open drawer. Ground oscilloscope at test point R or Y of same card.
5. Connect oscilloscope external trigger to test point F (Index) of SPL card at logic chassis location A18 (upper deck) or B18 (lower deck).
6. Select head (of step 2) for a read operation. Observe oscilloscope trace amplitude. Amplitude must be a minimum of 32 millivolts. Record amplitude.
7. Position carriage to track 200. Write data pattern of all ones with head from step 2.
8. Position carriage to track 202. Write data pattern of all ones with head from step 2.
9. Position carriage to track 201.
10. Select the head for read operation. Observe oscilloscope trace amplitude. Amplitude must be at least 85 percent of the amplitude recorded in step 6.
11. If the read/write head fails any of the above requirements, replace it.

Tuned Amplifier Check and Adjustment

NOTE

In following procedure it is necessary to position heads to specific track locations. These commands may be derived by either suitable software and the central processor or the tester card (p/n 40072100) installed in logic chassis (location A03 for upper spindle or B03 for lower spindle). The procedure also requires that data be written on a disk pack. Write operation may be performed via MDD exerciser or the central processor.

1. Position carriage to track 202.
2. Write a pattern of all ones with each head.
3. Extend deck drawer to rear.
4. Connect oscilloscope channels A and B to test points C and B (respectively) of SPL card at location A22 (upper deck) or B22 (lower deck). Set oscilloscope mode for add and invert channel B.
5. Connect oscilloscope time base B external trigger to test point F index of SPL card at location A18 (for upper deck) or B18 (for lower deck).
6. Connect oscilloscope time base A external trigger to test point C of SPL card at location A22 (for upper deck) or B22 (for lower deck).
7. Set oscilloscope horizontal so that channel A is delayed by channel B.
8. Select any head (via central processor or MDD exerciser) and read track 202.
9. Make oscilloscope settings and a trace comparison according to Figure 6-27. Displayed pulses must be symmetrical to within ±5 percent. If requirement is not met, adjust as follows:
   a. Use small allendriver to turn shaft of uppermost variable resistor (500 ohm) on edge of SPL card at logic chassis location A22 (upper deck) or B22 (lower deck).
   b. Stop turning shaft when requirement of step 9 is met.

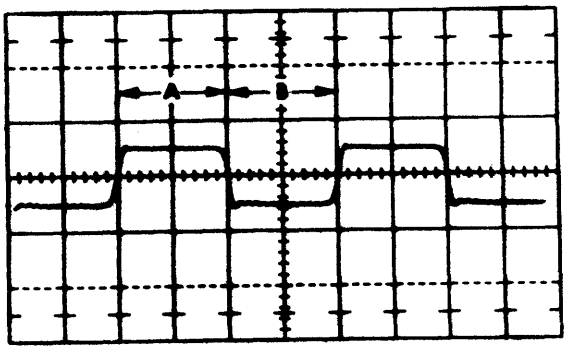


Figure 6-27. Symmetry Adjustment

10. Vertically align trace for equal amplitude above and below center horizontal grid line. Use a grease pencil to mark oscilloscope graticule very precisely with a fine vertical line at each point the trace crosses center horizontal grid line.

NOTE

Sync point must not change during following steps.

11. Remove channel B probe connection from logic chassis return channel B from invert to normal.
12. Set oscilloscope mode to alternate.
13. Connect channel B probe to test point D of SPL card at location A22 (upper deck) or B22 (lower deck).
14. Make oscilloscope settings and a trace comparison according to Figure 6-28, Trace D.
15. Turn shaft on variable capacitor (located between variable resistors) on edge of SPL card at location A22 (upper deck) or B22 (lower deck). Stop turning shaft when amplitude of trace is maximum. Trace amplitude must be 3.0 ± 0.5 volts peak-to-peak.
16. Move channel B probe to test point Y of SPL card at location A22 (upper deck) or B22 (lower deck).

17. Make trace comparison with Figure 6-28. Trace B (of figure) must be aligned to grease pencil marks as shown to within ±5 nsec. If requirement is met, go to step 18. If requirement is not met, adjust as follows:

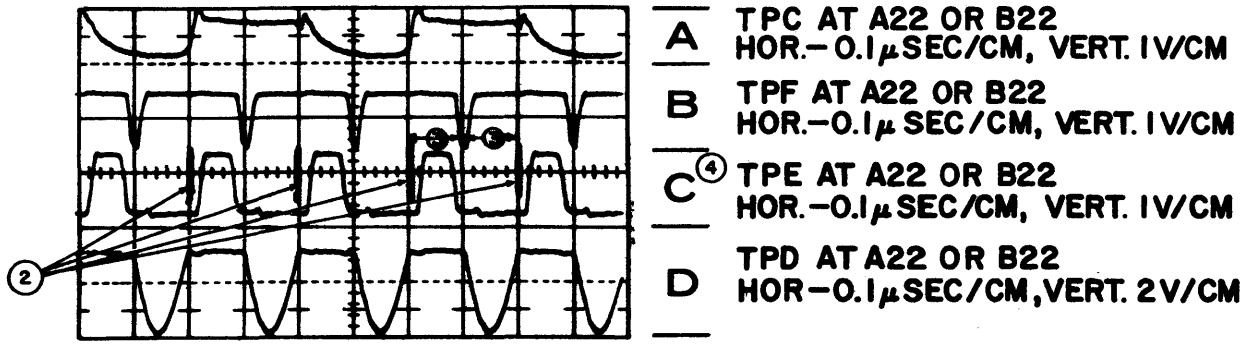
    a. Move channel B probe to test point Y of SPL card at location A22 (upper deck) or B22 (lower deck).

    b. Turn shaft on lower variable resistor (5K ohms) on edge of SPL card at location A22 (upper deck) or B22 (lower deck).

    c. Stop turning shaft when the centers of the trace B (of Figure 6-28) pulses are aligned midway between grease pencil marks on graticule to within ±5 nsec.

18. Repeat step 10 to make certain that trace still crosses horizontal grid line at original grease pencil marks. If trace has shifted, wipe graticule clean and repeat procedure from step 10.

19. Disconnect oscilloscope.



NOTES:

1. THIS FIGURE INTENDED TO SHOW GENERAL RELATIONSHIP OF FOUR TEST POINTS ONLY.

(2) GREASE PENCIL MARKS (SEE PROCEDURE).

(3) PERIODS FROM CENTER OF PULSE TO ADJACENT GREASE PENCIL MARKS ((2)) MUST AGREE TO WITHIN ± 5 NSEC.

(4) SHOWN FOR REFERENCE ONLY.

5848A

Figure 6-28. Tuned Amplifier Adjustment

TORSION ROD REMOVAL AND REPLACEMENT

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Remove disk pack.
4. Refer to Figure 6-29 and remove retaining ring securing end of faulty torsion rod to lever assembly.

CAUTION

Use extreme care during following steps so torsion rod does not scratch face of read/write heads. Do not touch face of any read/write head with hands. Avoid abusive contact with any part of a read/write head.

5. Carefully slide torsion rod out of receiver.
6. Check rotational freedom of related level assembly. If required, apply a light coat of Molykote, Type G to the points shown on Figure 6-29.
7. Apply a light coat of Molykote, Type G to shaft of replacement torsion rod.
8. Very carefully slide torsion rod into receiver and install retaining ring.
9. Make certain that torsion rod is engaging read/write heads on load button.
10. Use feeler gage to check gap between rear of grip rings and face of head/arm guide plate. Reposition grip rings along shaft until dimension is correct.

HEAD SELECT PREAMP CARD REMOVAL AND REPLACEMENT

1. Stop spindle motor.
2. Extend deck drawer to rear.
3. Set associated ON LINE/OFF LINE switch to OFF LINE and set related DC/OFF switch to OFF.
4. Release four half-turn fasteners securing shroud side covers enclosing head select preamp card to be removed. Set cover aside.
5. Disconnect each head cable plug connected to edge of card (Figure 6-30).

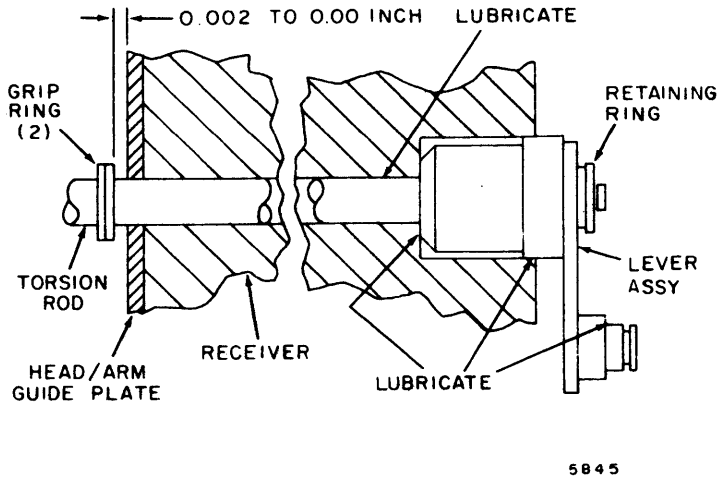


Figure 6-29. Torsion Rod

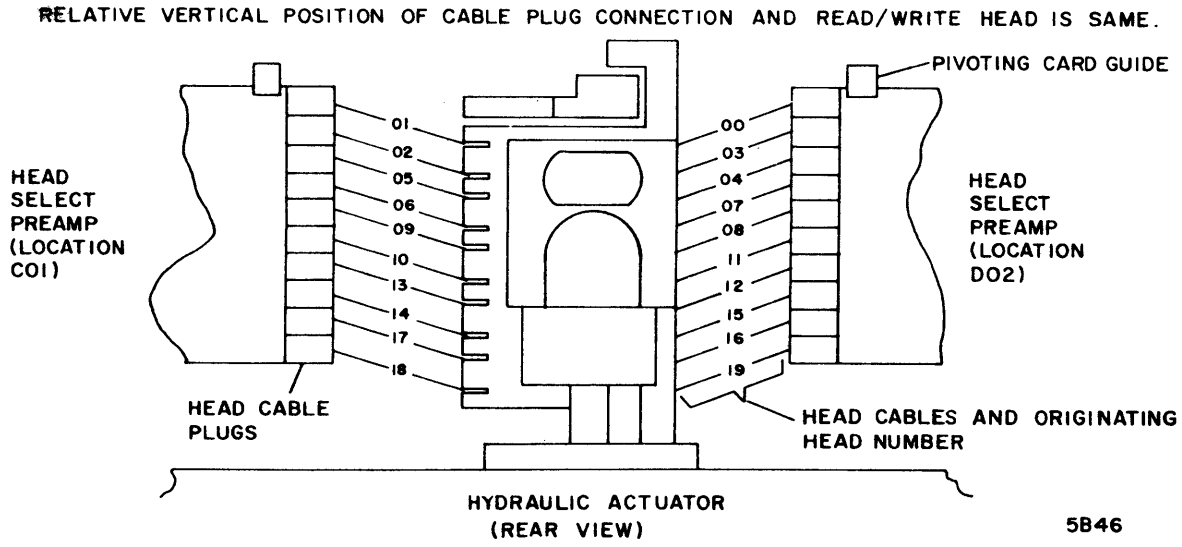


Figure 6-30. Read/Write Head Cable Connections

6. Raise pivoting card guide clear of top edge of card. Grasp notches in end of card with card puller (p/n 84146900).

7. Carefully extract card from chassis by pulling card straight away from connector.

8. Install repaired or new card carefully so that connector pins are not damaged.

9. Rotate pivoting card guide to engage edge of card.

NOTE

Head cables should not cross. Plug of top read/write connects to top position on edge of card. Plug of bottom read/write head connects to bottom position on edge of card.

10. Connect head cable plugs to edge of head select preamp card (Figure 6-30).

11. Install shroud side cover.

DETENT TROUBLESHOOTING

1. Perform Cylinder Transducer Check and Adjustment procedure.

NOTE

Following procedure requires MDD to perform seek operations. Commands controlling seek operations may be derived via a Tester Card (40072100) installed in logic chassis (position A03 for upper spindle or position B03 for lower spindle) or suitable software and the computer.

2. Connect oscilloscope probe to test point J (detent transducer preamplifier of card at logic chassis location A11 (upper deck) or B11 (lower deck). Ground oscilloscope at test point A or Z of same card to which probe is connected.
3. Attach a tachometer (84264100) to shaft in center of track number indicator dial.
4. Connect oscilloscope external trigger to test point B (I510, Any Seek) of card at location A08 (upper deck) or B08 (lower deck).
5. Connect tachometer leadwires to oscilloscope preamplifier input and preamplifier ground. Connection should be made so that forward seek causes a positive tachometer trace.
6. Start spindle motor.
7. Command MDD to perform 1-track repeat seek (one track forward and one trace reverse, continuously) centering on track 100.
8. Make oscilloscope settings and a trace comparison according to Part A of Figure 6-31. Point X of a properly adjusted transducer must occur during period Y. When requirement of Part A is met, a trace similar to Part B (forward seek) will be achieved.

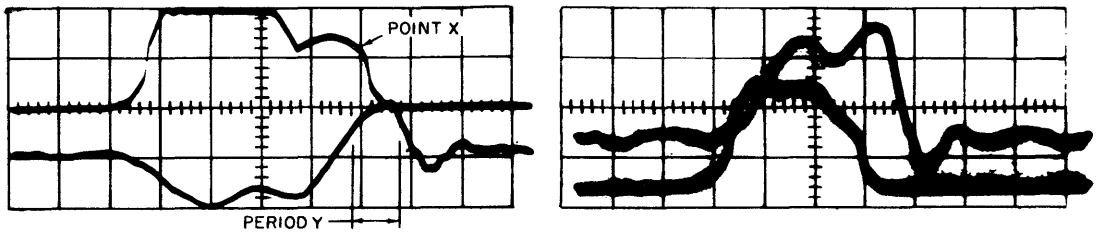


Figure 6-31. Detent Transducer Trace

HYDRAULIC ACTUATOR INTERMEDIATE SPEED TROUBLESHOOTING

CAUTION

Actuator intermediate speed shaft is adjusted and locked at factory. Normally this adjustment is adequate for the life of the actuator. Field adjustment of the shaft by inexperienced personnel could result in damage to the actuator or the detent pawl and/or detent gear mechanism.

The position of the intermediate speed shaft controls the actuator velocity during the intermediate speed portion of a seek operation. The net result of too much velocity during this phase can be that the seek operation stops beyond the desired track, and causes a seek error to be detected by the controller. If the velocity used during the intermediate speed segment of the seek is too low, the seek may terminate short of the desired track, and again cause a seek error.

Age of the actuator could cause a need for intermediate speed adjustment. However, the adjustment should be performed only after it is determined that the cylinder transducer and the detent transducer are properly adjusted and functioning correctly.

1. Install disk pack.
2. Start spindle motor, load heads, and allow a minimum warmup period of one hour.
3. Attach a tachometer (84264100) to shaft in center of track number indicator.
4. Connect tachometer leadwires to oscilloscope channel A preamplifier input and preamplifier ground so that a forward seek causes a positive-going tachometer trace.
5. Connect oscilloscope external trigger to test point C (Fwd. Latch) of SPL card at location A07 (for upper deck) or B07 (for lower deck).
6. Connect oscilloscope channel B probe to test point F (cylinder transducer preamplifier output) of card at location A11 (for upper deck) or B11 (for lower deck). Ground oscilloscope at test point A or Z of same card to which probe is connected.

NOTE

In following procedure it is necessary to command deck to perform certain seek operations. Commands may be derived by either suitable softward and central processor or tester card (p/n 40072100, installed at location A03 for upper deck or B03 for lower deck).

7. Command deck to perform 25-track repeat Seek (25 tracks forward and 25 tracks reverse, continuously) between tracks 25 and 50.
8. Make oscilloscope settings and compare oscilloscope traces with parts A and B of Figure 6-32. Point 3 should be approximately centered on point 4.

NOTE

To view a forward Seek, set oscilloscope to trigger on positive. Trigger negative for reverse.

9. Change oscilloscope settings according to parts C and D of Figure 6-32. Superimpose traces by adjusting vertical positioning. Point 3 must occur within $\pm 33\%$ of point 5.

WARNING

A very small amount of movement of intermediate speed adjust screw is required in next step. If screw comes out of actuator, a rapid and massive loss of hydraulic fluid (under pressure) will occur.

10. If intermediate speed is to be adjusted, refer to Figure 6-14. Loosen locking nut on adjust screw. Adjust screw to obtain trace referenced in step 9. Tighten locking nut.

11. Command deck to perform 100-track repeat Seek between tracks 25 and 125.

12. Repeat steps 8 through 10.

13. Repeat steps 7 through 12 until overshoot on both 25-track and 100-track seeks is within tolerance.

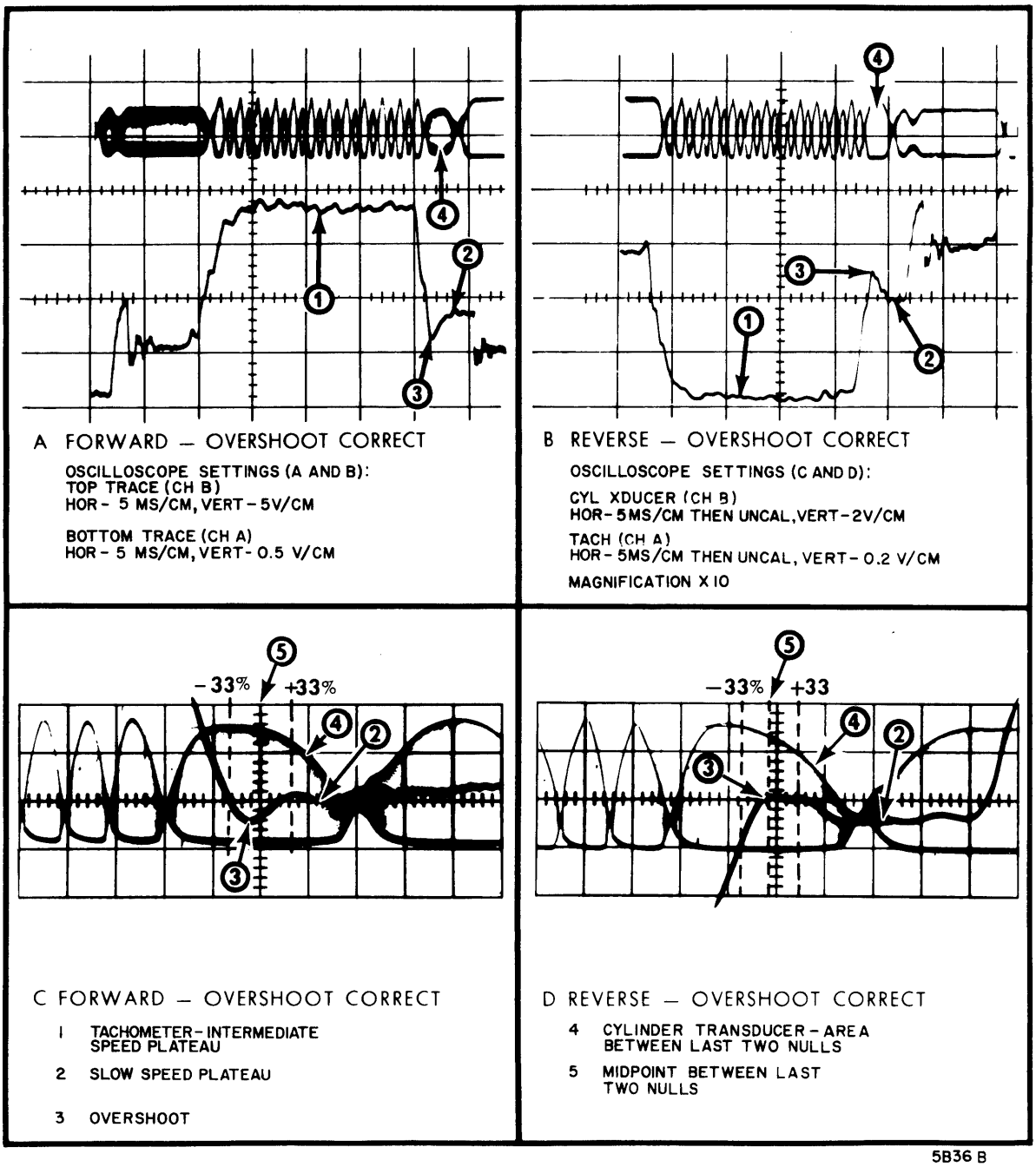


Figure 6-32. Intermediate Speed Characteristics

Repair of Hydraulic Fluid Leakage

1. Determine source. If it is necessary to tighten, turn or replace any hydraulic fitting, proceed as follows:

   a. Refer to Hydraulic Fluid Removal and Replacement procedure and remove fluid from unit.

   NOTE

   If the fitting being removed is located on the bottom of the actuator, remove actuator by performing steps 2 through 6 of the Hydraulic Actuator Assembly Removal and Replacement procedure.

   b. Disconnect hydraulic fitting.

   c. Check male and female threads for contaminants. Fittings must be free of dirt, grease or other contaminants. If necessary, clean fittings with Freon.

   d. Any loose accumulation of Loctite powder or Teflon tape must be removed. Film which adheres tightly must be removed.

   NOTE

   Teflon tape is used on male threads only.

   e. Apply Teflon tape (p/n 94195700) to male threads starting with the second thread from end of fitting. The tape must be wound one and one quarter turns opposite to the direction of rotation required to install fitting.

   f. Assemble fittings and tighten in place.

2. If actuator was removed, proceed as follows:

   a. Perform steps 7, 8 and 9 of the Hydraulic Actuator Assembly Removal and Replacement procedure.

FIRST SEEK PROBLEMS

It is assumed instructions per Section 2 have been followed. Refer to Power-on First Seek sequence flow chart and timing diagrams for sequencing format.

SYMPTOM	PROBABLE CAUSE
1. Disk pack not rotating	a. Faulty DC switch. b. Drive belt slipping. c. Missing power phase or faulty triac. d. Pack-on microswitch out of adjustment or faulty. e. Relay K01 not energized. f. Sector/Index Block microswitch out of adjustment or faulty.
2. Disk pack rotating/actuator fully retracted	a. Detent pawl failed to disengage from detent gear. b. Low oil level in hydraulic actuator. c. +40Y not present. d. Faulty hydraulic actuator.
3. Disk pack rotating/actuator extended to hydraulic home position	a. Detent pawl not engaged. b. Brush cycle microswitch out of adjustment or faulty. c. Solenoid Control Logic card failure. d. Faulty hydraulic actuator.
4. Disk pack rotating/actuator sitting at forward mechanical stop	a. Head loading cam malfunction. b. Head Loaded switch (S300) out of adjustment or faulty. c. Head Latch switch out of adjustment or faulty microswitch. d. Head Load linkage out of adjustment. e. Head Latch solenoid faulty. f. Speed Detector and Misc. Logic card malfunction.

SYMPTOM	PROBABLE CAUSE
	g. Solenoid Control Logic card malfunction.
	h. RTZS and Fault Detection Logic card malfunction.
	i. Faulty hydraulic actuator.
5. Disk pack rotating/actuator moves forward, heads load, RTZ, then moves forward to the forward mechanical stop	a. Detent pawl failed to engage.
	b. Cylinder transducer out of adjustment or faulty.
	c. RTZS and Faulty Detection Logic card malfunction.
	d. Speed Detector and Misc. Logic card malfunction.

READ/WRITE PROBLEMS

SYMPTOM	PROBABLE CAUSE
1. Read problems on more than one head	a. Controller failure.
	b. Damaged disk pack.
	c. Heads not fully loaded.
	d. Heads contaminated.
	e. Heads out of alignment.
	f. Static discharge spring intermittent.
	g. Insufficient grounding between MDD and controller.
	h. Faulty terminator.
	i. Transmitter or receiver card faulty.
	j. Read recovery card out of adjustment or faulty.
	k. Index to Burst adjustment.
	l. Faulty Analog Gate and Amplifier card.
	m. RTZS and Fault Detection malfunction.
	n. Faulty Head Select pre-amplifier card.

SYMPTOM	PROBABLE CAUSE
2. Read problem on one head	a. Head contaminated. b. Not fully loaded or out of alignment. c. Weak amplitude, head failure. d. Skew due to faulty head arm assembly.
3. Write failure with one head	a. Head contaminated. b. Faulty disk pack. c. Head not fully loaded. d. Head out of alignment or faulty head.
4. Write failure with all heads	a. Heads not fully loaded. b. Write data not received. c. Faulty write driver. d. Write gate not up.

UNIT SELECT

SYMPTOM	PROBABLE CAUSE
1. Fails to complete Unit Select	a. Faulty unit select receiver card or logic bit receivers. b. Steering Unit Logic card malfunction. c. Select and reserve transmitter card or Unit Ready transmitter card failure. d. Faulty microswitches on logic plug; adjustment needed.

POSITIONING ERRORS

SYMPTOM	PROBABLE CAUSE
1. Seek failure with definite pattern	a. Faulty transmitter or receiver card. b. Bad bit in upper/lower difference counter. c. Bad bit in cylinder address register.

TROUBLESHOOTING GUIDE (Cont'd)

SYMPTOM	PROBABLE CAUSE
	d. Solenoid control card failure.
	e. Controller failure.
2. Random Seek Failures	a. Bad bit in upper/lower difference counter or cylinder address register.
	b. Faulty transmitter or receiver card.
	c. Solenoid control card failure.
	d. Controller failure.
3. Random Seek Failures	a. Upper/lower difference counter logic card failure.
	b. Address register logic card failure.
	c. Faulty transmitter or receiver card.
	d. Carriage or rack need lubrication or adjustment.
	e. Detent actuator faulty or in need of adjustment.
	f. Hydraulic actuator fluid level low.
	g. Air in detent supply line.
	h. Detent transducer faulty or needs adjusting.
	i. Cylinder transducer faulty or needs adjusting.
	j. Faulty 187 KHz oscillator on Seek Error, On Cylinder or XDCR Amplifier cards.

FAULT CONDITIONS

Items listed below are in reference to the Error Select switch located on the Logic Chassis maintenance panel.

SYMPTOM	PROBABLE CAUSE
1. (W + E) · R	a. Controller malfunction.
	b. Failure with the Fault Status Logic card.
	c. Failure with Fault Detection Logic card.
	d. Faulty read, erase or write receiver Logic card.

SYMPTOM	PROBABLE CAUSE
2. R+W+E · Off Cylinder	a. Controller malfunction.
	b. Failure with the Fault Status Logic card.
	c. Failure with the Fault Detection Logic card.
	d. Faulty read, erase or write receiver card.
	e. Failure with Speed Detection Logic card.
	f. Losing On Cylinder pulse intermittently due to faulty Seek Error, On Cylinder or XDCR amplifier Logic cards.
3. Current	a. More than one head selected.
	1. Failure with Fault Status Logic card.
	2. Failure with RTZS and Fault Detection Logic card.
	3. Faulty head select pre-amplifier.
	4. Write/Erase circuit card faulty.
	5. Head Select Logic card faulty.
	b. Erase and no write driver ON.
	1. Read/Write head write coil open.
	2. RTZS and Fault Detection Logic card faulty.
	3. Write/Erase circuit card faulty.
	4. Faulty receiver.
	c. Erase and both Write Drivers ON.
	1. Faulty Write/Erase circuit card.
	d. One or both Write Drivers ON and no Erase Driver ON.
	1. Read/Write head erase coil open.
	2. Faulty Write/Erase circuit card.
	3. Faulty RTZS and Fault Detection Logic card.
	4. Faulty receiver card.
4. Voltage	a. Faulty Fault Status Logic card.
	b. Faulty RTZS and Fault Detection Logic card.

SYMPTOM	PROBABLE CAUSE
	c. DC voltages (+20, -20, +6 or +40) out of adjustment.
5. Seek Error	a. Cylinder pulses out of adjustment.
	b. Detent pawl adjustment.
	c. Faulty detent actuator.
	d. Detent pre-amplifier card failure.
	e. Detent actuator failure.
	f. Hydraulic fluid level low.
	g. Controller malfunction.
	h. Seek Error, On Cylinder or XDCR Amplifier card faulty.
	i. Faulty receiver card.
	j. Fault Status Logic card failure.
	k. Faulty Upper/Lower Difference counter.

SECTION 7

MAINTENANCE AIDS

Information for this section is included in BM1A5 Multiple Disk Drive.
Pub. No. 70602500

SECTION 8

PARTS DATA

Information for this section is included in CONTROL DATA® BM1A5/BM1A6 Multiple Disk Drive Parts List Manual.
Pub. No. 70601900

SECTION 9

WIRE LISTS

Information for this section is included in BM1A5/ Multiple Disk Drive.
Pub. No. 70602500

COMMENT SHEET

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Customer Engineering/Maintenance Manual

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