

5280



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IBM 5280 Distributed Data System

**Diskette Drive
Maintenance Information Manual**

First Edition (March 1980)

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This maintenance information manual (MIM) is to be used to service the diskette drive after it has been removed from the particular unit of the 5280 system in which it is housed. Customer engineers using this manual are assumed to have completed the 5280 education course.

This MIM has three major sections: *Maintenance, Tools and Test Equipment*, and *Theory*. *Maintenance* includes locations, procedures, and diagnostic aids. *Tools and Test Equipment* includes a list of special tools and test equipment and the part numbers of the tools and test equipment. *Theory* includes data flow, functional units, and features.

Definitions of terms and abbreviations that are not common, but are used in the MIM, are in the *Glossary of Terms and Abbreviations*.

There are several DANGER and CAUTION notices in this manual. You can use the blank lines below each notice to translate it into your own words. The locations of these notices are listed in the *Safety* section.

Related Publications

Related information can be found in the following manuals:

- *IBM 5280 General Information Manual*, GA21-9350
- *IBM 5280 Operator's Guide*, GA21-9364

- *IBM 5280 User's Setup Procedures*, GA21-9365
- *IBM 5280 Data Areas and Diagnostic Aids Handbook*, SY31-0595
- *IBM 5281 Data Station Maintenance Information Manual*, SY31-0596
- *IBM 5282 Dual Data Station Maintenance Information Manual*, SY31-0597
- *IBM 5286 Dual Programmable Data Station Maintenance Information Manual*, SY31-0599
- *IBM 5285 Programmable Data Station Maintenance Information Manual*, SY31-0600
- *IBM 5288 Programmable Control Unit Maintenance Information Manual*, SY31-0601
- *The IBM Diskette General Information Manual*, GA21-9182

HOW TO USE THIS MANUAL vii

MAINTENANCE PHILOSOPHY ix

SAFETY x

MAINTENANCE 1

LOCATIONS 1

330 Diskette Drive 1

331 Diskette Drive Control Card 2

333 Diskette Drive Control Card Connector Pins 4

COLLET 8

335 Collet/Flat Spring Removal and Replacement 8

 Removal 8

 Replacement 8

HEAD/CARRIAGE ASSEMBLY 10

337 Head/Carriage Service Check 10

339 Head/Carriage Adjustment 12

340 Pressure Pad Removal and Replacement (31SD only) 14

 Removal 14

 Replacement 14

341 Head/Carriage Removal and Replacement 15

 Removal 15

 Replacement 15

HEAD LOAD SOLENOID AND BAIL 18

343 Solenoid and Bail Service Check 18

344 Head Gap Service Check 20

345 Head Gap Adjustment 21

346 Solenoid and Bail Adjustment 22

347 Bail Removal and Replacement 24

 Removal 24

 Replacement 24

349 Solenoid and Idler Removal and Replacement 26

 Removal 26

 Replacement 26

AC DRIVE 28

351 AC Drive Motor Removal and Replacement 28

 AC Drive Motor with External Fan 28

 Removal 28

 Replacement 28

 AC Drive Motor with Internal Fan 30

 Removal 30

 Replacement 30

353 Capacitor Removal and Replacement 32

 Removal 32

 Replacement 32

355 Drive Fan and Pulley Removal and Replacement 34

 Removal 34

 Replacement 34

STEPPER DRIVER 36

357 Stepper Motor Removal and Replacement 36

 Removal 36

 Replacement 36

359 Stepper Motor Pulley and Clamp Removal and Replacement 38

 Removal 38

 Replacement 38

361 Drive Band Service Check 39

363 Drive Band Adjustment 40

365 Drive Band Removal and Replacement 42

 Removal 42

 Replacement 42

LED AND PTX ASSEMBLIES 44

367 Diskette Speed Service Check 44

369 LED Output Service Check 49

371 LED Removal and Replacement 51

 Removal 51

 Replacement 51

373 PTX Amplifier Service Check 52

375 PTX Removal and Replacement 54

 Removal 54

 Replacement 54

377 Diskette Drive Control Card Removal and Replacement 56

 Removal 56

 Replacement 56

TOOLS AND TEST EQUIPMENT 57

THEORY 59

 Introduction 59

 Diskette Description 59

 Stepper Motor 60

 Operation 60

 FM Format Principles 62

 Read Data 62

 Scope Charts 63

 MFM Format Principles 64

 Read Data 64

 Scope Charts 65

 Volume Label 66

 Volume Label Layout 66

 Volume Label Format 67

 Header Label 70

 Header Label Layout 70

 Header Label Format 71

 Data Recording Format 74

 Gap 1 74

 Sync Field 74

 AM 1 74

 ID Field 74

 CRC 75

 Gap 2 75

 AM 2 75

 Data Field 75

 Control Field 75

 Gap 3 75

 Gap 4 75

 Index 75

 Operation 76

 Typical Timing Sequence 77

GLOSSARY OF TERMS AND ABBREVIATIONS 79

The information in this MIM is to be used as reference material when diagnosing machine failures. This MIM contains maintenance procedures, tools and test equipment information, and theory.

The format for page numbering is XXX.Z. XXX is the number of the page and Z (although not normally used) is for expansion when it is not practical to give new numbers to all pages.

Three-digit reference numbers are assigned to location drawings and maintenance procedures to refer from the MAPs.

Maintenance Procedures Section

The maintenance procedures section contains location drawings and maintenance procedures for repairing, installing, or diagnosing the failing field-replaceable unit.

Tools and Test Equipment Section

The tools and test equipment needed to service the diskette drives are described in the tools and test equipment section.

Theory Section

The theory section contains descriptions of the functional units and features. These descriptions are preceded by a view of the diskette unit which gives you a general idea of the complete operation and where each function or feature fits in.

Index

The index is a detailed list of all material in the MIM and the pages on which that material is located.

The diskette drives need no scheduled maintenance. The MAPs guide you in diagnosing diskette drive failures. The MAPs refer to maintenance procedures in this manual when an adjustment, service check, or FRU replacement is needed.

All maintenance procedures are written with the assumption that the drive assembly has been removed from the enclosure and is fully accessible on a work surface. It might be practical in some instances, to perform specific procedures without removing the drive assembly. These instances can best be determined by the individual circumstances.

The head/carriage assembly and the drive hub and spindle pulley assembly are adjusted and tested at the factory. The drive hub and spindle pulley assembly are not field-replaceable units. If the track 40 adjustment surface or the drive hub and spindle pulley assembly are damaged, you should replace the entire diskette drive assembly. The head/carriage assembly is a field-replaceable unit.

The main differences between the 31SD diskette drive (for the diskette 1) and the 51TD diskette drive (for the diskette 1, 2, and 2D) are in the head/carriage assembly and the layout of the diskette drive control card. Maintenance procedures that are affected by such differences will provide two distinct sets of instructions within the affected step. These distinct differences will be labeled (31SD) and (51TD) as in the following example:

1. Remove the cover.
2. Disconnect the cables.
3. (31SD) Remove the head/carriage assembly.
(51TD) Insert a clean piece of paper between the read/write heads and remove the head/carriage assembly.
4. Invert the assembly.

When the callout of a figure is not affected by the difference between the drives, the 31SD drive figure will be used. In those instances where the callout is affected by the difference, the 51TD drive figure will also be used.

Safety

The diskette drives contain the following specific

DANGERS:

- Voltages are present on the connector terminals in the diskette drive.

- Motor and solenoid cases become hot after continuous use; allow enough time for parts to cool before servicing.

DANGER AND CAUTION NOTICES

Throughout this manual, the word DANGER is used to inform the CE of an action that could cause a personal injury. The word CAUTION is used to inform the CE of an action that could damage the machine, or affect the running of a customer program.

Danger Notices

Danger notices appear in the following maintenance procedures:

- 337 Head/Carriage Service Check
- 339 Head/Carriage Adjustment
- 341 Head/Carriage Removal and Replacement
- 343 Solenoid and Bail Service Check
- 346 Solenoid and Bail Adjustment
- 347 Bail Removal and Replacement
- 349 Solenoid and Idler Removal and Replacement
- 351 AC Drive Motor Removal and Replacement
- 353 Capacitor Removal and Replacement
- 355 Drive Fan and Pulley Removal and Replacement
- 373 PTX Amplifier Service Check

Caution Notices

Caution notices appear in the following maintenance procedures:

- 335 Collet/Flat Spring Removal and Replacement
- 337 Head/Carriage Service Check
- 339 Head/Carriage Adjustment
- 340 Pressure Pad Removal and Replacement
- 341 Head/Carriage Removal and Replacement
- 346 Solenoid and Bail Adjustment
- 347 Bail Removal and Replacement
- 357 Stepper Motor Removal and Replacement
- 363 Drive Band Adjustment
- 365 Drive Band Removal and Replacement
- 375 PTX Removal and Replacement

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you **MUST** work alone.
2. Remove all power, ac and dc, when removing or assembling major components, working in immediate areas of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. After turning off wall box power switch, lock it in the Off position or tag it with a "Do Not Operate" tag, Form 229-1266. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, observe the following precautions:
 - a. Another person familiar with power off controls must be in immediate vicinity.
 - b. Do not wear rings, wrist watches, chains, bracelets, or metal cuff links.
 - c. Use only insulated pliers and screwdrivers.
 - d. Keep one hand in pocket.
 - e. When using test instruments, be certain that controls are set correctly and that insulated probes of proper capacity are used.
 - f. Avoid contacting ground potential (metal floor strips, machine frames, etc.). Use suitable rubber mats, purchased locally if necessary.
5. Wear safety glasses when:
 - a. Using a hammer to drive pins, riveting, staking, etc.
 - b. Power or hand drilling, reaming, grinding, etc.
 - c. Using spring hooks, attaching springs.
 - d. Soldering, wire cutting, removing steel bands.
 - e. Cleaning parts with solvents, sprays, cleaners, chemicals, etc.
 - f. Performing any other work that may be hazardous to your eyes. **REMEMBER—THEY ARE YOUR EYES.**
6. Follow special safety instructions when performing specialized tasks, such as handling cathode ray tubes and extremely high voltages. These instructions are outlined in CEMs and the safety portion of the maintenance manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles—this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. After maintenance, restore all safety devices, such as guards, shields, signs, and grounding wires.
12. Each Customer Engineer is responsible to be certain that no action on his part renders products unsafe or exposes customer personnel to hazards.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. Ensure that all machine covers are in place before returning machine to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it; for example, under desk or table.
16. Avoid touching moving mechanical parts when lubricating, checking for play, etc.
17. When using stroboscope, do not touch **ANYTHING**—it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machine while performing and after completing maintenance.

**Knowing safety rules is not enough.
An unsafe act will inevitably lead to an accident.
Use good judgment—eliminate unsafe acts.**

ARTIFICIAL RESPIRATION

General Considerations

1. Start Immediately—Seconds Count
Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions
Remove foreign objects. Pull tongue forward.
3. Loosen Clothing—Keep Victim Warm
Take care of these items after victim is breathing by himself or when help is available.
4. Remain in Position
After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor
Have someone summon medical aid.
6. Don't Give Up
Continue without interruption until victim is breathing without help or is certainly dead.

Rescue Breathing for Adults

1. Place victim on his back immediately.
2. Clear throat of water, food, or foreign matter.
3. Tilt head back to open air passage.
4. Lift jaw up to keep tongue out of air passage.
5. Pinch nostrils to prevent air leakage when you blow.
6. Blow until you see chest rise.
7. Remove your lips and allow lungs to empty.
8. Listen for snoring and gurglings—signs of throat obstruction.
9. Repeat mouth to mouth breathing 10-20 times a minute. Continue rescue breathing until victim breathes for himself.



Thumb and
finger positions

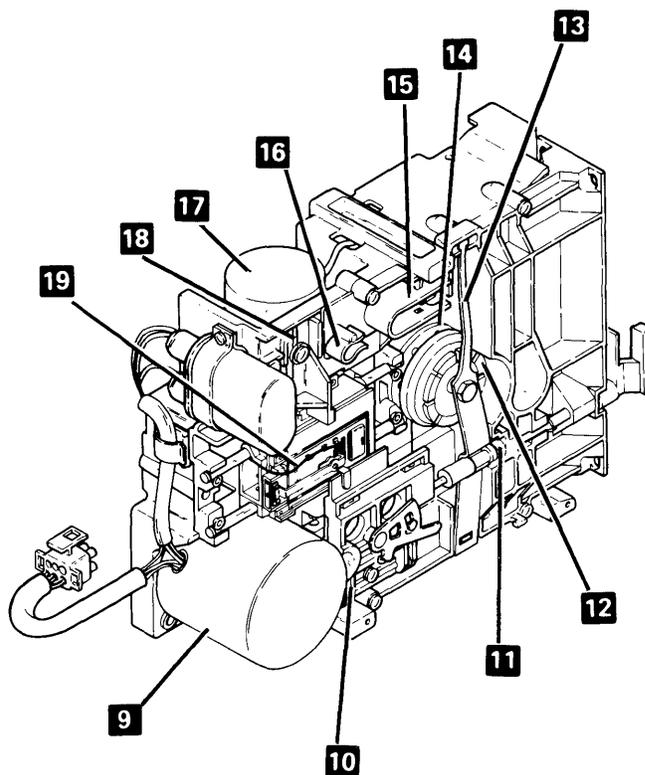
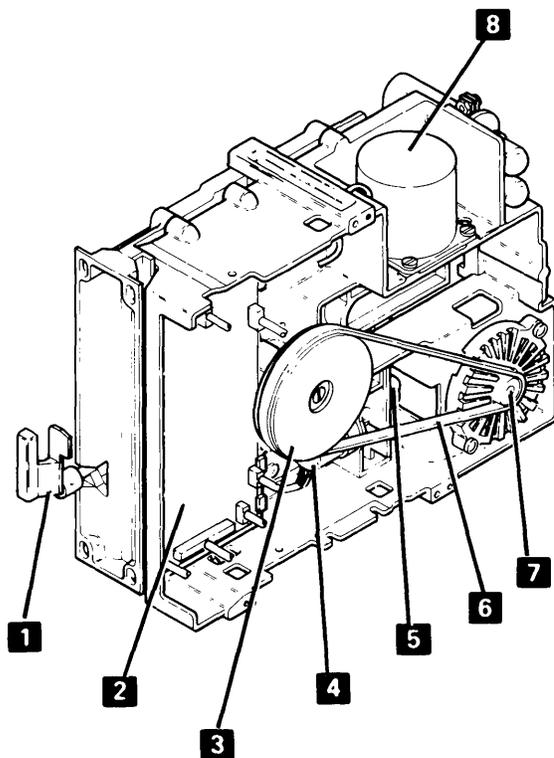


Final mouth-to-
mouth position

Locations

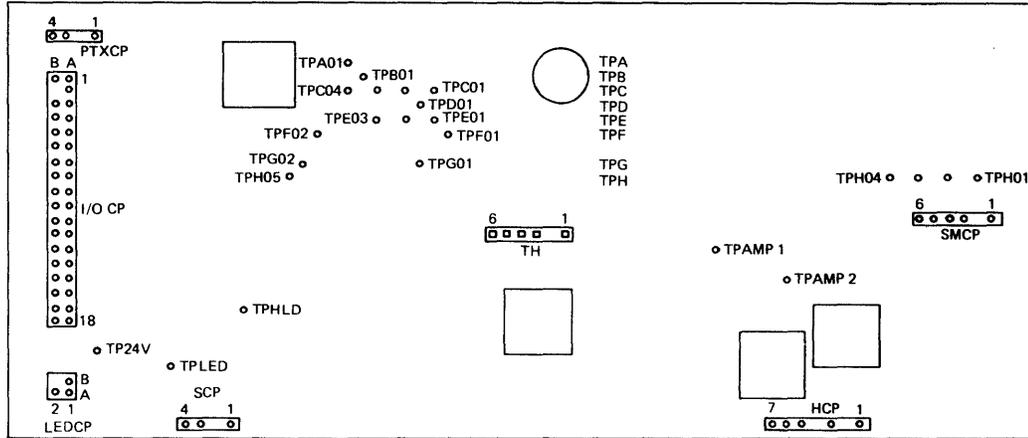
330 DISKETTE DRIVE

- 1** Diskette locking lever
- 2** Diskette drive control card
- 3** Spindle pulley
- 4** Head load solenoid
- 5** Solenoid idler
- 6** AC drive belt
- 7** AC drive pulley (with fan hidden)
- 8** Stepper motor
- 9** AC drive motor
- 10** Head load bail
- 11** Pressure roll
- 12** Collet
- 13** Collet flat spring
- 14** Drive hub
- 15** Carriage pressure spring
- 16** Thickness gauge clip
- 17** Stepper motor
- 18** Timing pin
- 19** Head/carriage assembly



331 DISKETTE DRIVE CONTROL CARD

31SD

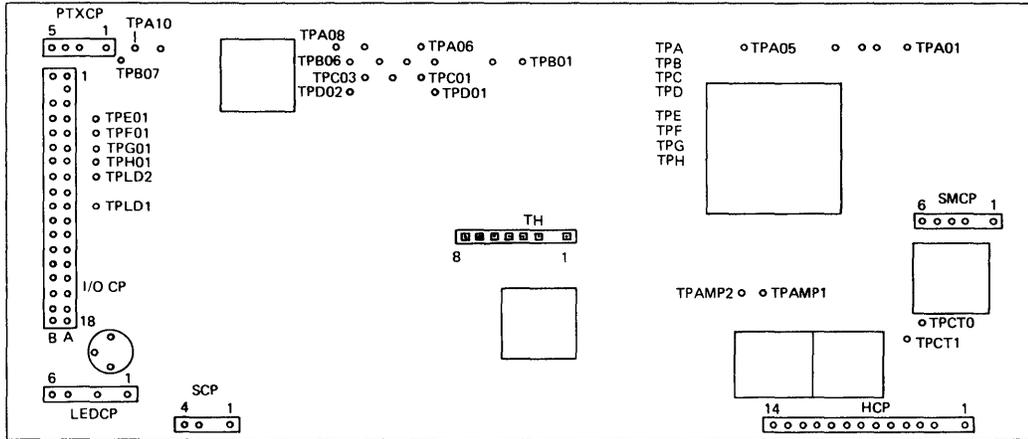


TH01	Diff Read B
TH02	No Pin
TH03	Diff Read A
TH04	Not Assigned
TH05	-Disable Stepper Motor
TH06	+18 V

TPA01	-5 Vdc
TPB01	-5 Vdc
TPC01	-Access 1
TPC02	31SD PTX
TPC03	Write Data
TPC04	Ground
TPD01	+Inner Tracks
TPE01	+Access 0
TPE02	+Head Engage
TPE03	+Index
TPF01	Ground
TPF02	+Write Erase Enabled

TPG01	+File Data
TPG02	-Erase Gate
TPH01	MC-3
TPH02	MC-2
TPH03	MC-1
TPH04	MC-0
TPH05	+Write Gate
TPAMP1	Preamp TP1
TPAMP2	Preamp TP2
TPHLD	-Head Load
TP24V	+24 Vdc
TPLED	31SD LED Voltage

51TD



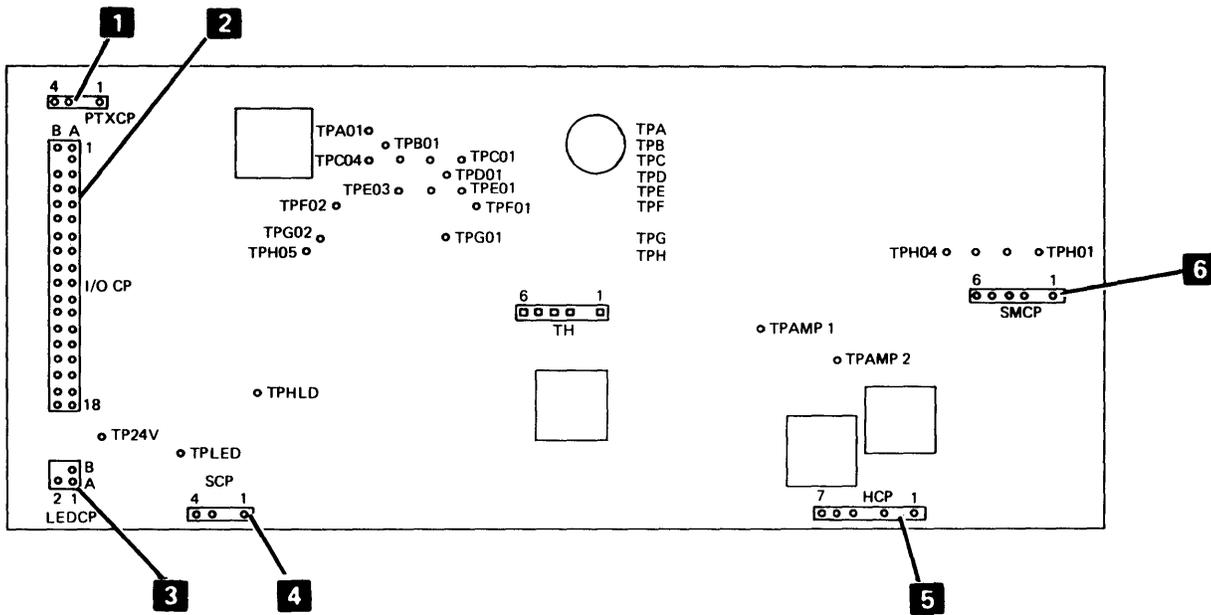
TH01	Diff Read B
TH02	No Pin
TH03	Diff Read A
TH04	High Gain
TH05	-Disable Stepper Motor
TH06	+14V
TH07	Access Clamp Voltage
TH08	Oscillator

TPA01	MC 3
TPA02	MC 1
TPA03	MC 2
TPA04	MC 0
TPA05	Ground
TPA06	-Erase Gate
TPA07	Ground
TPA08	-Head Load
TPA09	-5 Vdc
TPA10	51TD PTX
TPB01	-24 Vdc
TPB02	Ground
TPB03	+Select Head 1
TPB04	+Write Gate
TPB05	+Head Engage
TPB06	Write Data

TPB07	31SD PTX
TPC01	+Access 0
TPC02	+Inner Tracks
TPC03	-5 Vdc
TPD01	+Access 1
TPD02	+Switch Filter
TPE01	+Index
TPF01	+Diskette Sense
TPG01	+Write Erase Enabled
TPH01	+File Data
TPLD2	51TD LED Voltage
TPLD1	31SD LED Voltage
TPAMP2	Preamp TP2
TPAMP1	Preamp TP1
TPCT0	Center Tap Head 0
TPCT1	Center Tap Head 1

333 DISKETTE DRIVE CONTROL CARD CONNECTOR PINS

31SD



1 PTX Connector

A01 PTX col (+5 V)
 A02 blank
 A03 PTX emitter
 A04 not used

2 I/O Interface Connector

A01 -5 V
 A02 power supply ground
 A03 – A18 ground
 B01 +5 V
 B02 blank
 B03 +24 V
 B04 +index
 B05 +diskette 2 sense
 B06 +write/erase sense
 B07 +file data
 B08 +inner tracks
 B09 +erase gate
 B10 +access 0
 B11 not used
 B12 not used
 B13 +access 1
 B14 +write gate
 B15 +head engage
 B16 not used
 B17 write data
 B18 not used

3 LED Connector

A01 ground
 A02 not used
 B01 LED anode
 B02 blank

4 Solenoid Connector

A01 not used
 A02 blank
 A03 +24 V
 A04 -head load

5 Head Connector

A01 ground
 A02 blank
 A03 erase coil
 A04 blank
 A05 read/write coil
 A06 read/write coil
 A07 ground

6 Stepper Motor Connector

A01 +24 V
 A02 blank
 A03 MC-3
 A04 MC-2
 A05 MC-1
 A06 MC-0

51TD

7 PTX Connector

A01	diskette 1 col (+5 V)
A02	blank
A03	diskette 1 PTX emitter
A04	diskette 2, 2D PTX emitter
A05	diskette 2, 2D col (+5 V)

8 I/O Interface Connector

A01	-5 V
A02	power supply ground
A03 – A18	ground
B01	+5 V
B02	blank
B03	+24 V
B04	+index
B05	+diskette 2 sense
B06	+write/erase sense
B07	+file data
B08	+inner tracks
B09	+erase gate
B10	+access 0
B11	+select head 1
B12	not used
B13	+access 1
B14	+write gate
B15	+head engage
B16	+switch filter
B17	write data
B18	not used

9 LED Connector

A01	diskette 2, 2D ground
A02	blank
A03	diskette 2, 2D ground
A04	blank
A05	diskette 1 ground
A06	diskette 1 anode

10 Solenoid Connector

A01	not used
A02	blank
A03	+head load
A04	-head load

11 Head Connector

A01	not used
A02	blank
A03	head 0 read/write coil
A04	head 0 center tap
A05	head 0 read/write coil
A06	head 0 erase
A07	head 0 erase common
A08	ground
A09	ground
A10	head 1 erase common
A11	head 1 erase
A12	head 1 read/write coil
A13	head 1 center tap
A14	head 1 read/write coil

12 Stepper Motor Connector

A01	+24 V
A02	blank
A03	MC-3
A04	MC-2
A05	MC-1
A06	MC-0

Collet

335 COLLET/FLAT SPRING REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. If the diskette drive was removed from an IBM 5282 or an IBM 5286, remove the mounting bracket on the base of the drive by removing two screws on each side of the mounting bracket. (This bracket is not installed for the other data stations.)
3. Close the diskette locking lever **3**.
4. Loosen the bail lever screw **15**.
5. Push the bail **10** inward slightly and disconnect the bail actuator cable eyelet **17** from the bail lever **16**.
6. Open the diskette locking lever.
7. (51TD) Place a piece of clean paper between the heads, or insert a scratch diskette.
8. Loosen the bail mounting screw **8**.
9. Pull the pivot rod **9** out, then remove the bail and the bail return spring **11** by sliding them out from under the head load arm **1**. (Note the location of the bail return spring between the bail and the diskette guide for replacement.)
10. Remove the screw and the nut **13**.

CAUTION

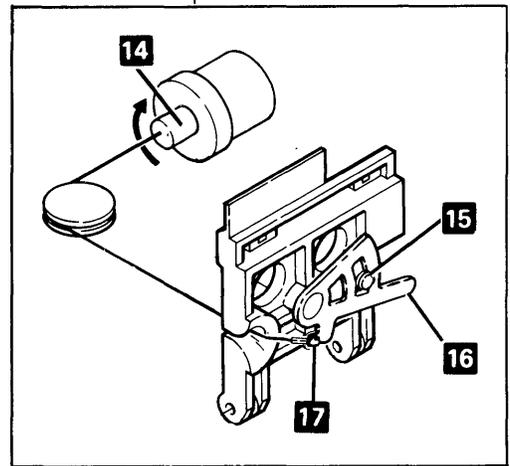
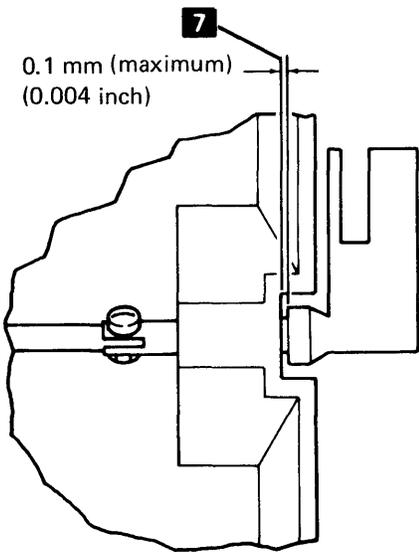
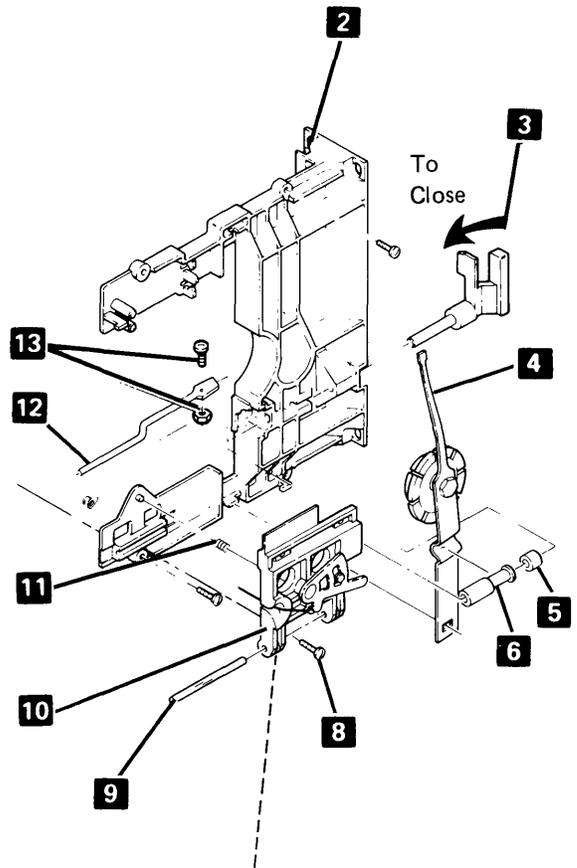
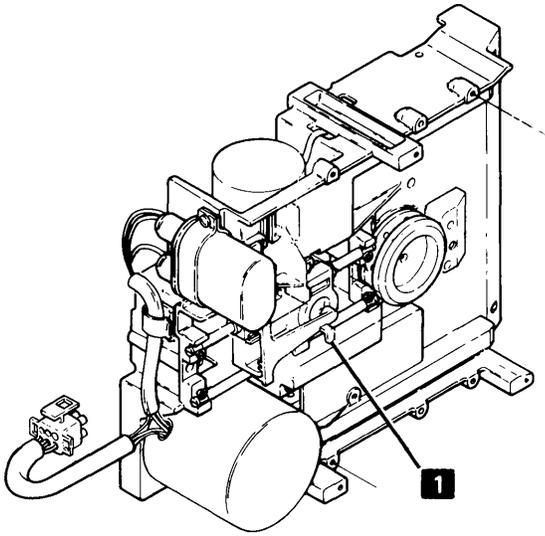
(31SD) Do not let the head hit the pressure pad, or the head could be damaged. (51TD) Do not let the heads hit each other, or the heads could be damaged.

11. Remove the diskette locking lever **3**.
12. Remove the collet actuator roll **6** and the pressure roll **5**.

13. Turn the collet actuator rod **12** up and out of the way.
14. Remove the collet/flat spring assembly **4**.

Replacement

1. Reinstall the collet/flat spring assembly **4**.
2. Reinstall the collet actuator roll **6** and the pressure roll **5**.
3. Turn the collet acuator rod **12** down against the flat spring.
4. Reinstall the diskette locking lever **3** in the open position.
5. Reinstall the screw and the nut **13**. Leave the screw loose.
6. Push the diskette locking lever toward the collet actuator rod until there is a maximum gap **7** of 0.1 millimeter (0.004 inch) between the diskette locking lever and the diskette guide **2**. Tighten the screw **13**.
7. Reinstall the bail **10** on the collet actuator rod **12**. Ensure that the bail return spring **11** is in the correct position. Place the bail **10** under the head load arm **1**. Install the pivot rod **9** and tighten screw **8**.
8. Close the diskette locking lever **3**.
9. Push the bail inward slightly and reconnect the bail actuator cable eyelet **17** to the bail lever **16**. Ensure that the crimp on the eyelet faces out.
10. If the bail actuator cable is twisted, turn the solenoid plunger **14**.
11. Open the diskette locking lever **3**.
12. (51TD) Remove the paper from between the heads, or remove the scratch diskette.
13. Insert and remove a diskette. The diskette should move into and out of the diskette drive smoothly without hitting the collet. If it does not, install a new flat spring.
14. Perform the head gap adjustment (see 345).



Head/Carriage Assembly

337 HEAD/CARRIAGE SERVICE CHECK

CAUTION

The head/carriage service check must be performed with the diskette drive installed (or in the same position as when installed) or the service checks might not be accurate.

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **9**.
3. Remove the cable guide **11**.
4. Turn the stepper motor pulley **7** by hand to track 40 and insert a timing pin **6**. (Ensure that the timing pin goes into the casting **8**.)
5. Power on.

CAUTION

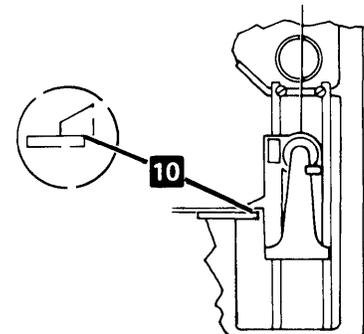
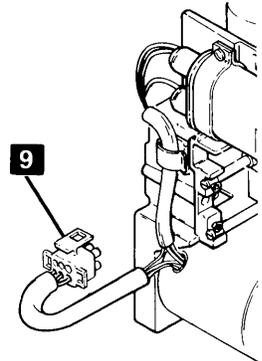
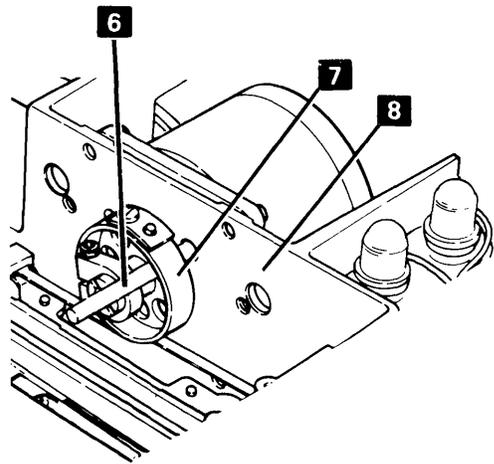
The PTX, LED, or diskette drive control card might be damaged if you install jumpers on the wrong test pins.

6. Install a jumper from **2** (ground) to **5** (-disable stepper motor).
7. Install a jumper from **1** (ground) to **3** (MC-0) to electrically detent the stepper motor.
8. Remove and reinsert the timing pin.
9. If the timing pin passes freely through the stepper motor pulley into the timing hole in the casting, go to step 14. If the timing pin does not pass freely through the stepper motor pulley into the timing hole in the casting, proceed with step 10.
10. Remove the timing pin.
11. Power off.

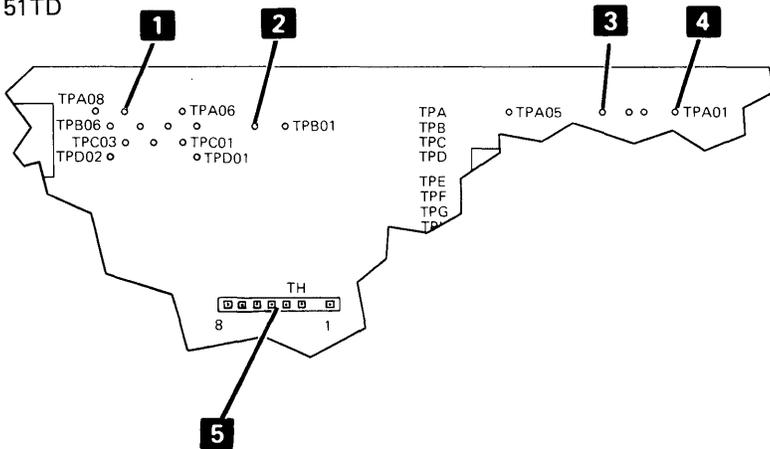
12. Remove the jumpers from **2** (ground) to **5** (-disable stepper motor) and from **1** (ground) to **3** (MC-0).
13. Go to 339 step 4.
14. Remove the timing pin.
15. Remove the jumper end from **3** (MC-0) and install it on **4** (MC-3). This moves the stepper motor pulley to track 39.
16. Verify that the stepper motor pulley is at track 39 by visually checking for no gap between the timing pointer and the timing block **10**.
17. Remove the jumper end from **4** (MC-3) and install it on **3** (MC-0). This moves the stepper motor pulley to track 40.
18. Verify that the stepper motor pulley is at track 40 by visually checking that the timing hole in the pulley is aligned with the timing hole in the casting. Use a dental mirror to check. Do not insert the timing pin.
19. Check the gap between the timing pointer and the timing block **10** as follows:
 - a. Insert thickness gauges totaling 0.483 millimeter (0.019 inch) between the timing block and the timing pointer and visually check that the head/carriage assembly does not move.
 - b. Insert thickness gauges totaling 0.533 millimeter (0.021 inch) between the timing block and the timing pointer and visually check that the head/carriage assembly moves slightly.
20. If the conditions in step 19 are not correct, go to 339, step 16. If the conditions are correct, proceed with step 21.
21. Power off.

Note: Because of the torque characteristics of the stepper motor, step 19 can be performed only once. If it is necessary to perform this step again, go back to step 14 of this service check.

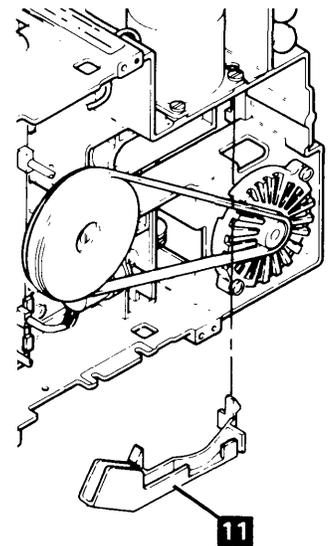
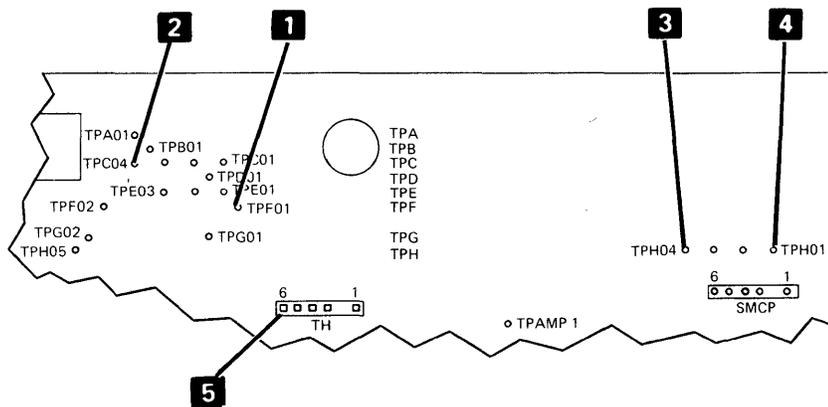
22. Remove the jumper from **2** (ground) to **5** (-disable stepper motor) and the jumper from **1** (ground) to **3** (MC-0).
23. Reinstall the cable guide **11**. (Ensure that the head/carriage assembly moves freely.)
24. If a new head/carriage assembly was installed, go to 344. If a new head/carriage assembly was not installed, proceed with step 25.
25. Reconnect the AC drive motor power cable.
26. Power on.



51TD



31SD



339 HEAD/CARRIAGE ADJUSTMENT

CAUTION

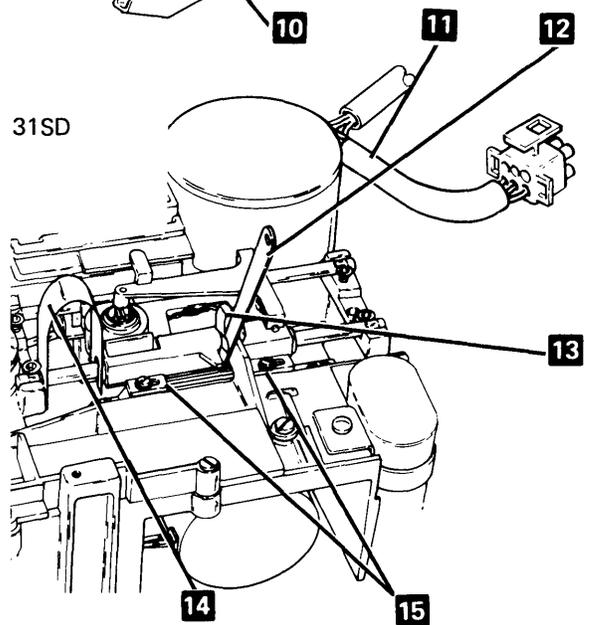
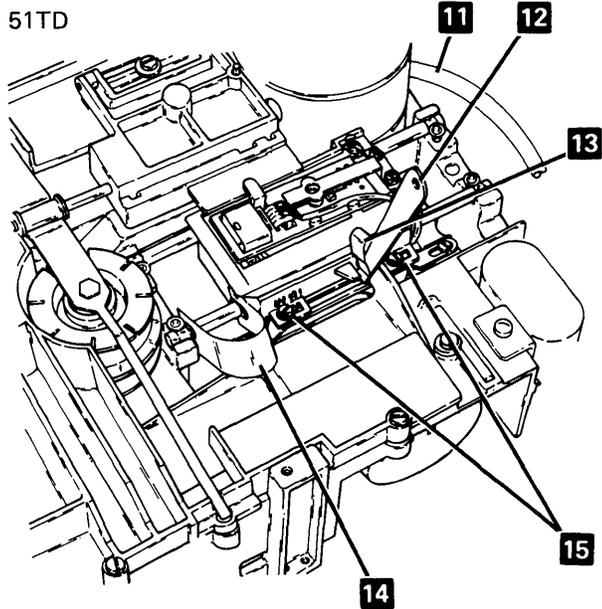
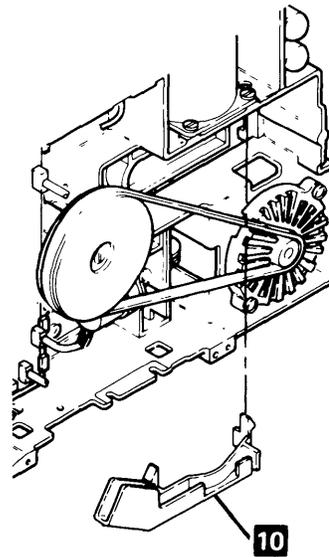
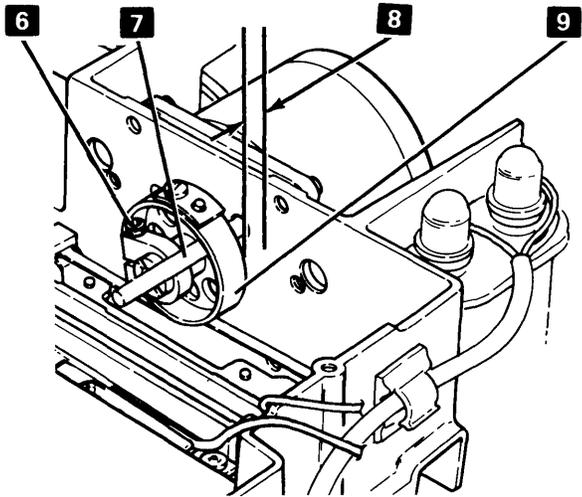
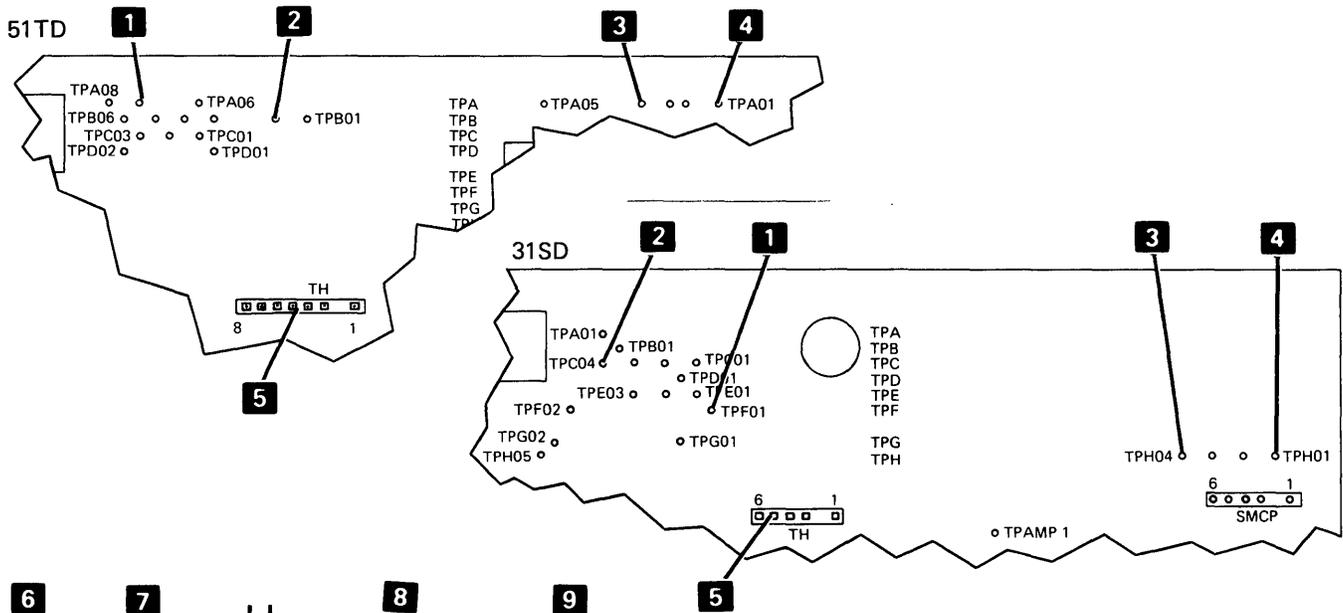
The head/carriage assembly adjustment must be performed with the diskette drive installed (or in the same position as when installed) or the adjustment might not be accurate.

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **11**.
 3. Remove the cable guide **10**.
 4. Measure and record the gap **8** between the stepper motor pulley and the casting. The gap is _____.
 5. Loosen the clamp screw **6** so the stepper motor shaft can turn inside the pulley.
 6. Turn the stepper motor pulley **9** by hand to track 40 and insert the timing pin **7**.
 7. Power on.
 8. Install a jumper from **2** (ground) to **5** (-disable stepper motor).
 9. Install a jumper from **1** (ground) to **3** (MC-0).
 10. Set the gap **8** to the same size as the gap recorded in step 4 and tighten the clamp screw. (Ensure that the timing pin passes freely through the stepper motor pulley into the timing hole in the casting.)
 11. Remove the timing pin.
 12. Loosen the two screws **15** that hold the bracket to the carriage.
 13. Remove the jumper end from **3**; and momentarily touch it to **4**.
 14. Reinstall the jumper end on **3**.
- Note:** Steps 13 and 14 set up the required torque condition of the stepper motor for the following steps.
15. Verify that the stepper motor pulley is at track 40 by visually checking that the timing hole in the pulley is aligned with the timing hole in the casting. Use a dental mirror to check. Do not insert a timing pin.
 16. Insert thickness gauges **12** totaling 0.508 millimeters (0.020 inch) between the timing pointer on the carriage and the track 40 adjustment surface on the casting. Clamp the thickness gauge **12** to the casting with the retaining clip **13** provided (part 4240632). The clip is attached to the diskette guide. (For location, see 330 **16**.)
 17. Slide the head/carriage assembly against the thickness gauge so it just touches but is not forced against the thickness gauge. Insert the carriage pressure spring **14** (part 4240631) between the casting and the carriage to hold the carriage against the thickness gauge. The carriage pressure spring is attached to the diskette guide. (For location, see 330 **15**.)
 18. Tighten the two screws that hold the bracket to the carriage.
 19. Remove the retaining clip and the carriage pressure spring.
 20. Go to 337, step 14.



340 PRESSURE PAD REMOVAL AND REPLACEMENT (31SD ONLY)

Removal

1. Move the head load arm **4** away from the read/write head **5**.

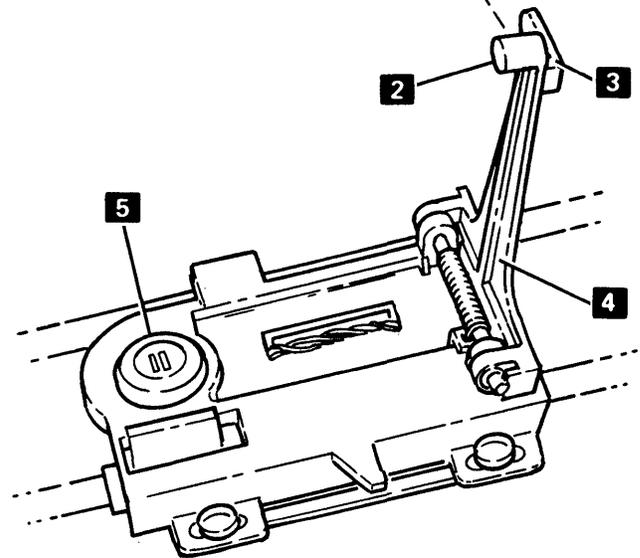
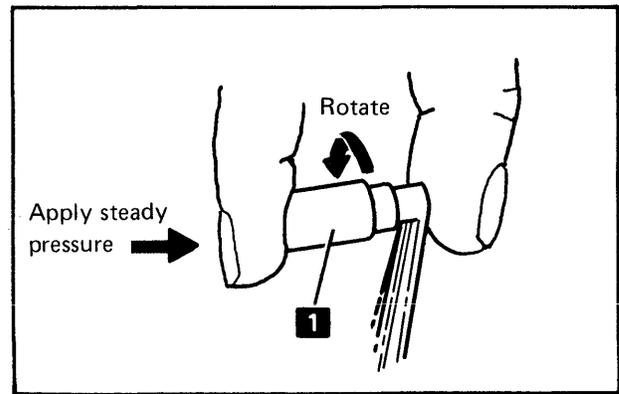
CAUTION

Do not scratch the head load arm.

2. Use a scissor clamp (part 9900233) to pull the pressure pad **2** off the head load arm.

Replacement

1. Clean the pressure pad mounting surface **3** with a lint-free cloth that is moistened with isopropyl-alcohol solvent.
2. Remove the paper cover that protects the adhesive layer on the new pad.
3. Place the new pad in the center of the mounting surface on the head load arm.
4. Lightly press the new pad in place with a clean screwdriver.
5. Use the small end of the pressure pad tool **1** and press the pressure pad onto the head load arm.
6. Turn the pressure pad tool at least one revolution in one direction only.
7. Move the head load arm toward the read/write head.



341 HEAD/CARRIAGE REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Remove the head cable connector **21** from the diskette drive control card **20** and remove the head cable from the cable guide **22**.
3. Remove the cable guide **22**.

CAUTION

The drive band must not be bent or damaged in any way.

4. Remove the two screws **8** and the screw **5**, then remove the drive band **15**. (Note the position of the drive band and the clamps; they must be in the same position when reinstalled.)
5. Remove the carriage bracket **7** from the carriage.
6. (51TD) Place a piece of clean paper between the heads.
7. Remove the two screws **11** (one on each end of guide rod **9**) and remove guide rod **9**.
8. Lift and turn the head/carriage assembly to remove it from guide rod **10**.

Replacement

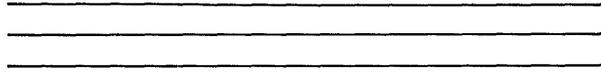
CAUTION

When installing the head/carriage assembly, ensure that the bail is under the tab of the carriage arm, the bail return spring is properly installed, and the drive band is not damaged in any way. (51TD) Ensure that a strip of clean paper is inserted between the head surfaces during installation.

1. Reinstall the head/carriage assembly on guide rod **10**. Then place the head/carriage assembly to the lower limit (track 00).
2. Reinstall guide rod **9** and tighten the two screws. Ensure that the guide rod notch **12** is aligned with the screw.
3. Move the head/carriage assembly by hand to track 40.
4. Reinstall the carriage bracket on the carriage with the screws installed in the center of the hole.
5. Connect the welded adapter end of the drive band **14** to the slotted end of the carriage bracket. Use the clamp **16** to install the drive band to the stepper motor pulley. Ensure that the drive band is parallel to the carriage bracket and the edge of the pulley.
6. Block the head/carriage assembly approximately 25 millimeters (1 inch) from the casting **19**.
7. Pull on the welded adapter end of the drive band **14** with 2.5 ± 0.25 pounds of force (use gauge **18**, part 460870) and tighten the band clamping screw. Ensure that the drive band is parallel to the stepper motor pulley edge.
8. Remove the block from between the casting and the head/carriage assembly.
9. (51TD) Remove the paper from between the heads.
10. Move the head/carriage assembly back and forth by hand and ensure that the drive band tracks straight and that the drive band is parallel to the stepper motor pulley edge (see 361).
11. Connect the head cable connector to the diskette drive control card.
12. Turn the stepper motor pulley by hand to track 40 and insert the timing pin.

DANGER

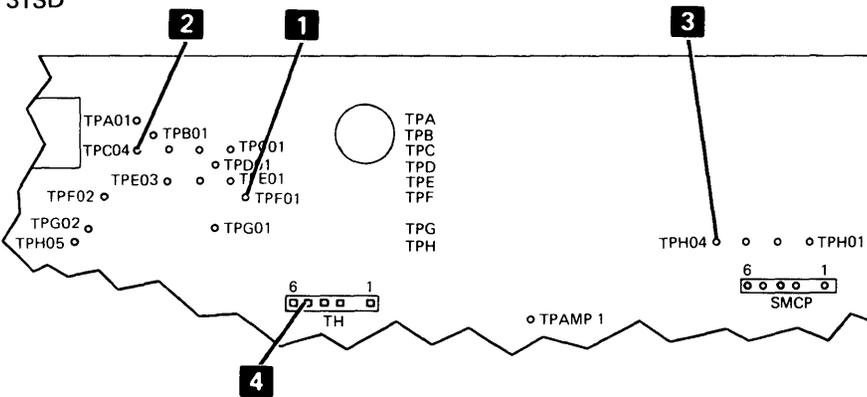
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.



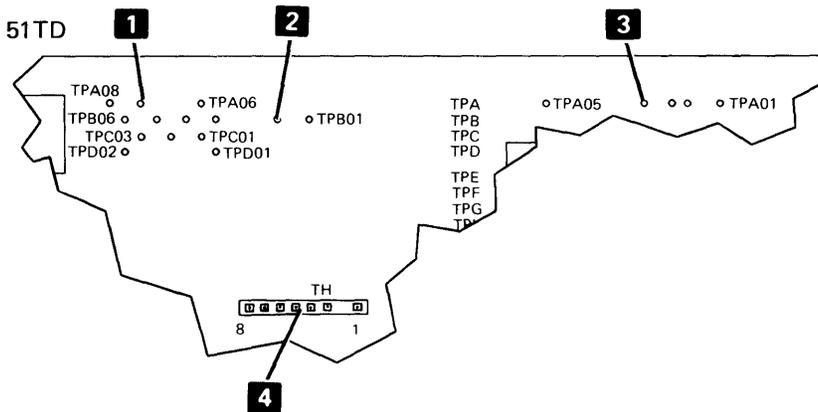
13. Disconnect the AC drive motor power cable **17**.
14. Remove the timing pin.
15. Power on.
16. Install a jumper from **2** (ground) to **4** (-disable stepper motor).
17. Install a jumper from **1** (ground) to **3** (MC-0).

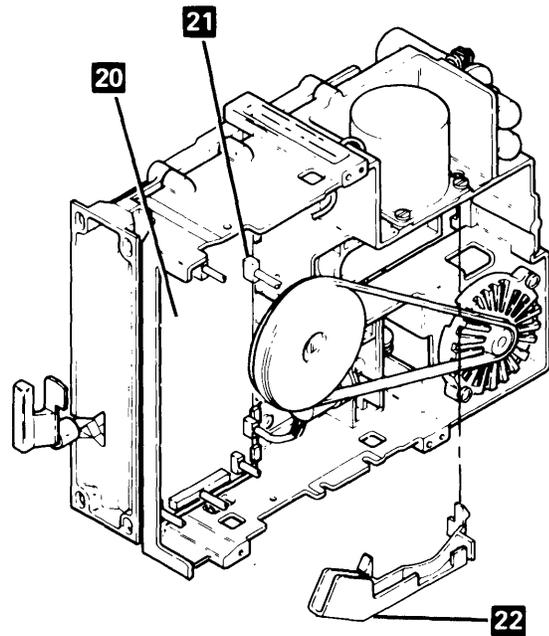
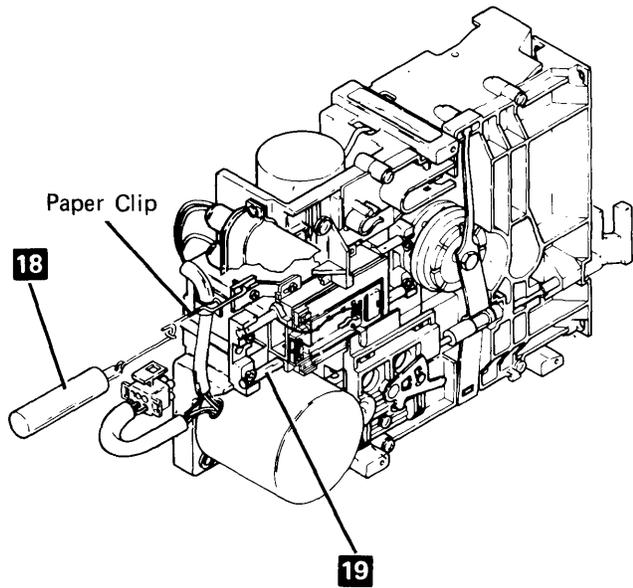
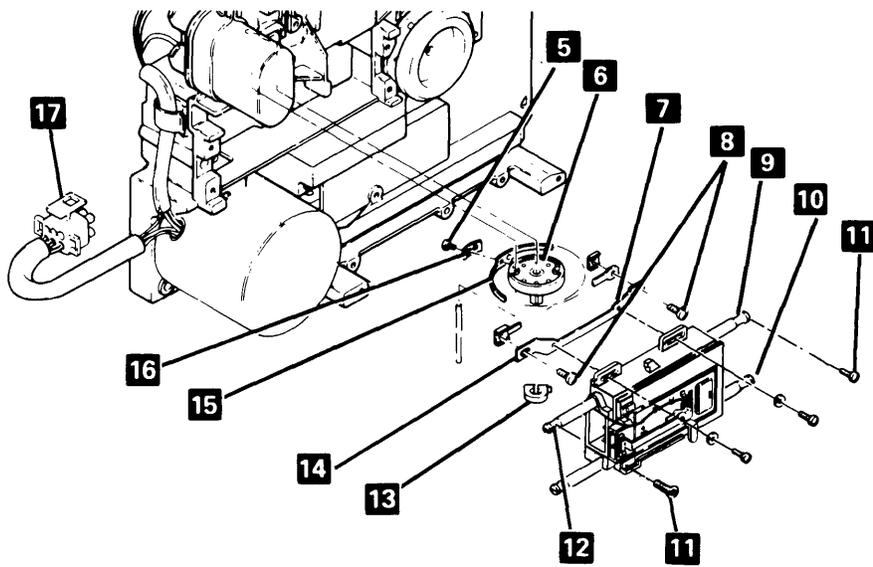
18. If the timing pin passes freely through the stepper motor pulley into the timing hole in the casting, go to step 23. If the timing pin does not pass freely, proceed with step 19.
19. Remove the timing pin.
20. Remove the jumpers installed in steps 16 and 17.
21. Power off.
22. Go to 339, step 4.
23. Remove the timing pin.
24. Go to 339, step 12.

31SD



51TD





Head Load Solenoid and Bail

343 SOLENOID AND BAIL SERVICE CHECK

1. Power off.

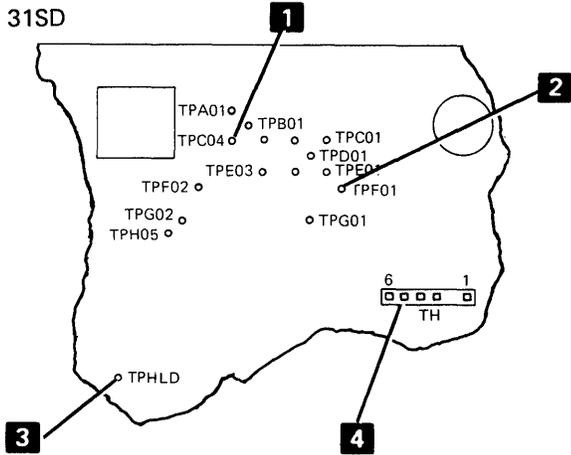
DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

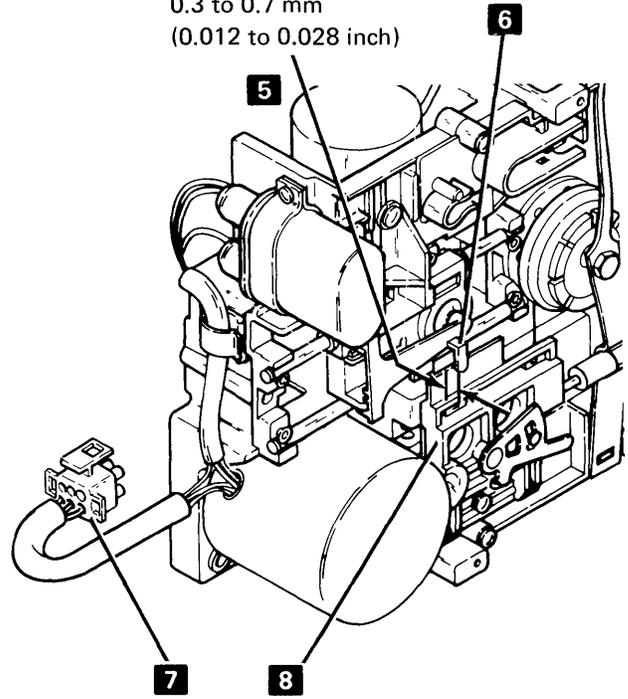
2. Disconnect the AC drive motor power cable **7**.
3. Insert a diskette into the diskette drive and close the diskette locking lever **9**.
4. Power on.
5. Install a jumper from **2** (ground) to **3** (-head load).

6. Install a jumper from **1** (ground) to **4** (-disable stepper motor).
7. Visually check for a 0.3 to 0.7 millimeter (0.012 to 0.028 inch) gap **5** between the bail **8** and the head load arm **6** for all of the carriage travel (track 00 through track 76).
8. If the gap is within the limits, proceed with step 9. If the gap is not within the limits, go to 346, step 7.
9. Remove the jumpers installed in steps 5 and 6.
10. Open the diskette locking lever and remove the diskette.
11. Close the diskette locking lever.
12. Power off.
13. Reconnect the AC drive motor power cable.
14. Power on.

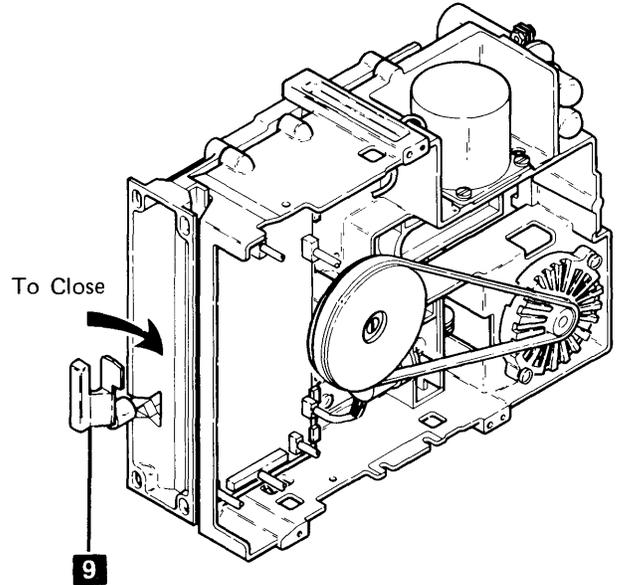
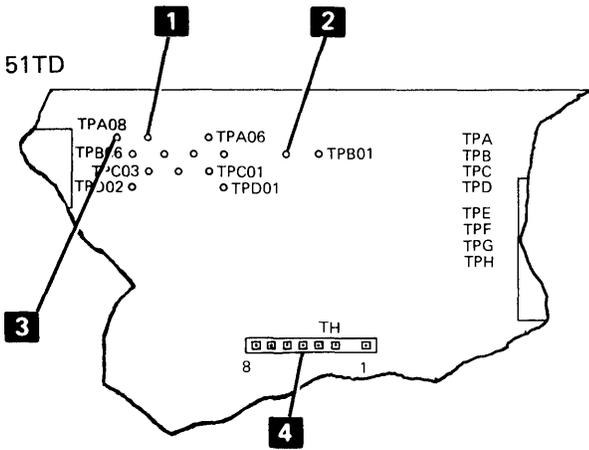
31SD



0.3 to 0.7 mm
(0.012 to 0.028 inch)

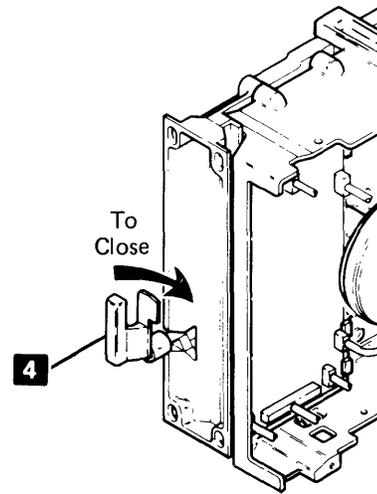
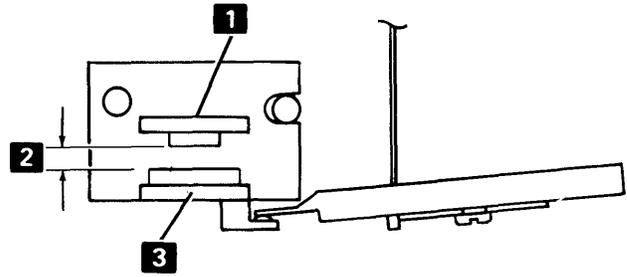


51TD



344 HEAD GAP SERVICE CHECK

1. Power off.
2. Close the diskette locking lever **4**.
3. (31SD) Visually check for a gap **2** of 3 to 4 millimeters (0.118 to 0.157 inch) between the head **1** and the head load arm **3**. (51TD) Visually check for a gap **2** of 2 to 3 millimeters (0.079 to 0.118 inch) between the head surfaces **1** and **3**.
4. If the gap is correct, proceed with step 5. If the gap is not correct, go to 345, step 3.
5. Open the diskette locking lever.
6. Power on.
7. If a new head/carriage assembly was installed, go to 343.



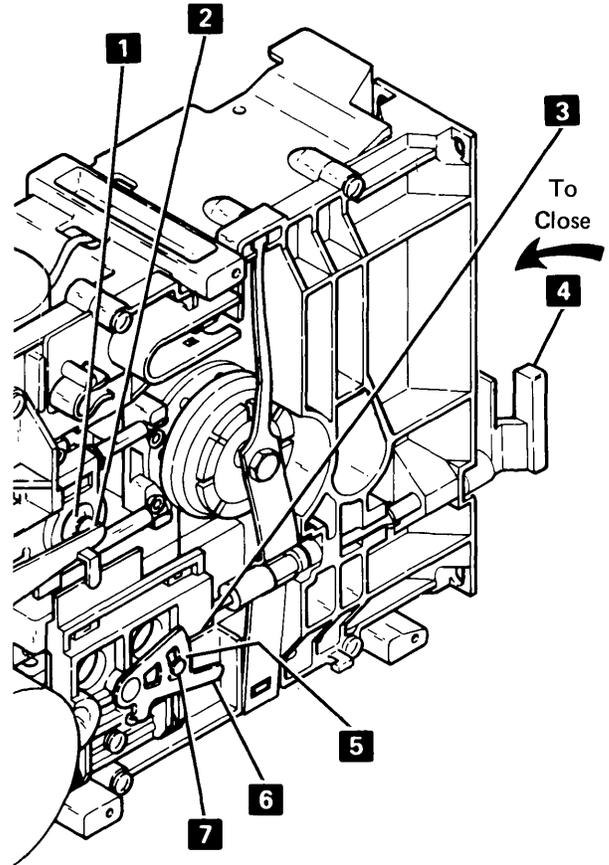
345 HEAD GAP ADJUSTMENT

1. Power off.
2. Close the diskette locking lever **4**.
3. Loosen the bail lever screw **7** just enough so that the bail lever **6** can be adjusted.

CAUTION

(31SD) Do not let the head hit the pressure pad or the head could be damaged. (51TD) Do not let the heads hit each other or the heads could be damaged.

4. (31SD) Move the bail lever slowly until the head load arm **2** just touches the head **1**. (51TD) Move the bail lever until the two heads just touch each other.
5. Note the location of the marks **5** on the bail lever relative to the bail alignment edge **3**.
6. (31SD) Turn the bail lever one and one half marks clockwise. (51TD) Turn the bail lever one mark clockwise.
7. Tighten the bail lever screw.
8. Go to 344, step 3.



346 SOLENOID AND BAIL ADJUSTMENT

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **5**.
3. Power on.
4. Insert a diskette and close the diskette locking lever **8**.
5. Install a jumper from **2** (ground) to **1** (-head load).
6. Install a jumper from **3** (ground) to **4** (-disable stepper motor).

DANGER

The solenoid case becomes hot after continuous use.

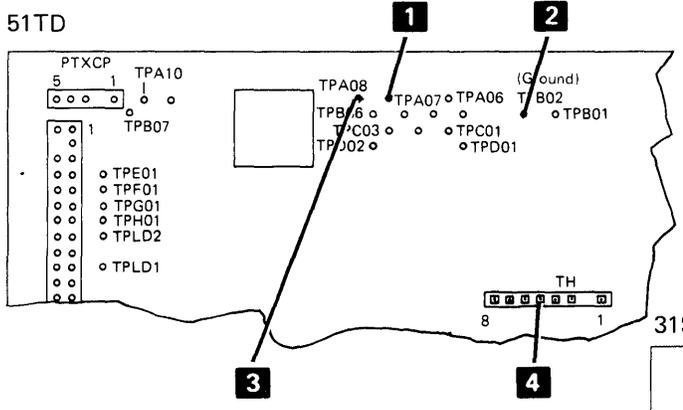
7. Loosen the solenoid locking screw **9**.

CAUTION

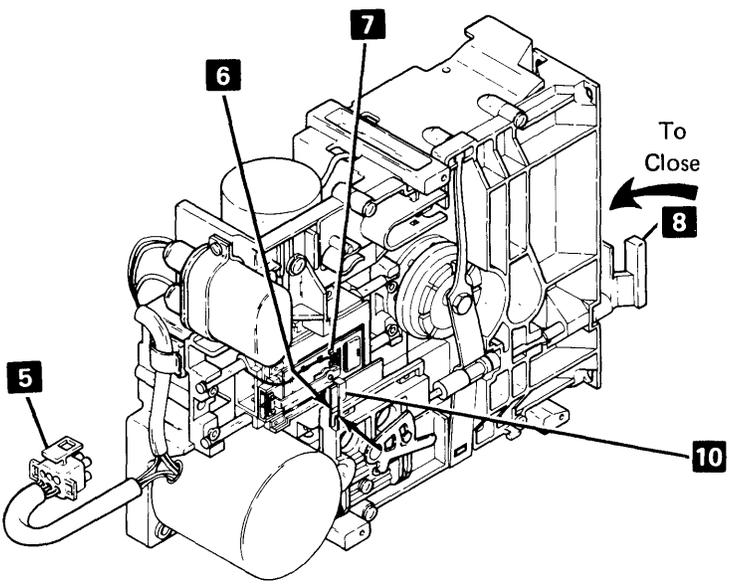
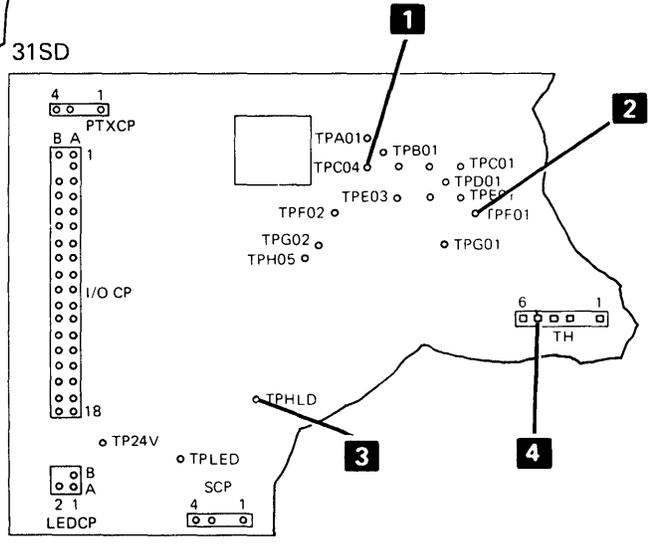
Do not let the solenoid plunger or the bail actuator cable turn.

8. Turn the solenoid to obtain a gap of 0.3 to 0.7 millimeter (0.012 to 0.028 inch) between the head load arm **10** and the bail **6**.
9. Tighten the solenoid locking screw.
10. Move the head/carriage assembly **7** by hand from one end to the other and check the gap **6** at each end of the head/carriage movement.
11. If the gap is not within the limits for all of the head/carriage movement, go back to step 7. If the gap **6** is correct, proceed with step 12.
12. Remove the jumpers installed in steps 5 and 6.
13. Open the diskette locking lever and remove the diskette.
14. Power off.
15. Reconnect the AC drive motor power cable.

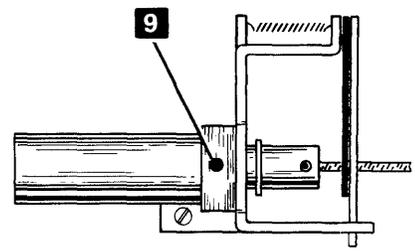
51TD



31SD



To Close



347 BAIL REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **6**.
3. (51TD) Insert a strip of clean paper between the heads **11** or insert a scratch diskette.
4. Close the diskette locking lever **1**.
5. Loosen the bail lever screw **8**.
6. Push the bail **4** inward slightly and disconnect the bail actuator cable eyelet **10** from the bail lever **9**.
7. Open the diskette locking lever.
8. Loosen the bail mounting screw **2**.

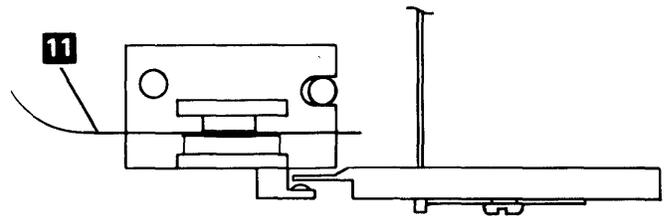
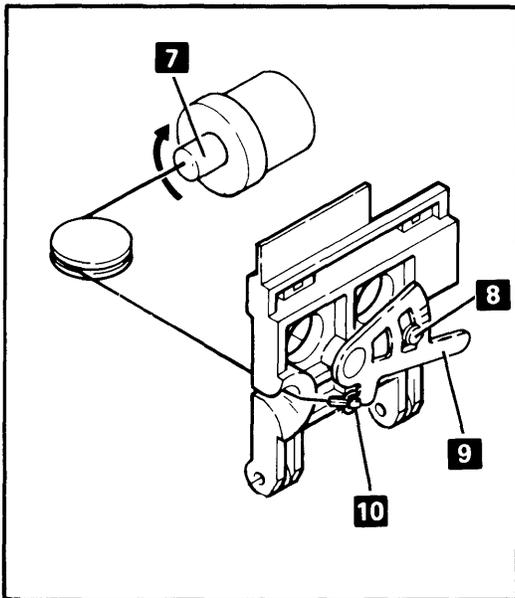
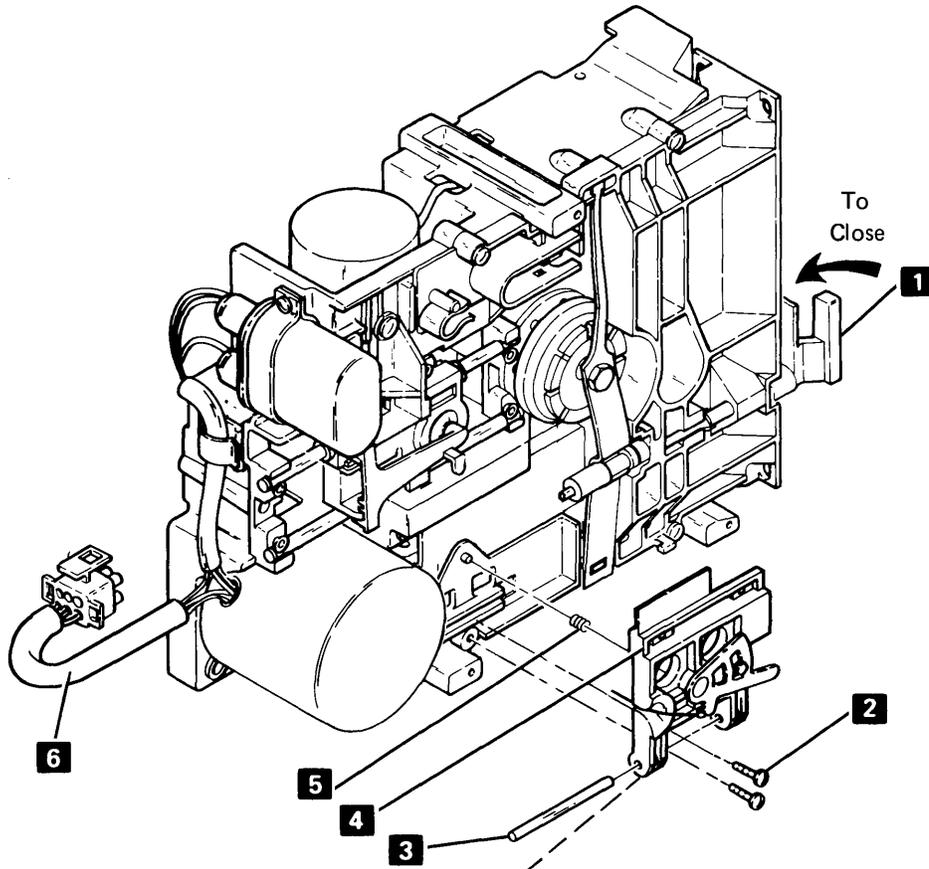
CAUTION

(31SD) Do not let the head hit the pressure pad, or the head could be damaged. (51TD) Do not let the heads hit each other, or the heads could be damaged.

9. Remove the pivot rod **3**, the bail **4**, and the bail return spring **5**. (Note the location of the bail return spring for the replacement procedure.)

Replacement

1. Reinstall the bail return spring, the bail, and the pivot rod.
2. Close the diskette locking lever.
3. Push the bail inward slightly and connect the bail actuator cable eyelet to the bail lever. (Ensure that the cable eyelet crimp is facing out.)
4. If the bail actuator cable is twisted, turn the solenoid plunger **7** by hand until the cable is straight.
5. Open the diskette locking lever.
6. (51TD) Remove the paper from between the heads, or remove the scratch diskette.
7. Perform the head gap adjustment (see 345).



349 SOLENOID AND IDLER REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

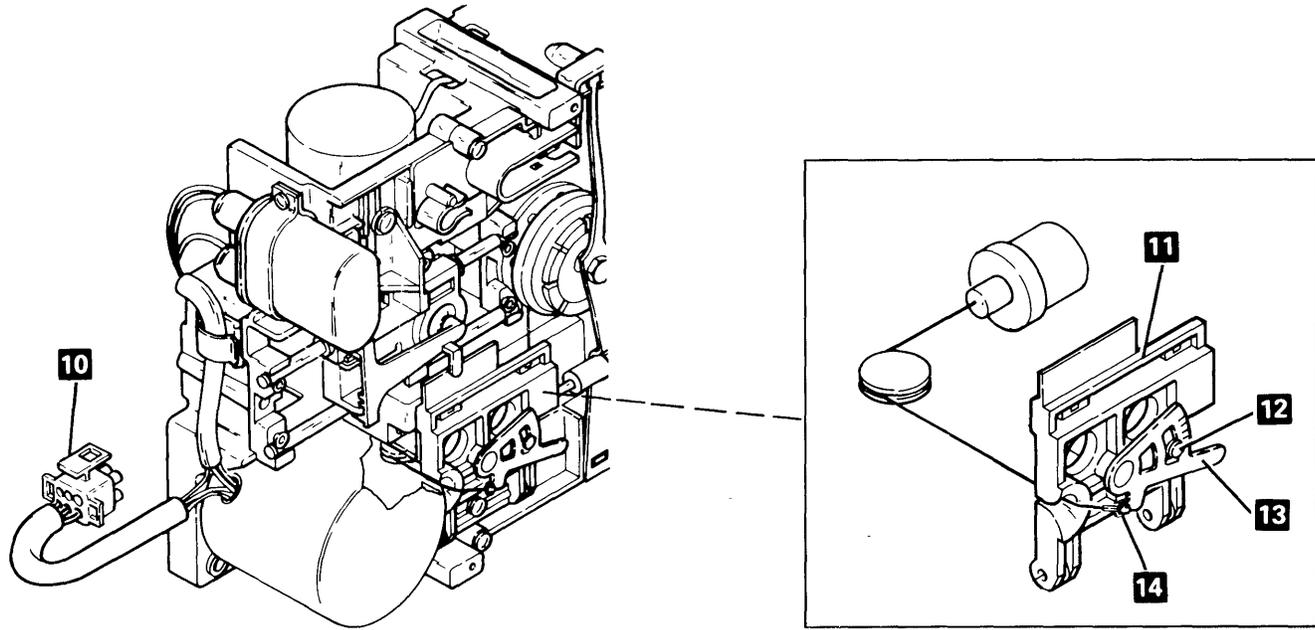
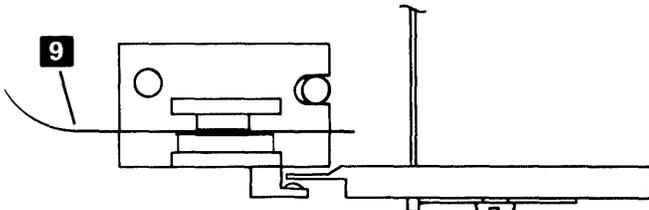
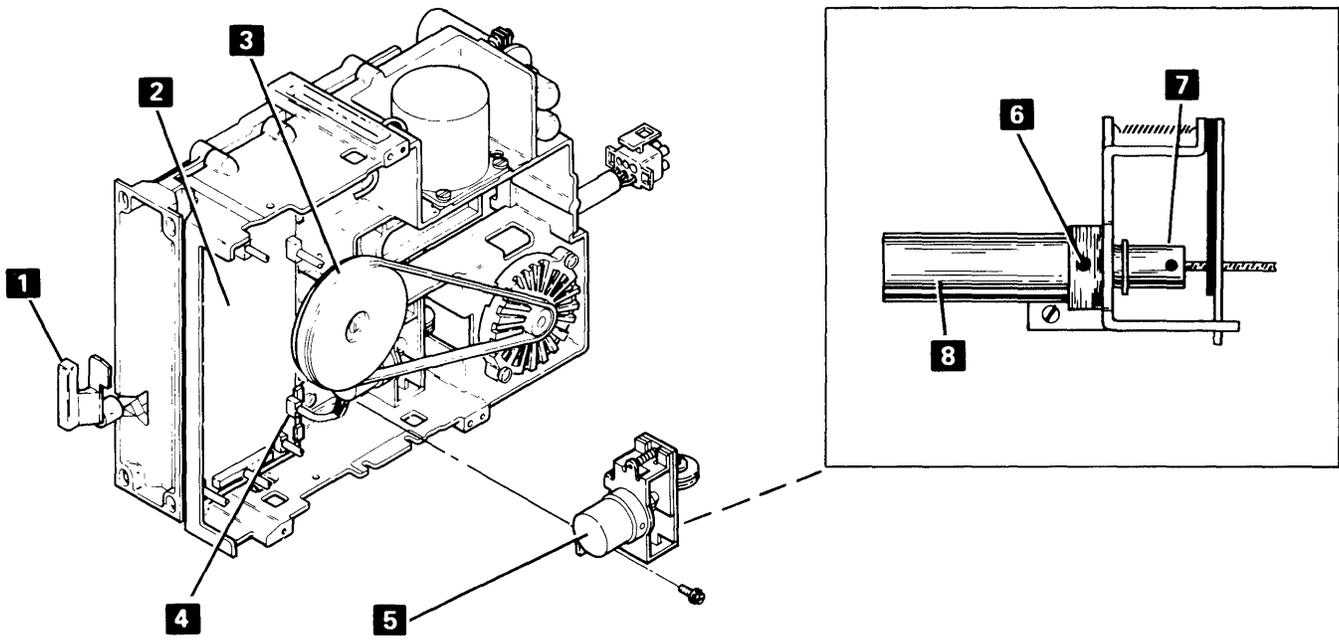
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **10**.
3. (51TD) Insert a strip of clean paper between the heads **9**, or insert a scratch diskette.
4. Close the diskette locking lever **1**.
5. Loosen the bail lever screw **12**.
6. Push the bail **11** inward slightly and disconnect the bail actuator cable eyelet **14** from the bail lever **13**.
7. Open the diskette locking lever.
8. Remove the AC drive motor belt **3**.
9. Disconnect the solenoid cable connector **4** from the diskette drive control card **2**.
10. Remove the solenoid, the bracket, and the cable as a unit **5**.
11. Loosen the solenoid locking screw **6** and unscrew the solenoid **8** from the bracket. (The solenoid and the bail actuator cable are installed as a unit.)

Replacement

To reinstall the solenoid and idler, observe the following exceptions and reverse the steps in the removal procedure.

1. When you reinstall the bail actuator cable, ensure that the eyelet crimp is facing out.
2. If the bail actuator cable is twisted, turn the solenoid plunger **7** by hand until the cable is straight.
3. After the replacement procedure is completed, perform the head gap adjustment (see 345).



AC Drive

351 AC DRIVE MOTOR REMOVAL AND REPLACEMENT

AC Drive Motor with External Fan

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **2**.
3. Remove the AC drive motor belt **11**.

DANGER

The AC drive motor case becomes hot after continuous use.

4. Remove the two fan enclosure mounting screws **9**; then remove the fan enclosure **8**.
5. Loosen the setscrew **6**; then remove the AC drive motor fan and pulley **7**.

DANGER

High voltage might be present at the capacitor terminals.

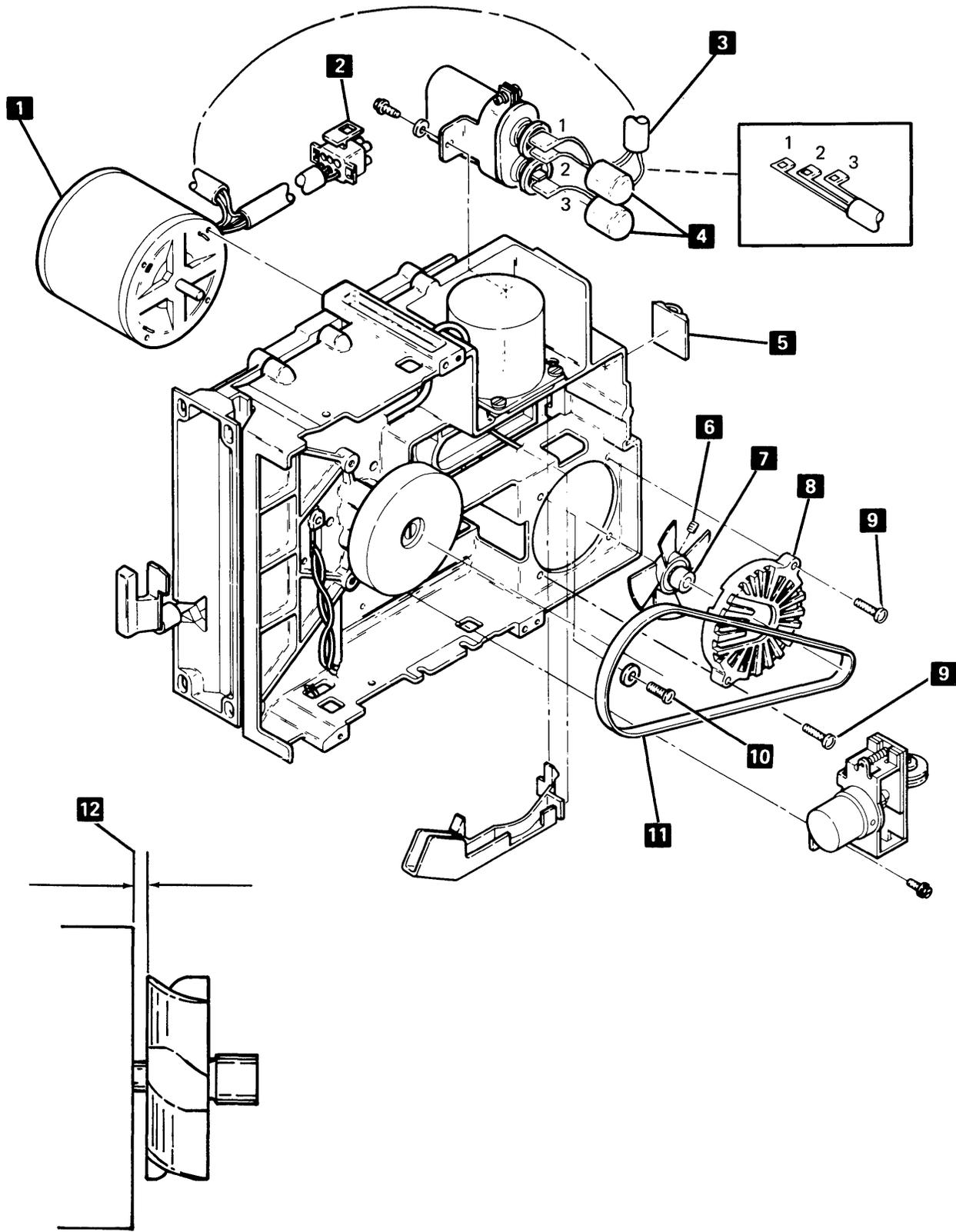
6. Remove the two insulator caps **4** from the capacitor terminals.

7. Discharge the capacitor by jumpering its terminals with a large-bladed screwdriver.
8. Remove the AC drive motor leads **3** from the capacitor terminals.
9. Remove the AC drive motor leads from the cable guide **5** on the casting.
10. Remove the two insulator caps from the AC drive motor leads.
11. Remove the two remaining mounting screws **10** and remove the AC drive motor **1**.

Replacement

To reinstall the AC drive motor, observe the following exceptions and reverse the steps in the removal procedure.

1. When installing the AC drive motor leads on the capacitor, note the cable numbers to determine which lead goes on which terminal.
2. When installing the drive fan and pulley on the AC drive motor, ensure that the setscrew is centered on the flat surface of the motor shaft.
3. Place the drive fan and pulley on the AC drive motor shaft with a gap **12** of 0.5 millimeter \pm 0.1 millimeter (0.020 inch \pm 0.001 inch) between the motor face and the fan hub.



AC Drive Motor with Internal Fan

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **2**.
3. Remove the AC drive motor belt **9**.

DANGER

High voltage might be present at the capacitor terminals.

4. Remove the two insulator caps **4** from the capacitor terminals.
5. Discharge the capacitor by jumpering its terminals with a large bladed screwdriver.
6. Remove the AC drive motor leads **3** from the capacitor terminals.
7. Remove the two insulator caps from the AC drive motor leads.

8. Loosen the setscrew **6**; then remove the AC drive motor pulley **8**.
9. Remove the four AC drive motor mounting screws **7**; then remove the AC drive motor.

Replacement

1. Reinstall the AC drive motor **1** with the four mounting screws **7** (leave the four screws loose).
2. Reinstall the AC drive motor pulley **8**. Ensure that the setscrew **6** is centered on the flat surface of the motor shaft (leave the setscrew loose).
3. Move the AC drive motor pulley **8** toward the AC drive motor until the AC drive motor pulley is in the casting **5**; then tighten the four AC drive motor mounting screws **7**.
4. Move the AC drive motor pulley out of the casting and tighten the setscrew **6** (the allen wrench should be flush with the casting when you tighten the setscrew).
5. Reconnect the AC drive motor cable **2**.
6. Reinstall the AC drive motor leads **3**; note the cable numbers to determine which lead goes on which terminal.
7. Reinstall the two insulator caps **4** on the capacitor terminals.
8. Reinstall the AC drive motor belt **9**.

353 CAPACITOR REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

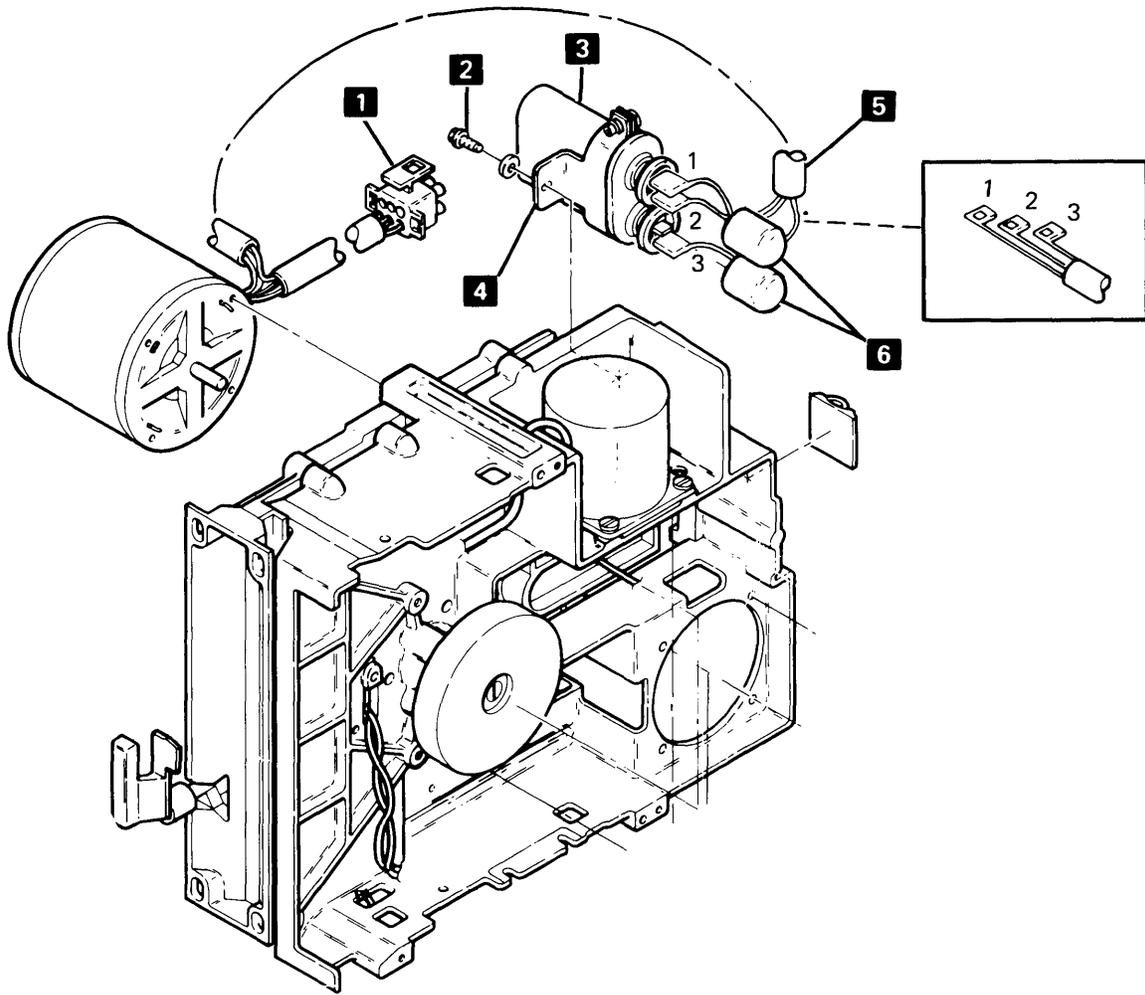
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **1**.
3. Remove the two insulator caps **6** from the capacitor terminals.

4. Discharge the capacitor **3** by jumpering its terminals with a large-bladed screwdriver.
5. Remove the three motor leads **5** from the capacitor terminals.
6. Remove the screw **2**, then remove the capacitor bracket assembly **4**.

Replacement

To reinstall the capacitor, reverse the steps in the removal procedure.



355 DRIVE FAN AND PULLEY REMOVAL AND REPLACEMENT

Removal

1. Power off.

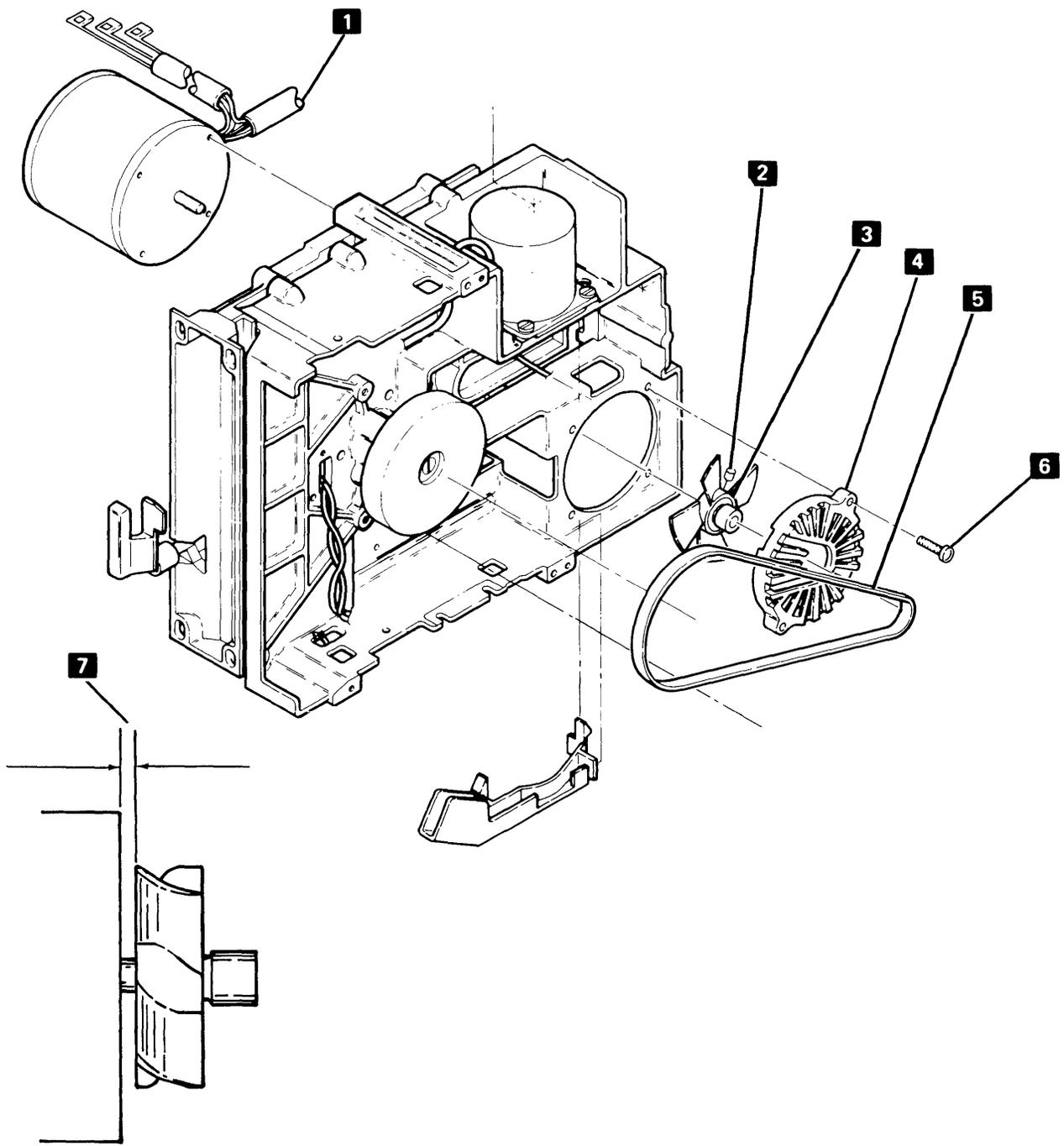
DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **1**.
3. Remove the drive belt **5**.
4. Remove the two fan enclosure mounting screws **6**; then remove the fan enclosure **4**.
5. Loosen the setscrew **2**.
6. Remove the drive fan and pulley **3**.

Replacement

1. Reinstall the drive fan and pulley on the motor shaft with the setscrew **2** centered on the flat surface of the shaft. (Leave the setscrew loose.)
2. Place the drive fan and pulley on the motor shaft with a gap **7** of 0.5 ± 0.1 millimeter (0.020 ± 0.001 inch) between the motor face and the fan hub.
3. Tighten the setscrew.
4. Reinstall the fan enclosure.
5. Reinstall the drive belt.
6. Reconnect the AC drive motor power cable.



Stepper Drive

357 STEPPER MOTOR REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Disconnect the head cable connector **12** from the diskette drive control card **10** and remove the head cable from the cable guide **15**.
3. Remove the cable guide **15**.

CAUTION

The drive band assembly can be easily damaged. Do not bend, dent or scratch the drive band.

4. Remove the three screws **5**, **6**, and **9** and the clamps **1** and **3** that attach the drive band **8** to the stepper motor pulley **2** and carriage bracket **4**.
5. Remove the drive band.
6. Measure and record the gap **17** between the stepper motor pulley and casting.
The gap is _____.
7. Loosen the screw **16** and remove the stepper motor pulley **2** and the clamp **7**.
8. Disconnect the stepper motor cable connector **11** from the diskette drive control card.

9. Remove the four stepper motor mounting screws **14**.
10. Remove the stepper motor **13**.

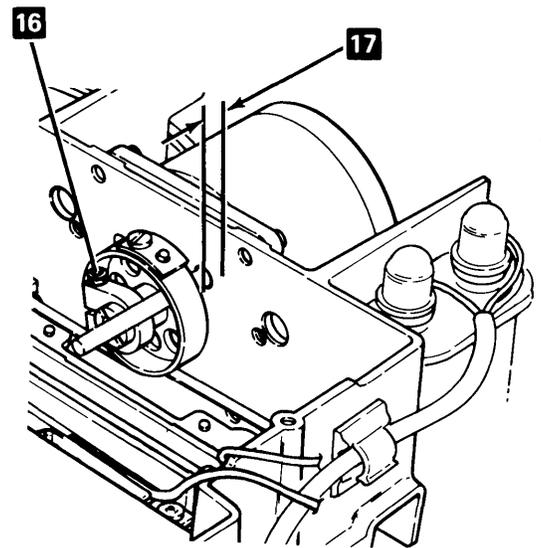
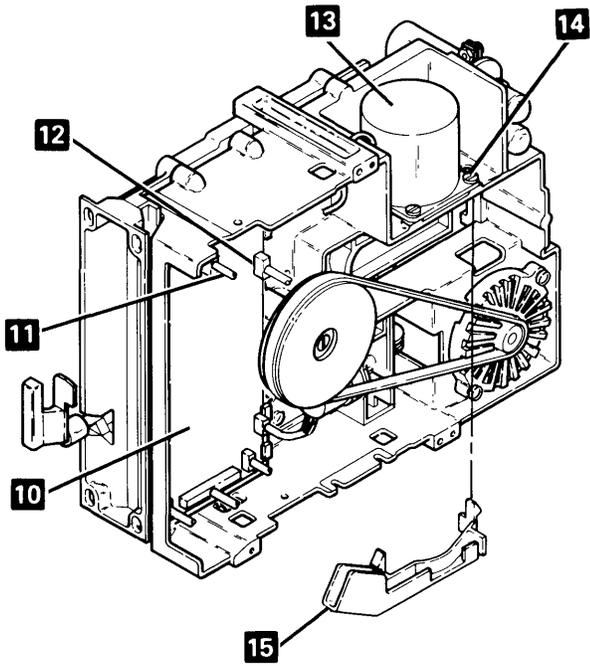
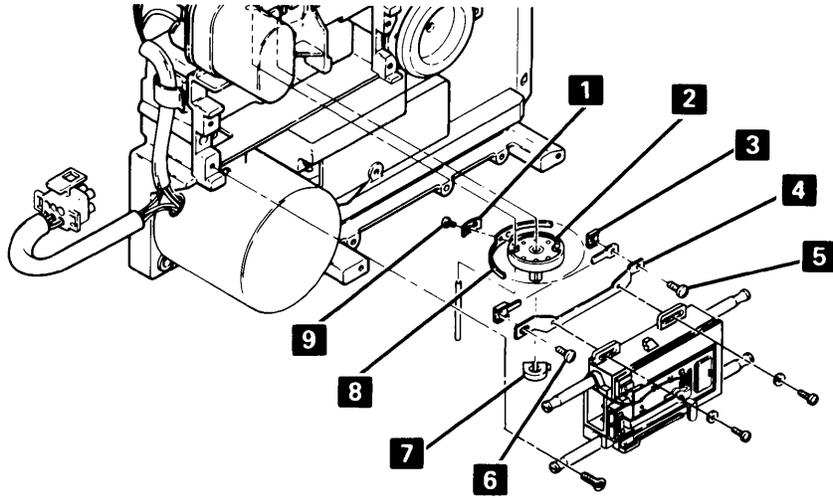
Replacement

1. Reinstall the stepper motor by using the four mounting screws. (Ensure that the stepper motor cable faces toward the diskette drive control card **10**.)
2. Reconnect the stepper motor cable connector **11** to the diskette drive control card **10**.
3. Reinstall the stepper motor pulley and the clamp. (Adjust the gap **17** to the dimension recorded in the removal procedure step 6.)

CAUTION

The drive band assembly can be easily damaged. Do not bend, dent, or scratch the drive band.

4. Reinstall the drive band (see 365).
5. Go to 341, head carriage replacement procedure, step 5.



359 STEPPER MOTOR PULLEY AND CLAMP REMOVAL AND REPLACEMENT

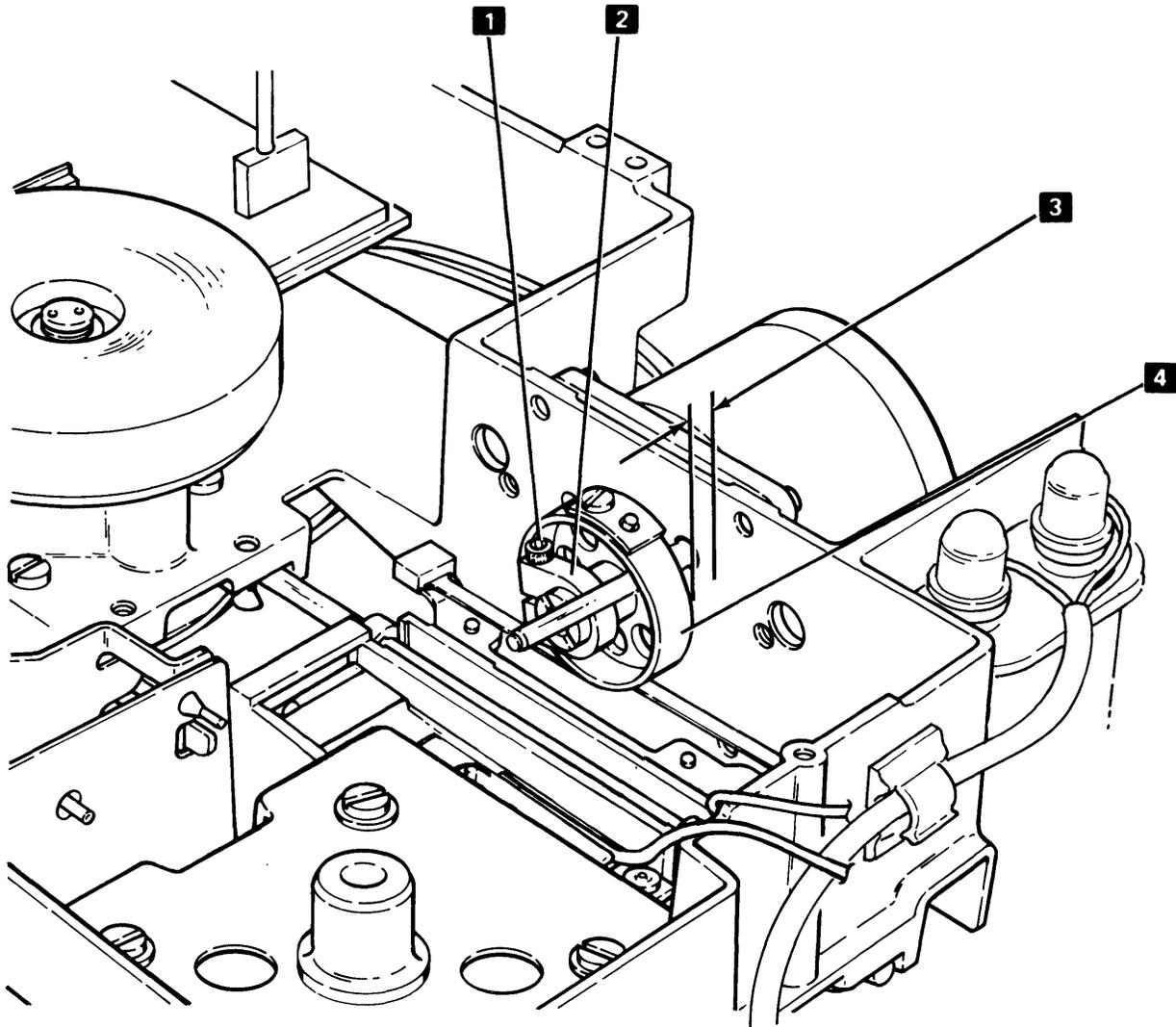
Removal

1. Power off.
2. Remove the drive band (see 365).
3. Measure and record the gap **3** between the stepper motor pulley and the casting.
The gap is _____.
4. Loosen the clamp screw **1** and remove the pulley **4** and the clamp **2**.

Replacement

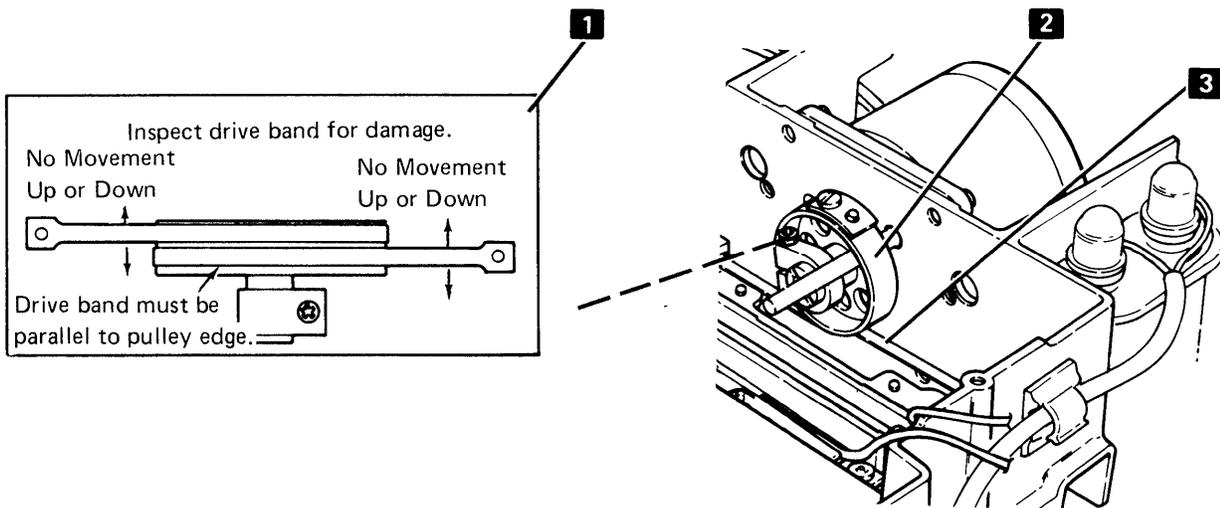
To reinstall the stepper motor pulley and clamp, observe the following exceptions and reverse the steps in the removal procedure.

1. When reinstalling the pulley and clamp, set the gap **3** to the same gap as recorded in step 3 of the removal procedure. (Ensure that the clamp is even with the end of the stepper motor shaft.)
2. After the replacement procedure is completed, go to 341, head carriage replacement procedure, step 5.



361 DRIVE BAND SERVICE CHECK

1. Power off.
2. If the drive band shows signs of damage, install a new drive band (see 365).
3. Turn the stepper motor pulley **2** by hand between tracks 00 and 76.
4. If the drive band **3** does not move parallel to the pulley edge **1**, go to 363, step 2.



363 DRIVE BAND ADJUSTMENT

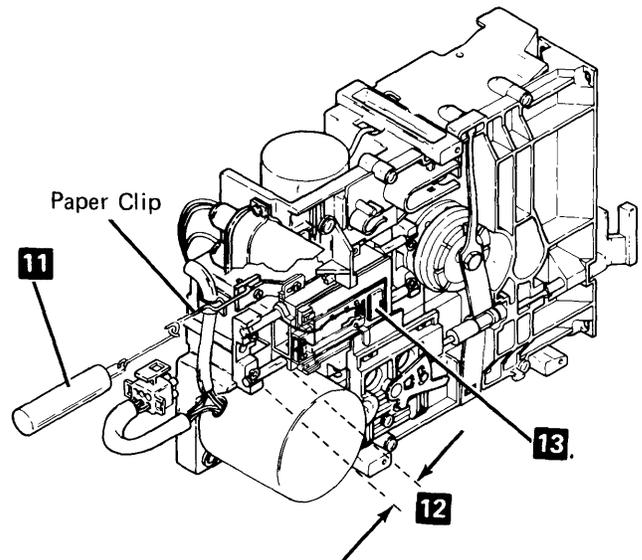
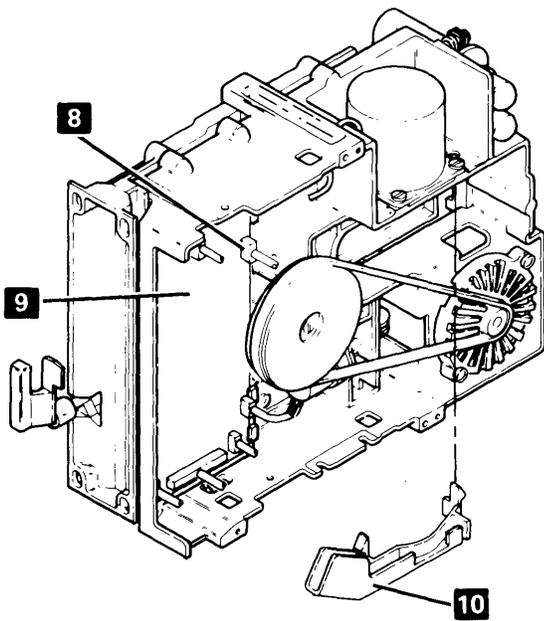
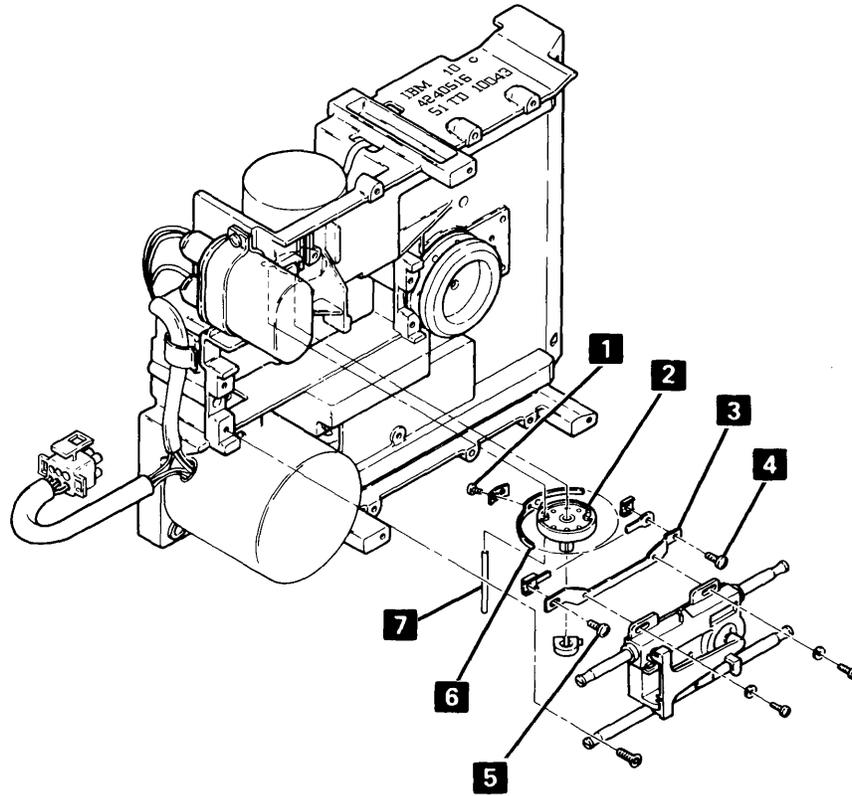
1. Power off.
2. Disconnect the head cable connector **8** from the diskette drive control card **9** and remove the head cable from the cable guide **10**.
3. Remove the cable guide **10**.
4. Place the head/carriage assembly **13** at approximately track 40.
5. Insert the timing pin **7** into the timing hole in the pulley and the casting to align the head/carriage assembly at track 40.

CAUTION

The drive band assembly can be easily damaged. Do not bend, dent, or scratch the drive band.

6. Loosen the three mounting screws **1**, **4**, and **5** that attach the drive band **6** to the pulley **2** and the carriage bracket **3**.

7. Tighten the screw **4**. Ensure that the drive band is parallel to the carriage bracket when the screw is tight.
8. Tighten screw **1**. Ensure that the drive band is parallel to the edge of the pulley when the screw is tight.
9. Block the head/carriage about 25 millimeters (1 inch) from the end of the casting **12**.
10. Use the force gauge **11** (part 460870) to pull on the loose end of the drive band with 2.5 ± 0.25 pounds of force and tighten the screw **5**. Ensure that the drive band remains parallel to the carriage bracket. If the drive band does not remain parallel to the carriage bracket, return to step 6.
11. Move the carriage back and forth by hand and ensure that the drive band stays parallel with the edge of the pulley.
12. Go to 339, step 12.



365 DRIVE BAND REMOVAL AND REPLACEMENT

Removal

CAUTION

The drive band can be easily damaged. Do not bend, dent, or scratch the drive band.

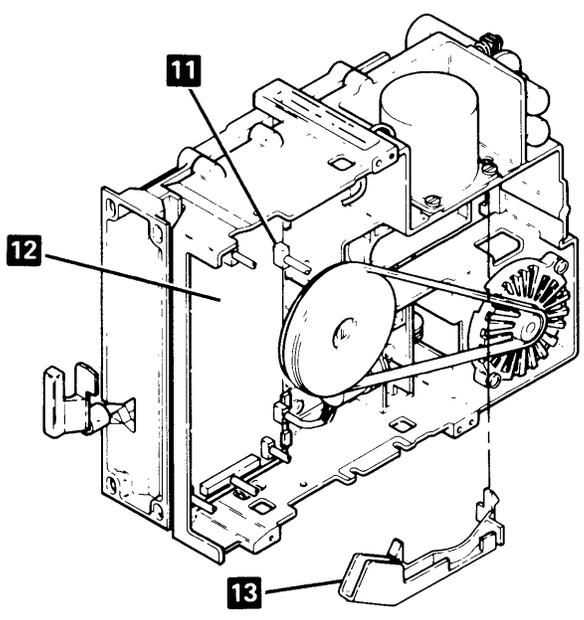
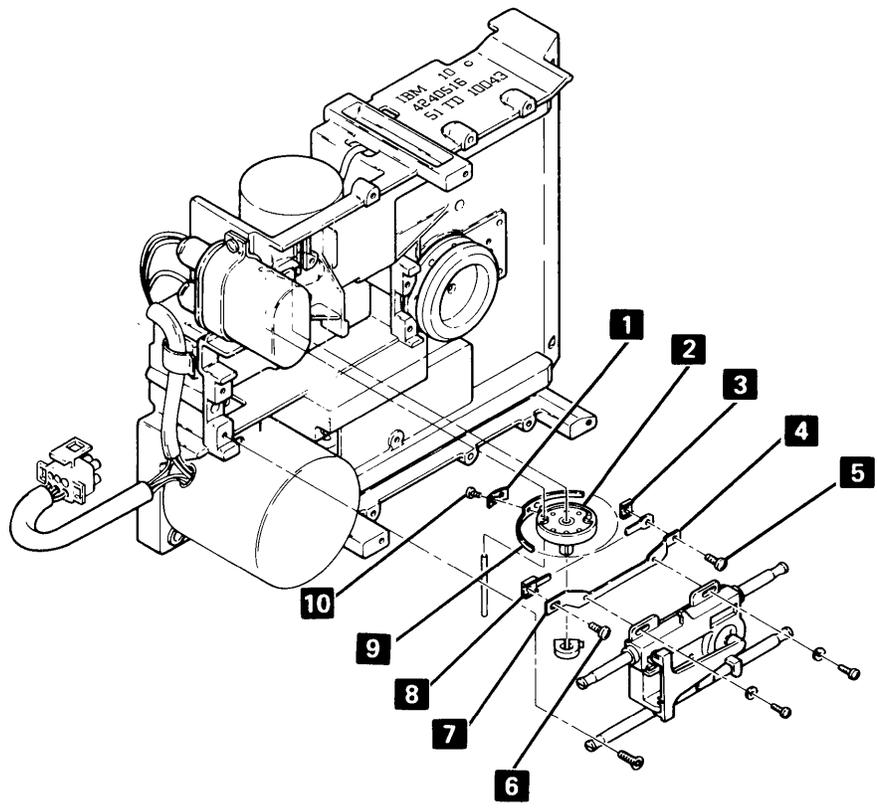
1. Power off.
2. Disconnect the head cable connector **11** from the diskette drive control card **12** and remove the head cable from the cable guide **13**.
3. Remove the cable guide **13**.
4. Remove the three screws **5**, **6**, and **10** and the clamps **1** and **3** that attach the drive band **9** to the stepper motor pulley **2** and the carriage bracket **4**. (Note the position of the drive band and clamps for the replacement procedure.)
5. Remove the drive band.

Replacement

CAUTION

The drive band can be easily damaged. Do not bend, dent, or scratch the drive band.

1. Use the screw **6** to attach the end of the drive band with the welded adapter **8** to the end **7** of the carriage bracket. Do not tighten the screw.
2. Use the screw **10** and the clamp **1** to attach the drive band **9** to the stepper motor pulley **2**. The drive band must be parallel to the edge of the pulley.
3. Use the screw **5** and the clamp **3** to attach the other end of the drive band to the carriage bracket. The drive band must be parallel to the carriage bracket.
4. Adjust the drive band (see 363, step 9).



LED and PTX Assemblies

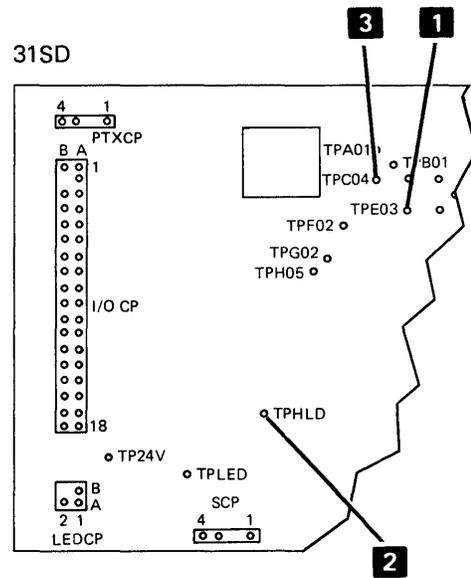
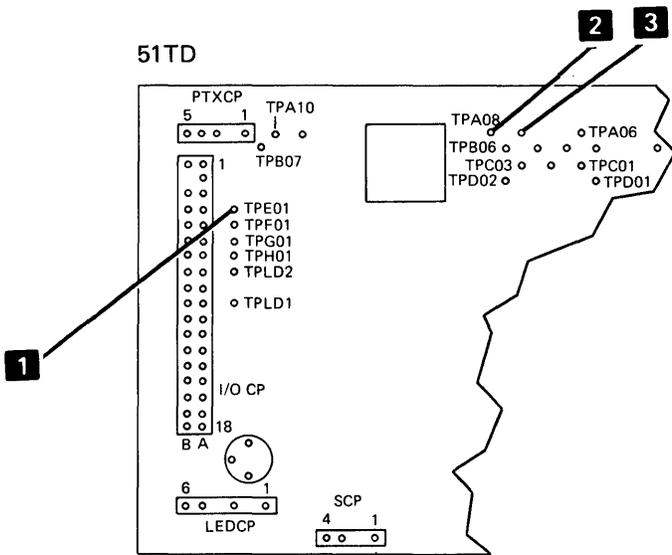
367 DISKETTE SPEED SERVICE CHECK

1. Open the diskette locking lever **5**.
2. Insert a diskette into the diskette drive.
3. Close the diskette locking lever **5**.
4. Install a jumper from **2** (-head load) to **3** (ground) to activate the head load solenoid.
5. If you are using an oscilloscope, proceed with step 5. If you are not using an oscilloscope, go to step 11.
6. Set up an oscilloscope to the settings shown in **4**.
7. Place the channel 1 probe on **1**.

Note: Use a Tektronix¹ 453, 454, or a similar oscilloscope with x10 probes.

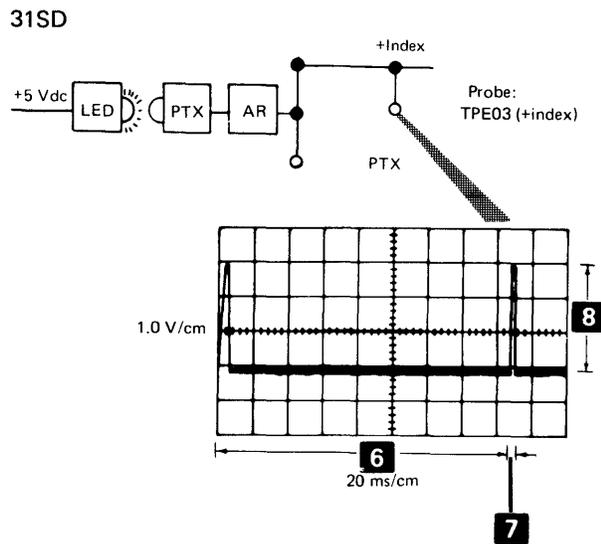
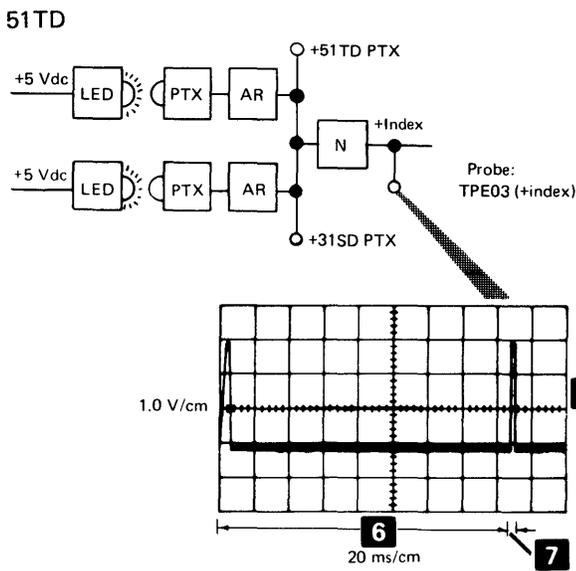
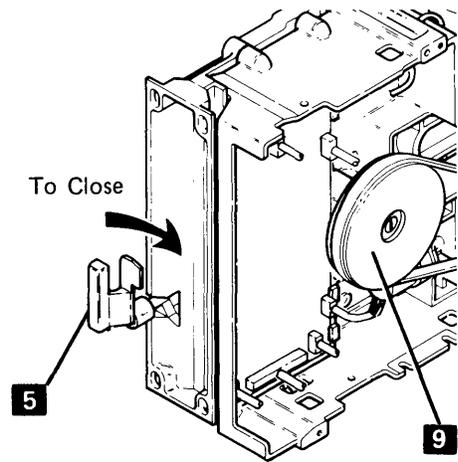
8. Observe an index pulse width of 1.5 milliseconds to 3.0 milliseconds **7** occurring every 166.7 ± 4.2 milliseconds **6**. Pulse amplitude should be between 2.4 Vdc and 4.2 Vdc **8**.
9. Remove the jumper installed in step 4.
10. Go to step 17.
11. Cut out the correct stroboscope wheel **10** for your diskette drive.
12. Power off.
13. Attach the stroboscope wheel **10** to the diskette drive spindle pulley **9**.
14. Power on.
15. Direct the beam of a fluorescent lamp onto the stroboscope wheel. (If the diskette speed is correct, the outer ring of dots on the stroboscope wheel will appear to be moving in a counterclockwise direction and the inner ring of dots will appear to be moving in a clockwise direction.)
16. Remove the jumper installed in step 4.
17. Open the diskette locking lever and remove the diskette.

¹Trademark of Tektronix, Inc.

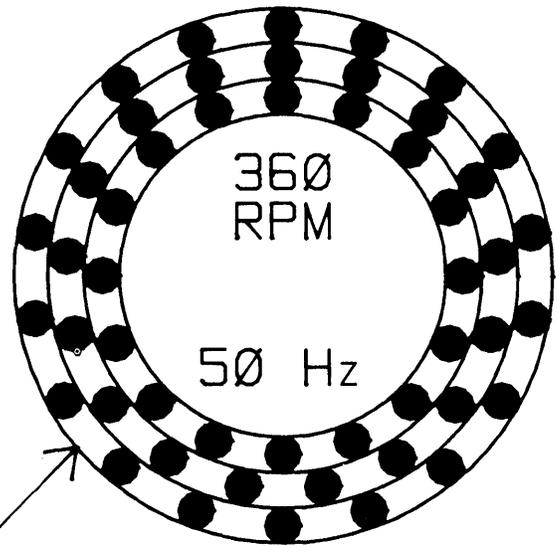
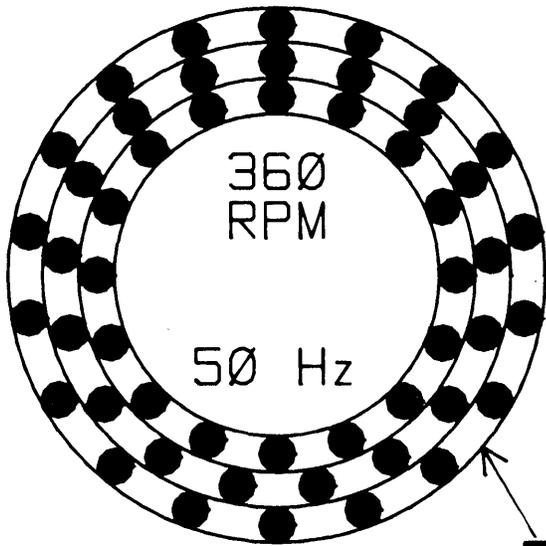


4

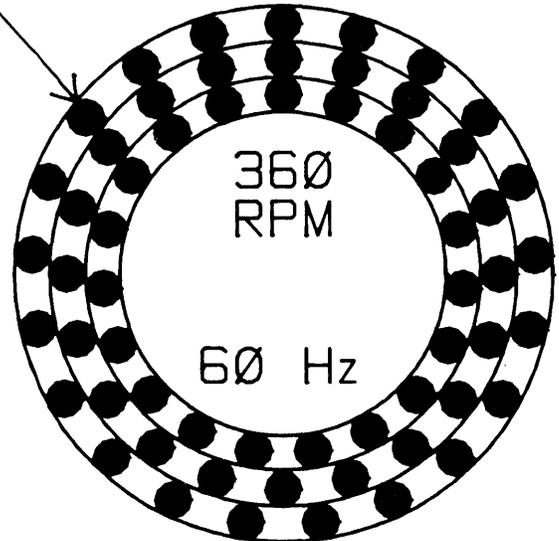
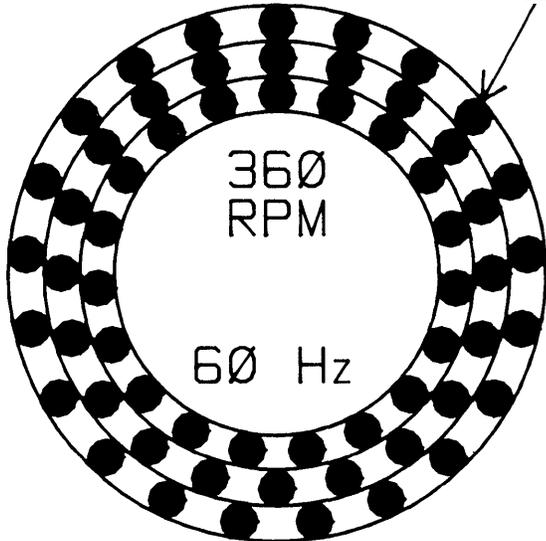
Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	Internal
Trigger Mode	Normal
Channel 1 volts/division	Channel 1
Channel 1 input	1.0 V/cm
Times per division	DC
Channel 1 probe to	20 ms
	+Index Test Pin



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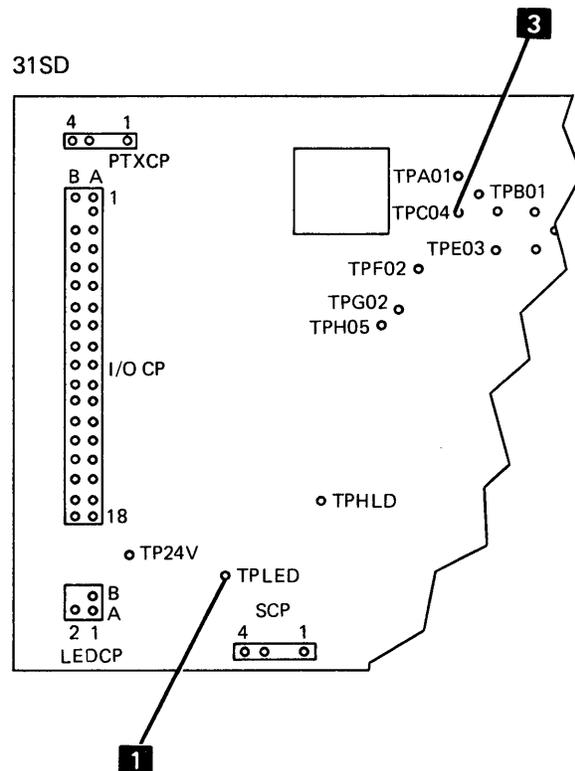
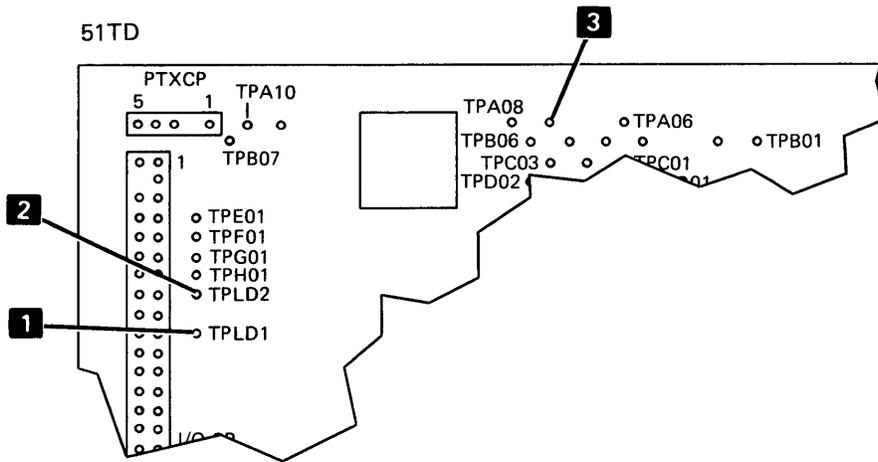
Cut on
this line.



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369 LED OUTPUT SERVICE CHECK

1. Connect the negative probe of the multimeter to **3**.
2. Set the multimeter scale to 5 Vdc and connect the positive probe to **1**.
3. Check for a voltage level of 1 Vdc through 2 Vdc.
4. (51TD) Move the positive probe to **2**.
5. (51TD) Check for a voltage level of 1 Vdc through 2 Vdc.



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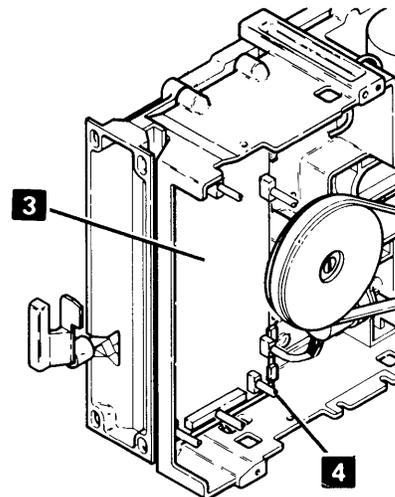
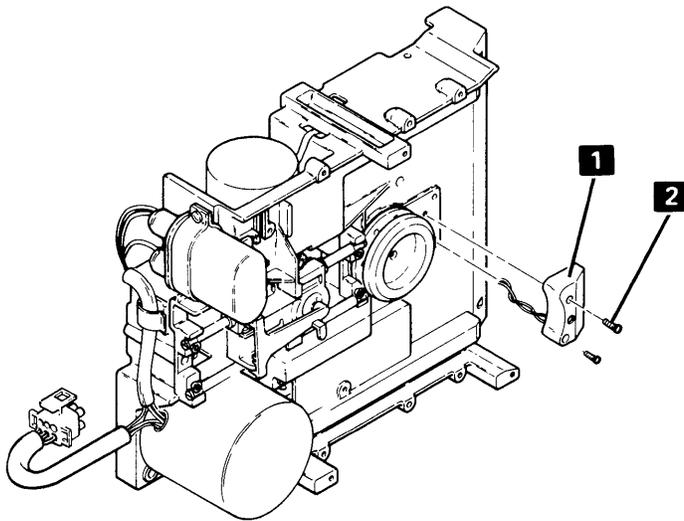
371 LED REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Disconnect the LED cable connector **4** from the diskette drive control card **3**.
3. Remove the LED cable. (Note the cable routing for the replacement procedure.)
4. Remove the two screws **2**.
5. Remove the LED assembly **1**.

Replacement

To reinstall the LED, reverse the steps in the removal procedure.



373 PTX AMPLIFIER SERVICE CHECK

1. Power off.

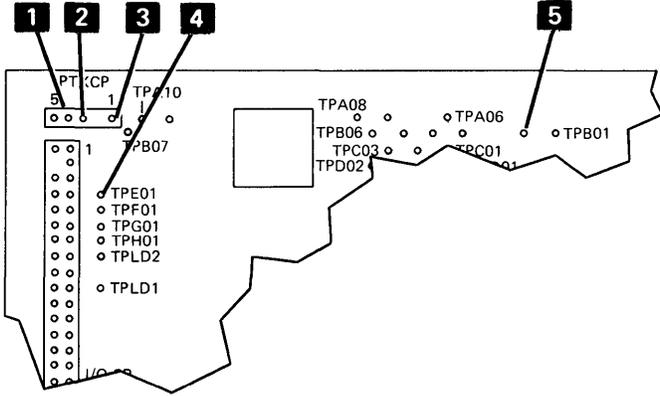
DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

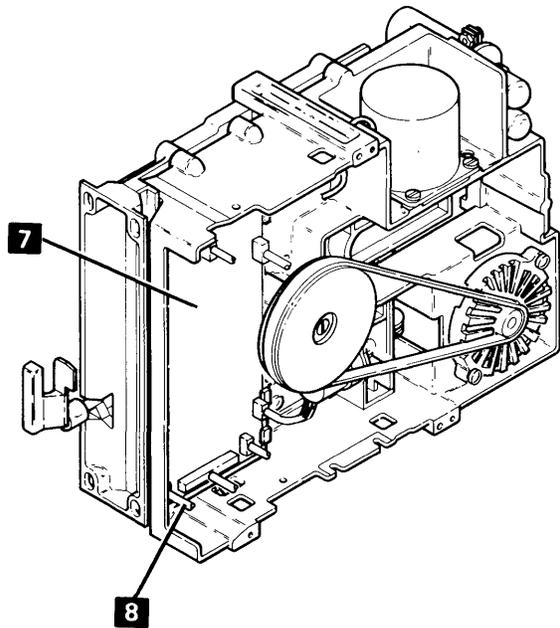
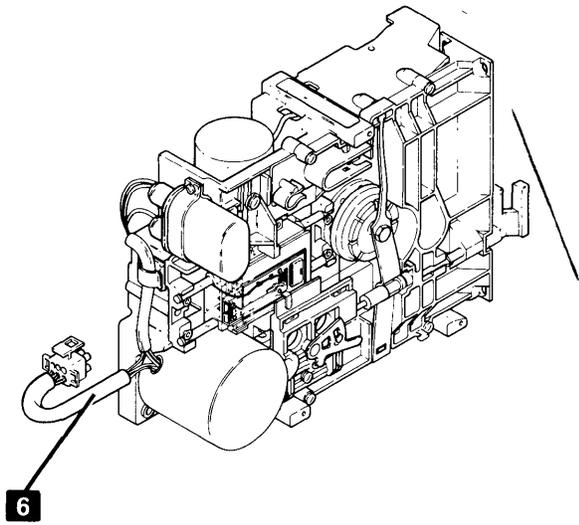
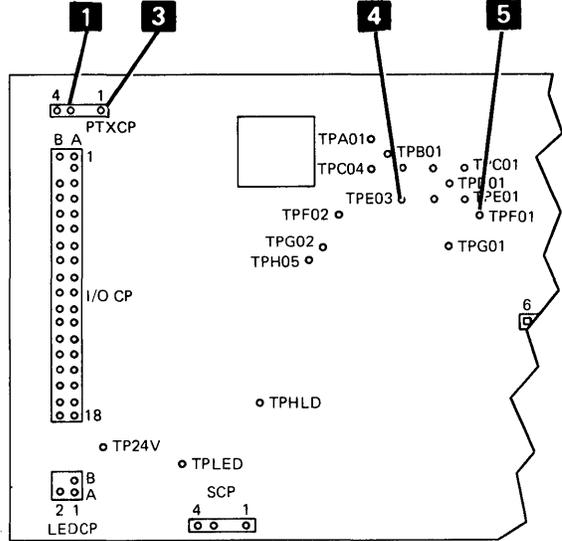
2. Disconnect the AC drive motor power cable **6**.
3. Disconnect the PTX cable connector **8** from the diskette drive control card **7**.
4. Power on.
5. Set the multimeter scale to 5 Vdc and connect the positive probe to **4** (+index).
6. Connect the negative probe of the multimeter to **5** (ground).
7. Check for a voltage level of less than 1 Vdc.

8. Connect one end of a jumper to **1**.
9. Observe the multimeter and touch the other end of the jumper to **3** several times. The multimeter should read 2.5 Vdc or more when **3** is touched. (A wrong reading can occur the first time **3** is touched.)
10. (51TD) Repeat steps 8 and 9 with the jumper on **2**.
11. Power off.
12. Remove the jumper.
13. Reconnect the PTX cable connector **8** to the diskette drive control card **7**.
14. Reconnect the AC drive motor power cable **6**.
15. Power on.

51TD



31SD



375 PTX REMOVAL AND REPLACEMENT

Removal

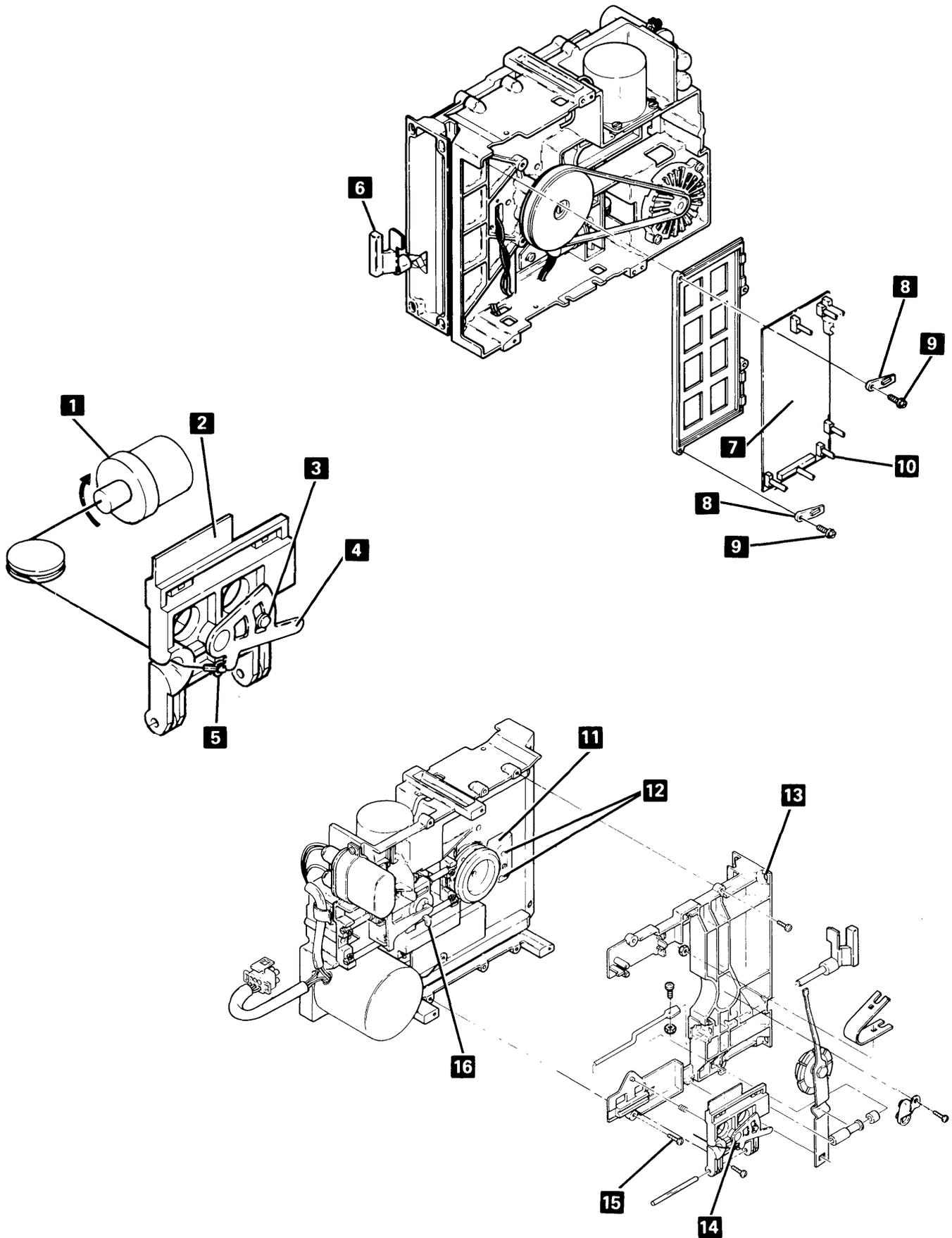
1. Power off.
2. Disconnect the LED cable connector **10** from the diskette drive control card **7**. (Note the cable path for replacement.)
3. Close the diskette locking lever **6**.
4. Loosen the bail lever screw **3**.
5. Push the bail **2** inward slightly and disconnect the bail actuator cable eyelet **5** from the bail lever **4**.
6. Open the diskette locking lever **6**.
7. (51TD) Place a piece of clean paper between the heads, or insert a scratch diskette.
8. Remove the four diskette guide screws **15**.
9. Remove the diskette guide **13** by lifting it up and sliding the bail out from under the head load arm **16**.
10. Remove the remaining cables from the diskette drive control card **7**. (Note the cable connections for the replacement procedure.)
11. Loosen the two retaining screws **9**.
12. Turn the two card retainers **8** out of the way and remove the diskette drive control card **7**.
13. Remove the two PTX mounting screws **12**.
14. Remove the PTX assembly **11**.

CAUTION

(31SD) Do not let the head hit the pressure pad or the head could be damaged. (51TD) Do not let the heads hit each other or the heads could be damaged.

Replacement

To reinstall the PTX assembly, reverse the steps in the removal procedure then go to 347, bail replacement procedure, step 2.



377 DISKETTE DRIVE CONTROL CARD REMOVAL AND REPLACEMENT

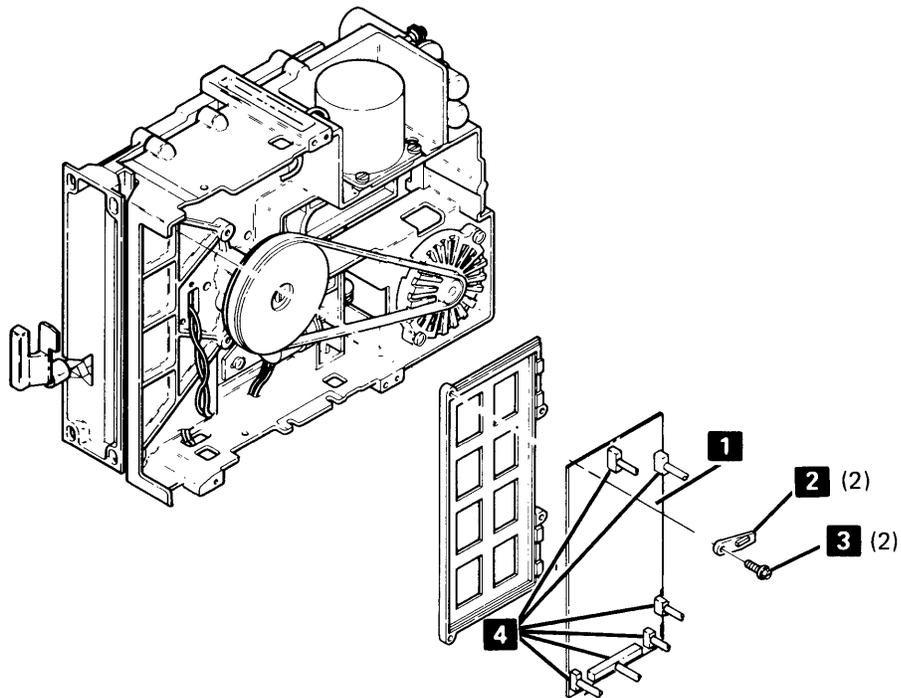
Removal

1. Power off.
2. Remove the six cable connectors **4** from the diskette drive control card **1**.
3. Loosen the two retaining screws **3**.

4. Turn the retainers **2** until they are not in the way of the diskette drive control card.
5. Remove the diskette drive control card **1**.

Replacement

To reinstall the diskette drive control card, reverse the steps in the removal procedure.



Tools and Test Equipment

The following tools and test equipment are supplied.

Description	Part Numbers
Diskette head carriage spring	4240631
Diskette timing pin	5562019 (two supplied)
Diskette thickness gauge clip	4240632

In addition to the above equipment and the standard CE tool kit, the following tools and test equipment, which are not supplied, may also be required.

Description	Part Number
General logic probe	453212
Two pound force gauge	4600870
Oscilloscope (475 or equivalent)	

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INTRODUCTION

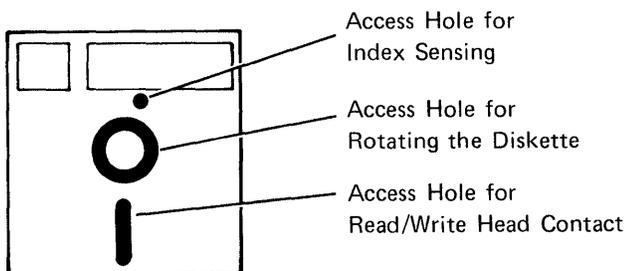
The diskette drives used with the IBM 5280 system are input/output (I/O) devices that rely upon the unit in which they reside for power and some signals. The diskette drive stores and retrieves data by writing data on diskettes for later use and by reading data from diskettes for immediate use. The commands and controls needed for operating the diskette drives are provided by the system. The IBM 5280 system uses two types of diskette drives: 31SD and 51TD.

The 31SD diskette drive can read from and write on a diskette 1. The 31SD diskette drives write and read only in FM (frequency modulation). If a diskette 2 or a diskette 2D is inserted into a 31SD diskette drive, the diskette drive will not come ready.

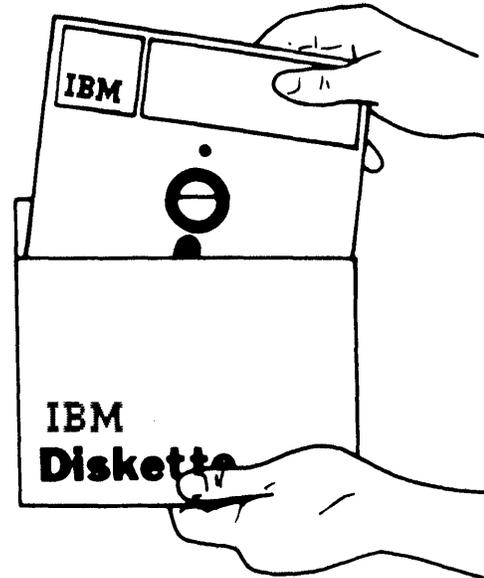
The 51TD diskette drive can read from and write on diskettes 1, 2, and 2D. The 51TD diskette drive can read and write in both FM and MFM (modified frequency modulation).

DISKETTE DESCRIPTION

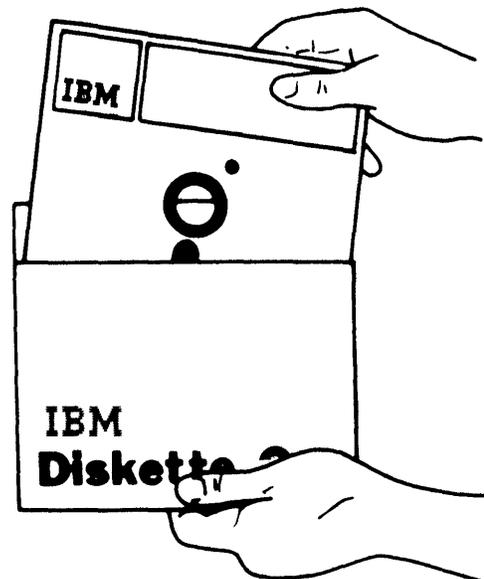
The IBM diskette is a thin, flexible disk, housed in a protective envelope. Information is stored magnetically on the diskette surface, which is coated with magnetic oxide. The diskette is free to turn inside the envelope. As the diskette turns, the inner surface of the envelope cleans the diskette. The envelope has access holes for turning the diskette, for read/write head contact, and for index sensing. Data can be read from or written on both sides of a diskette 2 and a diskette 2D and one side of a diskette 1.



The location of the index hole on the diskette 1 differs from that on a diskette 2 and diskette 2D. When a diskette 1 is inserted into a diskette drive, index sensing circuits sense that a diskette 1 is being used and the use of the blank side is prevented.



Diskette 1



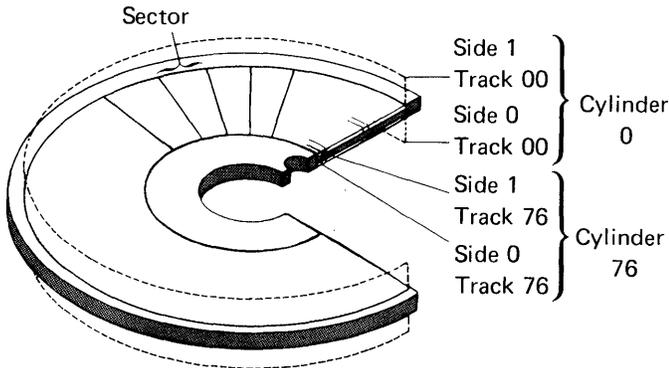
Diskette 2

Information is written on tracks located on the diskette. A track is a circular path on the diskette surface. Information is magnetically written on or read from a track by a read/write head as the diskette turns.

There are 77 tracks on each side of a diskette. Track 00, which is the outside track, is reserved as a label track and is not used for data. Tracks 75 and 76, which are the two innermost tracks, are reserved as replacement tracks and are only used for data if another track becomes damaged or defective. There are a total of 74 data tracks on one side of a diskette 1 and on each side of a diskette 2 and diskette 2D.

A sector is a portion of a track set aside for one record.

A cylinder consists of the tracks on a diskette that can be read from or written on without repositioning the read/write heads.



STEPPER MOTOR

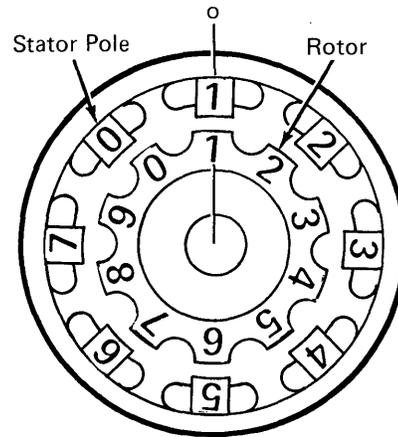
The stepper motor consists of a permanent magnet rotor (armature) and pairs of two-phase stator windings. The motor is a sealed unit that has no gears or commutators and requires no maintenance.

During assembly, the rotor is magnetized at the plant of manufacture. Disassembly of the motor reduces the magnetic flux of the rotor. This causes a reduction in the torque produced by the motor. For this reason, you should not disassemble the motor.

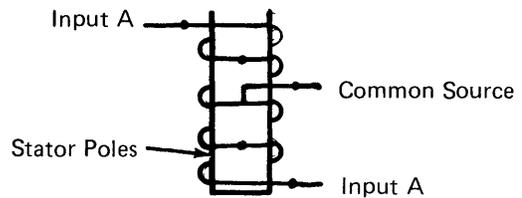
With the power on the rotor can not be easily turned by hand. With the power off, any residual detenting is felt as a drag or roughness, and might cause a clicking sound as the shaft is turned.

Operation

For ease of understanding, the motor used in this example turns 9° per step. The actual motor turns 1.8° per step. This simplified motor consists of eight coil-wound stator poles on a ten-pole permanent magnet rotor.

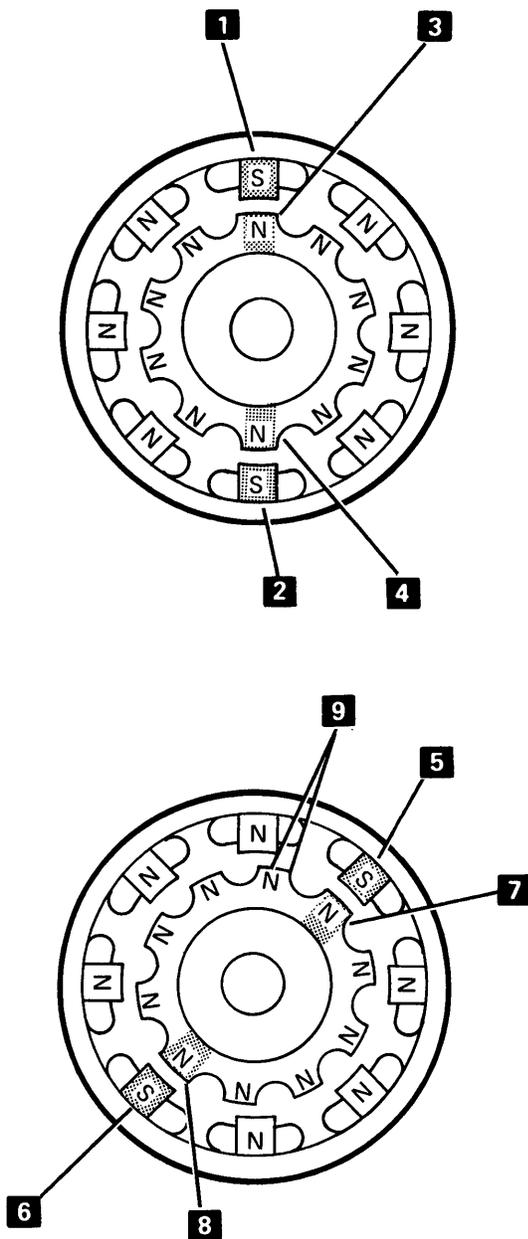


Stator Pole Winding



The stator poles are used in pairs. Stator poles opposite each other, such as stator poles numbers 2 and 6 in the preceding figure, are magnetized together to provide the necessary torque for the rotor to turn. The stator poles that are magnetized last remain magnetized until the diskette control circuitry sends signals to move the rotor again. These poles remaining magnetized provides an electrical detent to the stepper motor.

The permanent magnetic rotor poles all have their north poles facing the stator poles. When the stator poles have current flowing through them, their south poles face the rotor poles. In magnetism, opposite poles attract; therefore the closest north pole of the rotor is attracted to and moves to the magnetized stator pole.



Stator poles **1** and **2** are magnetized. This holds rotor poles **3** and **4** electrically detented. When the electrical current is moved from stator poles **1** and **2** to stator poles **5** and **6**, rotor poles **7** and **8** are attracted to and align with stator poles **5** and **6**. The rotor moves the distance shown by **9**.

In the diskette drive, the stepper motor drive band is attached to the head/carriage assembly. As the motor turns, the band moves the head/carriage assembly. A 1.8° rotation of the motor moves the head/carriage assembly the distance of one track. A clockwise movement of the rotor moves the head/carriage assembly toward the center of the diskette. The stepper motor moves the head/carriage assembly one track in 5 milliseconds. Thirty-five milliseconds are required to stop the moving head/carriage assembly and to allow the heads to settle. Total seek time is 5 milliseconds times the number of tracks traveled plus 35 milliseconds.

FM FORMAT PRINCIPLES

FM (frequency modulation) format is a method of recording data on a diskette surface. The frequency of pulses is changed (modulated) to represent data.

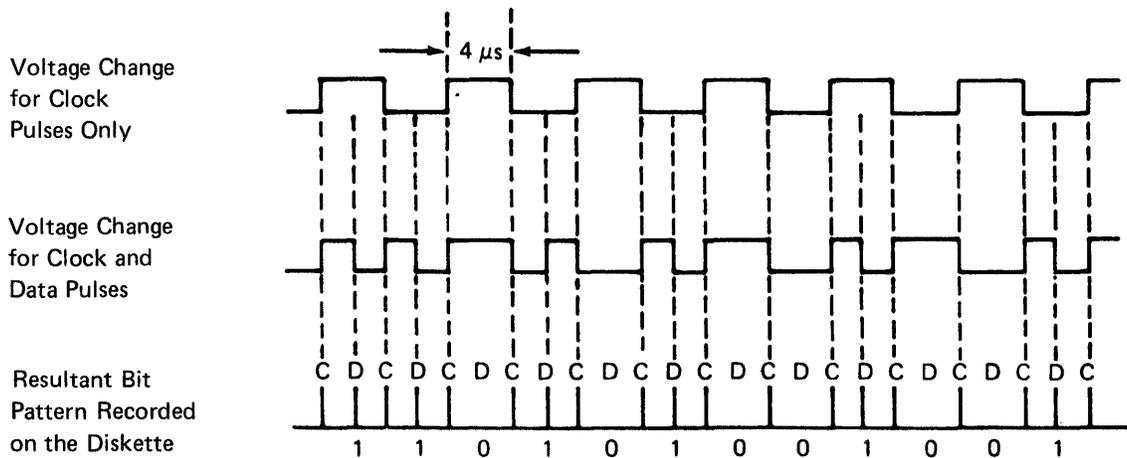
When no data is present (all 0-bits), only clock pulses are present. These pulses occur at a frequency of every 4 microseconds.

When data is present, the pulse frequency changes. Each 1-bit is inserted halfway between adjacent clock pulses so that there is double the frequency. If a 0-bit is recorded, nothing is inserted between the clock pulses, so the pulse frequency is not changed.

The raw data in FM format is 250 000 bits (31 250 bytes) per second.

Read Data

Each clock pulse or 1-bit is recorded on the diskette surfaces as a change in magnetic direction (flux) from the bit immediately preceding it. As this change in flux passes the read/write heads, it causes the current in the read/write heads to change direction. This change in the direction of the current is recognized by the diskette drive control circuitry as either a clock pulse or a 1-bit. If there is no change in the direction of the current between two adjacent clock pulses, the diskette drive control circuitry recognizes that a 0-bit is present.

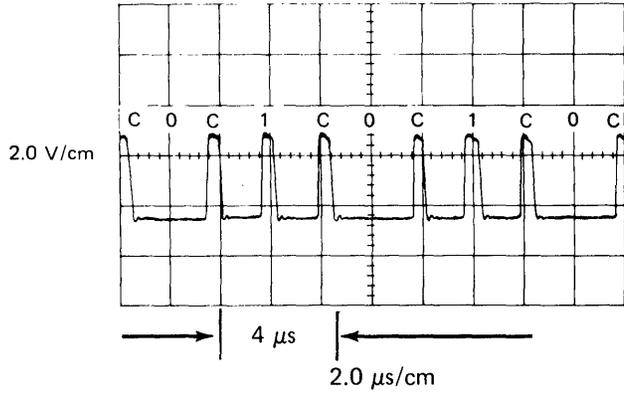


The C and D above the line show the clock and data bit times.

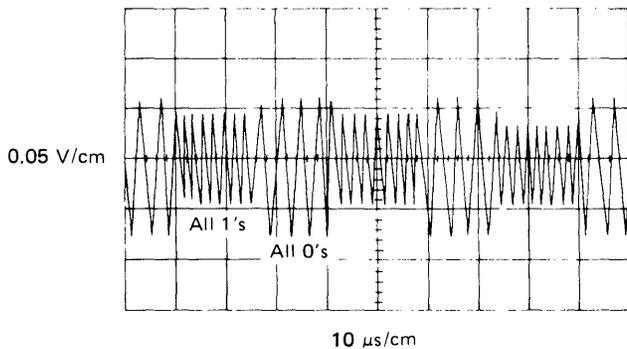
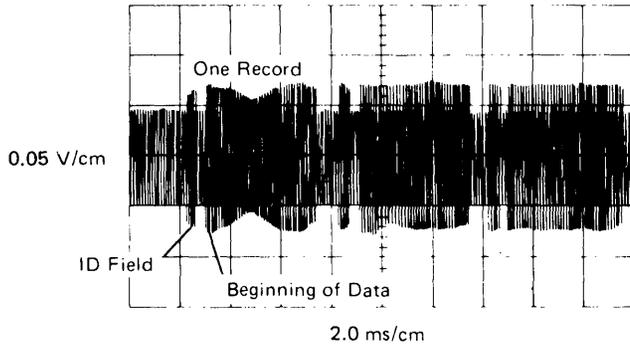
The numbers under the line show whether a 1-bit or a 0-bit is recorded.

Scope Charts

File Data
Example: 01010



Read Head Signal at TP1 and TP2



Note: Use Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweepmode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger	Normal
Mode	Channel 1
Channel 1 volts/division	2.0 V/cm
Channel 1 input	DC
Times per division	2 μs/cm
Connect channel 1 to	+File data
Connect trigger to	+Index test pin

Observe: Clock pulses every 4 μs. Pulse duration should be between 100 and 500 ns. Pulse amplitude should be between 2.4 and 4.2 volts.

Note: Use Tektronix 453, 454, or similar oscilloscope with x10 probes.

Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger	Normal
Mode	Add
Channel 1 volts/ division	0.05 mV/cm
Channel 2 volts/division	0.05 mV/cm
Channel 1 input	AC
Channel 2 input	AC
Invert	Pull out
Times per division	2 ms/cm
Connect channel 1 to	Preamp TP1
Connect channel 2 to	Preamp TP2
Connect trigger to	+Index test pin

Observe: The amplitude of the read signal should be between 6.5 to 560 mV.

MFM FORMAT PRINCIPLES

MFM (modified frequency modulation) format is a method of recording data on a diskette surface. The frequency of pulses is changed (modulated) to represent data.

When no data is present (all 0-bits) only clock pulses are present. These pulses occur at a frequency of every 2 microseconds.

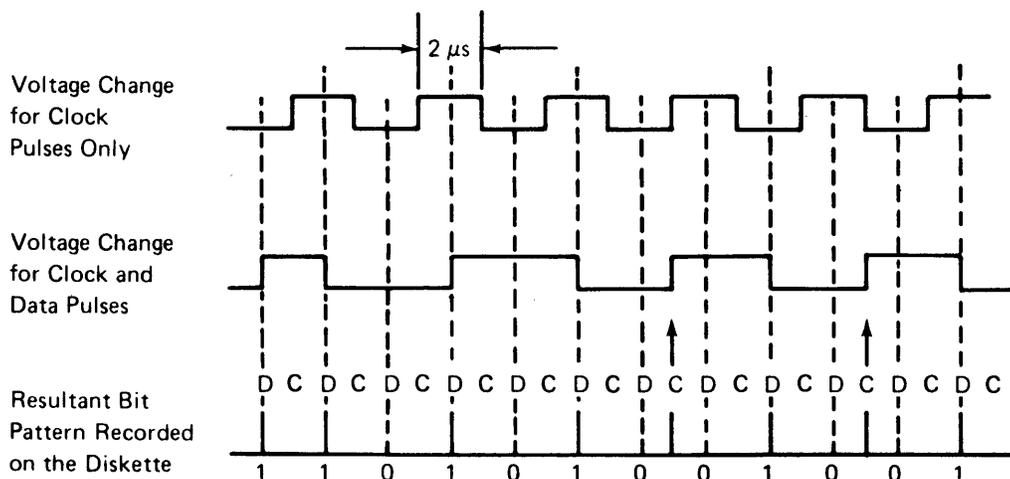
When data is present, the pulse frequency changes. Each 1-bit is inserted halfway between adjacent clock pulses. The clock pulses are suppressed however, so the frequency remains the same. All clock pulses will be suppressed unless two 0-bits (no pulse) occur next to each other. When this happens, the clock pulse that would normally occur at the clock time between the 0-bits is not suppressed. Therefore, the pulse frequency changes for that specific time.

The raw data rate in MFM format is 500 000 bits (62 500 bytes) per second.

Read Data

Each clock pulse or 1-bit is recorded on the diskette surface as a change in magnetic direction (flux) from the bit immediately preceding it. As this change in flux passes the read/write heads, it causes the current in the read/write heads to change direction. This change in the direction of the current is recognized by the diskette drive control circuitry as either a clock pulse or a 1-bit. If there is no change in the direction of the current at data time, the diskette drive control circuitry recognizes that a 0-bit is present.

MFM format, when compared to FM format, can record twice the amount of data on a diskette surface.



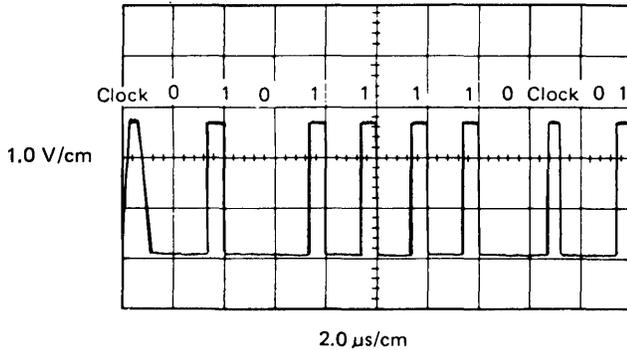
The C and D above the line show the clock and data bit times.

The numbers under the line show whether a 1-bit or a 0-bit is recorded.

Scope Charts

File Data

Example: 0101111001

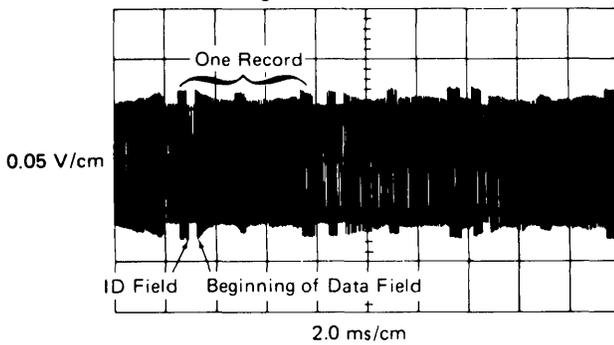


Note: Use Tektronix 453, 454, or similar oscilloscope with x10 probes.

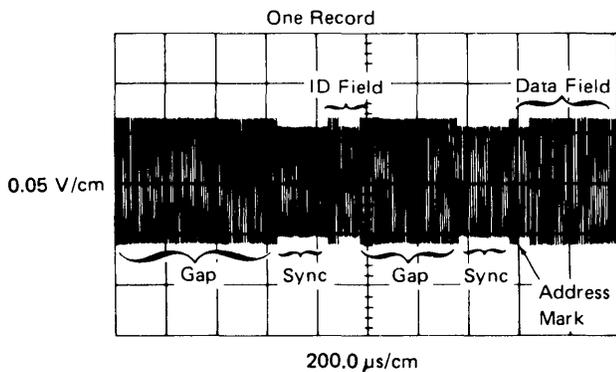
Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger Mode	Normal
Channel 1 volts/division	1.0 V/cm
Channel 1 input	DC
Times per division	2 μ s/cm
Connect channel 1 to	+File data
Connect trigger to	+Index test pin

Observe: Clock or data pulses every 2 to 4 μ s. Pulse duration should be between 100 and 500 ns. Pulse amplitude should be between 2.4 and 4.2 volts.

Read Head Signal at TP1 and TP2



Note: Use Tektronix 453, 454, or similar oscilloscope with x10 probes.

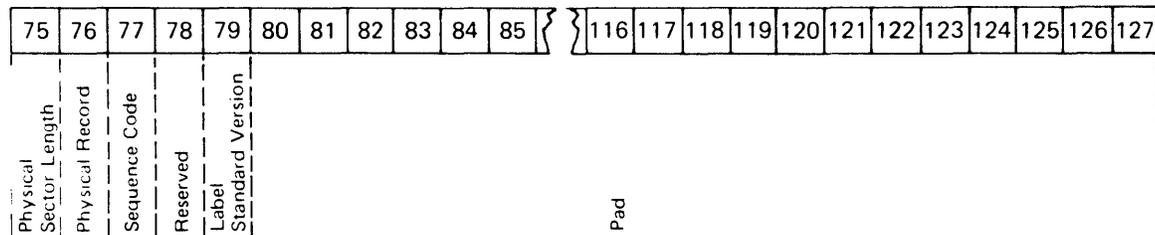
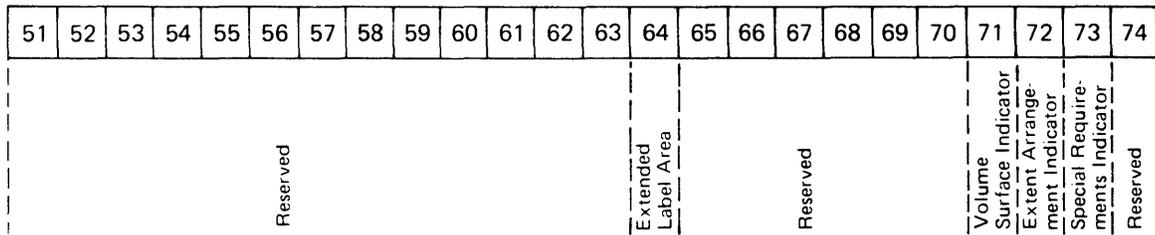
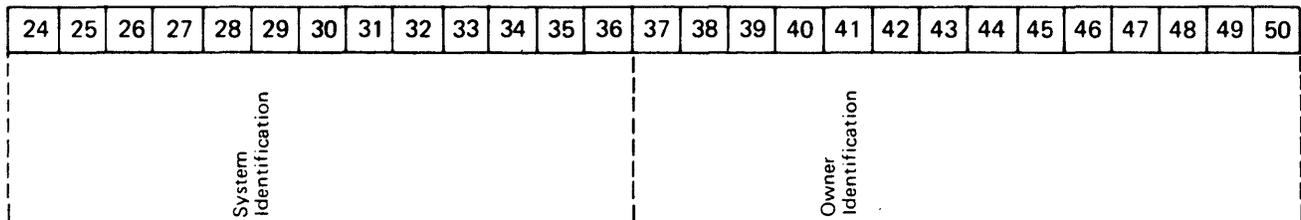
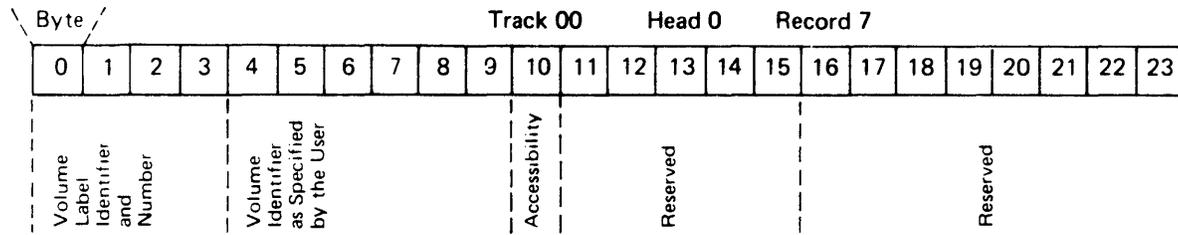


Channel A sweep mode	Normal
Channel A level	+
Channel A coupling	DC
Channel A slope	+
Channel A source	External
Trigger Mode	Normal
Channel 1 volts/division	5 mV/cm
Channel 2 volts/division	5 mV/cm
Channel 1 input	AC
Channel 2 input	AC
Invert	Pull out
Times per division	2 ms/cm
Connect channel 1 to	Preamp TP1
Connect channel 2 to	Preamp TP2
Connect trigger to	+Index test pin

Observe: The amplitude of the read signal should be between 6.5 to 560 mV.

VOLUME LABEL

Volume Label Layout



Volume Label Format

The volume label is located at track 00, head 0, record 7 on all diskettes. This label identifies the diskette and indicates to the diskette control circuitry how the information on the diskette is arranged. The volume label is encoded on the diskette every time the diskette initialization utility program is used to initialize the diskette. The volume label is always encoded in FM format. This label is read and verified each time a Sense command is issued to the diskette drive.

Volume Label Fields

Volume Label Identifier and Number (bytes 0 through 3): Identifies this portion of the diskette as a volume label, for example, VOL1.

Volume Identifier as Specified By the User (bytes 4 through 9): Identifies the diskette. This field contains up to six alphanumeric characters, and is specified during diskette initialization.

Accessibility (byte 10): Indicates if the diskette can be read from or written to. A *blank* in this field permits access to the information on the diskette. Any other character in this field prohibits access.

Not Used (bytes 11 through 36):

Owner Identification (bytes 37 through 50): Identifies the owner of the diskette or the owner of the information on the diskette. This field contains 14 alphanumeric characters.

Not Used (bytes 51 through 63):

Extended Label Area (byte 64): Indicates how many, if any, additional tracks have been allocated as header label tracks. Up to nine (9) additional tracks on each side of a diskette 2D can be set aside for additional header labels. For example: 0 = no additional tracks, 1 = one additional track, and so on.

Not Used (bytes 65 through 70):

Volume Surface Indicator (byte 71): Identifies the diskette as a diskette 1, diskette 2, or diskette 2D.

space = diskette 1
2 = diskette 2
M = diskette 2D

Extent Arrangement Indicator (byte 72): Indicates if there are any constraints on the arrangement of extents, data set labels, or unallocated space on this diskette as follows:

- P =
- Extents must be adjacent
 - Extents must start at cylinder 1, head 0, sector 1
 - Data set labels must start at cylinder 1, head 0, sector 1
 - Data set labels must be in the same sequence as the extents they describe
 - All unallocated space must follow the last data set extent

Blank = No constraints

Special Requirements Indicator (byte 73): Indicates if there are any special requirements for accessing data on this volume. A *blank* indicates that there are no special requirements. An R indicates that some of the data sets were recorded in a logically nonsequential manner.

Not Used (byte 74):

Physical Sector Length (byte 75): Identifies the length of the physical record (sector) on cylinder 1 through 76.

blank = 128 bytes
1 = 256 bytes
2 = 512 bytes
3 = 1024 bytes

Physical Record Sequence Code (bytes 76 through 77):
 Indicates how the physical records are sequenced on the diskette. This field will contain either a blank or the characters 01 through 13. A blank or a 01 indicates the sectors are physically sequential. Otherwise, this field is used as an increment to determine the next physical sector.

26 Sectors Per Track

When this field contains:

The sequencing will be:

	Blank	01	02	03	04	05	06	07	08	09	10	11	12	13
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	3	4	5	6	7	8	9	10	11	12	13	14	14
3	3	5	7	9	11	13	15	17	19	21	23	25	2	2
4	4	7	10	13	16	19	22	25	2	2	2	2	15	15
5	5	9	13	17	21	25	2	2	11	12	13	14	3	3
6	6	11	16	21	26	2	9	10	20	22	24	26	16	16
7	7	13	19	25	2	8	16	18	3	3	3	3	4	4
8	8	15	22	2	7	14	23	26	12	13	14	15	17	17
9	9	17	25	6	12	20	3	3	21	23	25	4	5	5
10	10	19	2	10	17	26	10	11	4	4	4	16	18	18
11	11	21	5	14	22	3	17	19	13	14	15	5	6	6
12	12	23	8	18	3	9	24	4	22	24	26	17	19	19
13	13	25	11	22	8	15	4	12	5	5	5	6	7	7
14	14	2	14	26	13	21	11	20	14	15	16	18	20	20
15	15	4	17	3	18	4	18	5	23	25	6	7	8	8
16	16	6	20	7	23	10	25	13	6	6	17	19	21	21
17	17	8	23	11	4	16	5	21	15	16	7	8	9	9
18	18	10	26	15	9	22	12	6	24	26	18	20	22	22
19	19	12	3	19	14	5	19	14	7	7	8	9	10	10
20	20	14	6	23	19	11	26	22	16	17	19	21	23	23
21	21	16	9	4	24	17	6	7	25	8	9	10	11	11
22	22	18	12	8	5	23	13	15	8	18	20	22	24	24
23	23	20	15	12	10	6	20	23	17	9	10	11	12	12
24	24	22	18	16	15	12	7	8	26	19	21	23	25	25
25	25	24	21	20	20	18	14	16	9	10	11	12	13	13
26	26	26	24	24	25	24	21	24	18	20	22	24	26	26

15 Sectors Per Track

When this field contains:

	Blank	01	02	03	04	05	06	07
The sequencing will be:	1	1	1	1	1	1	1	1
	2	2	3	4	5	6	7	8
	3	3	5	7	9	11	13	15
	4	4	7	10	13	2	4	7
	5	5	9	13	2	7	10	14
	6	6	11	2	6	12	2	6
	7	7	13	5	10	3	8	13
	8	8	15	8	14	8	14	5
	9	9	2	11	3	13	5	12
	10	10	4	14	7	4	11	4
	11	11	6	3	11	9	3	11
	12	12	8	6	15	14	9	3
	13	13	10	9	4	5	15	10
	14	14	12	12	8	10	6	2
	15	15	14	15	12	15	12	9

8 Sectors Per Track

When this field contains:

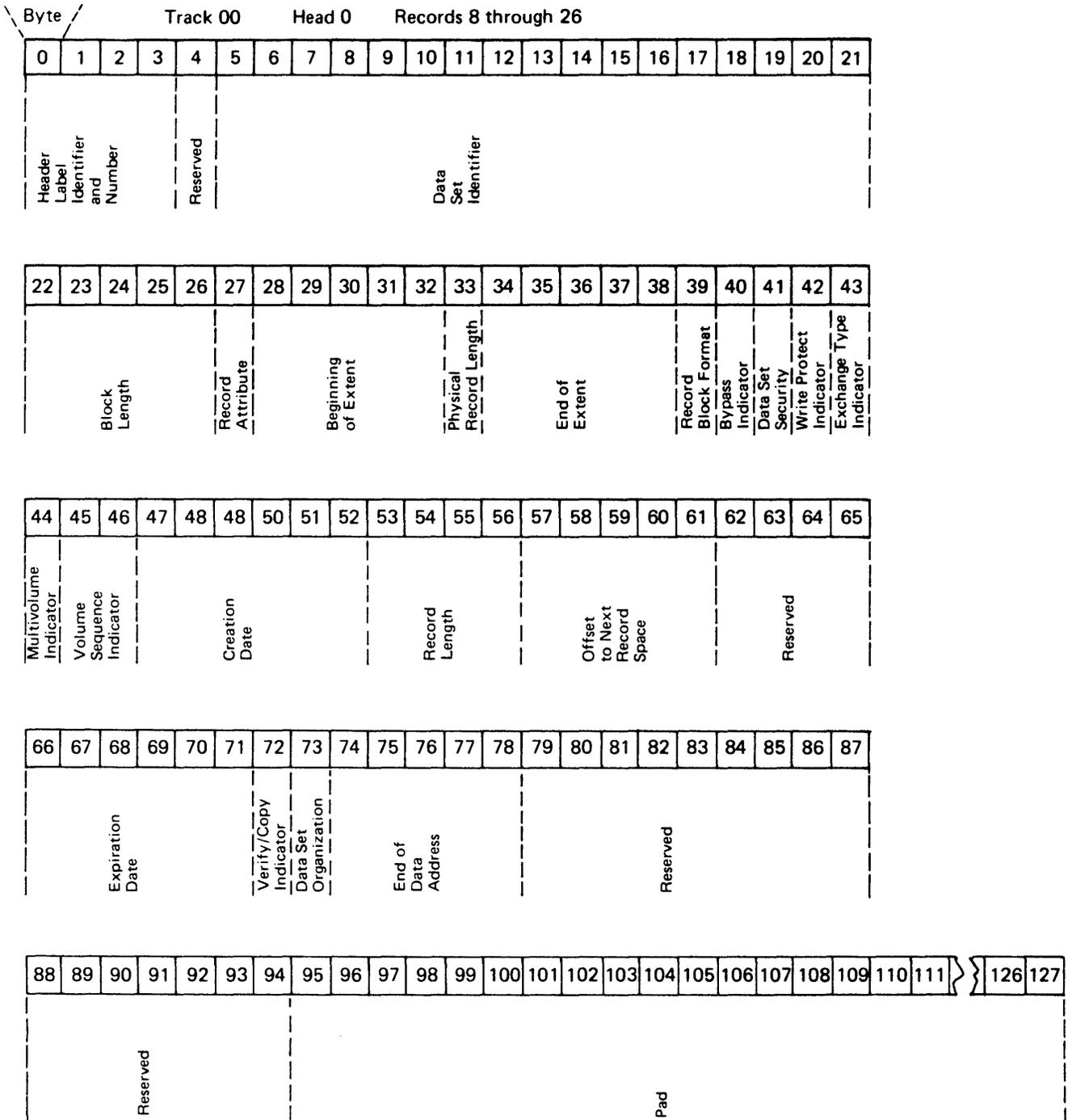
	Blank	01	02	03	04
The sequencing will be:	1	1	1	1	1
	2	2	3	4	5
	3	3	5	7	2
	4	4	7	2	6
	5	5	2	5	3
	6	6	4	8	7
	7	7	6	3	4
	8	8	8	6	8

Label Standard Version (byte 79): Indicates what kind of labels are on the diskette. A blank indicates other than IBM standard labels. A W indicates that IBM standard labels are on the diskette.

Pad (bytes 80 through 127): Indicates the end of the volume label. The pad extends to the end of the sector.

HEADER LABEL

Header Label Layout



Header Label Format

The header labels are located on track 00, head 0, records 8 through 26 on all diskettes. In addition, on a diskette 2 or diskette 2D, the header labels are also located at track 00, head 1, records 1 through 26. On a diskette 2D, additional header labels can be set aside for all record lengths. Up to nine additional tracks on each side of the diskette 2D can be allocated for header labels. The header labels are used to reserve a block of record space for a particular use. They also contain controls, status information, and the record name of that block of records.

Header Label Fields

Header Label Identifier and Number (bytes 0 through 3): Identifies this record as a header and denotes which header it is; for example: HDR1.

Reserved (byte 4):

Data Set Identifier (bytes 5 through 21): Establishes a name for this block of records. This field is optional.

Block Length (bytes 22 through 26): Specifies the number of characters per block. This field must be set to the range of 00001 through 04096 for 31SD and 00001 through 08192 for 51TD. For a basic exchange data set, this field must be set to the range of 00001 through 00128 for 31SD and 00001 through 00256 for 51TD.

Record Attribute (byte 27): Indicates the blocking and spanning attributes of the data set as follows:

space	=	Records unblocked, unspanned
B	=	Records blocked, unspanned
R	=	Records blocked, spanned

Beginning of Extent (bytes 28 through 32): Identifies the position of the first record of the data set. The first two bytes are the cylinder number, the next byte is the head number, and the last two bytes are the sector number.

Physical Record Length (byte 33): Indicates the length of the physical record as follows:

space	=	Record length of 128 bytes
1	=	Record length of 256 bytes
2	=	Record length of 512 bytes
3	=	Record length of 1024 bytes

End of Extent (bytes 34 through 39): Identifies the address of the last position on the diskette reserved for the data set identified by this label. The first two bytes are the cylinder number, the next byte is the head number, and the last two bytes are the sector number.

Record Block Format (byte 39): Indicates the type of blocking used by the data set as follows:

F	=	Fixed length records in fixed blocks
V	=	Record length not fixed

Bypass Indicator (byte 40): Indicates if this data set should be read. This field serves many purposes and is useful when program files are stored on the same diskette as data files. This field is set as follows:

space	=	Data set can be read
B	=	Data set cannot be read

Data Set Security (byte 41): Indicates whether this data set can be processed or not. If this field is blank, normal processing can take place. If any other code is present in this field, the data set cannot be processed.

Write Protect Indicator (byte 42): Indicates if this is a protected data set.

space	=	no protection. Can read or write this data
P	=	Protected. Can read only

Exchange Type Indicator (byte 43): Indicates that the data set has specified attributes. This field is used as a summary indicator for certain other fields in this label as follows:

space = Basic exchange data set for 31SD
H = Basic exchange data set for 51TD
E = No summation of the attributes exists

The *space* and *H* indicate the following attributes:

- Physical record size is 128 bytes for 31SD, 256 bytes for 51TD
- Unblocked, unspanned records
- Record length maximum is 128 bytes for 31SD, 256 bytes for 51TD
- Sequentially organized
- Data set identifier is a single name of up to eight characters
- Data in the data set must be recorded in EBCDIC, ASCII, or user code and must be in the same code as the data set label describing it.
- The data set label must reside on cylinder 0.

Multivolume Indicator (byte 44): Indicates if the data set is complete on this diskette or is continued on another diskette. This field will contain one of the following:

C = Data set continued on another diskette
L = This is the last volume of a multivolume data set
space = The complete data set is contained on this diskette

Volume Sequence Number (bytes 45 through 46): Indicates the volume number of this diskette in a multivolume data set.

Creation Date (bytes 47 through 52): Indicates the date this data set was created. This field is coded YYMMDD or all space characters.

Record Length (bytes 53 through 56): Indicates the length of a stored logical record to be transferred to an application program. This field will contain the numeric value of the length of the logical record or will contain spaces. A space in this field means that the record length equals the block length.

Offset to Next Record Space (bytes 57 through 61): Indicates the starting position of the next sequential record relative to the end of the last block preceding the EOD (end of data) address. This field will contain either spaces or a decimal value to be used as a negative displacement value.

Reserved (bytes 62 through 65):

Expiration Date (bytes 66 through 71): Indicates the date on which this data set can be destroyed. This field is coded YYMMDD for data sets that can be destroyed or 999999 for data sets which cannot be destroyed.

Verify/Copy Indicator (byte 72): Indicates if the data set has been verified. In verify mode, this field will contain a V when the last nondeleted record in the data set has been processed.

Data Set Organization (byte 73): Indicates how the data set is organized. If SEQ (sequential) is specified, the field is set to D. If SEQ is not specified, the field is set to space.

End of Data Address (bytes 74 through 78): Indicates the address of the next available unused block in the extent. The first two bytes are the cylinder number, the next byte is the head number, and the last two bytes are the sector number.

Not Used (byte 79):

Not Used (byte 80):

Not Used (bytes 81 through 94):

System Code (bytes 95 through 107):

File Application Type (bytes 108 through 109):

Not Used (bytes 110 through 117):

Data Header/Trailer Label Indicator (byte 118): Used only by I and E exchange.

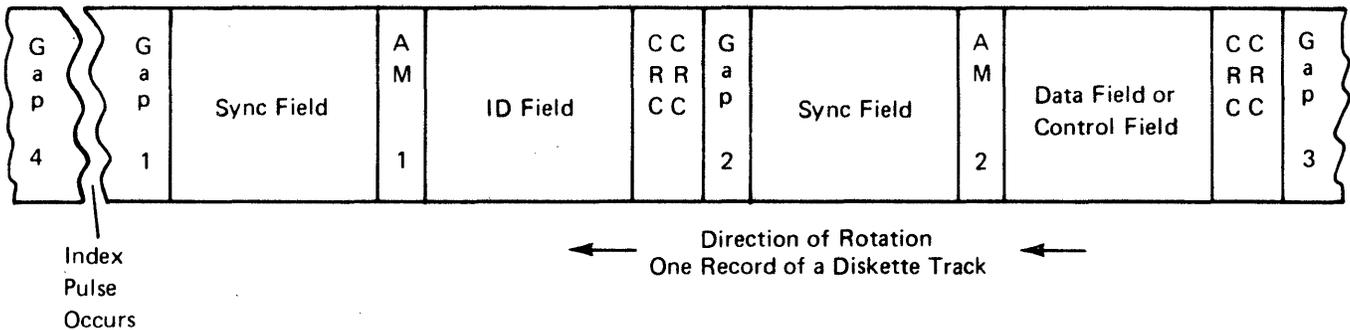
Number of Data Header Labels (bytes 119 through 120): Used only by I and E exchange.

Number of Data Trailer Labels (byte 121): Used only by I and E exchange.

Record Delete Character (byte 122): Used only by I and E exchange.

Pad (bytes 123 through 127): Indicates the end of this data set header label. The pad extends to the end of the sector. Each position of this field contains hex FF.

DATA RECORDING FORMAT



Gap 1

This gap separates the index pulse from the sync field of the first record. In FM format, gap 1 consists of 73 bytes of hex FF. In MFM format, gap 1 consists of 146 bytes of hex 4E.

Sync Field

This field synchronizes the diskette control circuitry to the information being read from the diskette. Each sync field contains a set number of bytes of hex 00. In FM format, the sync field contains 6 bytes. In MFM format, this field contains 12 bytes.

AM 1

AM 1 is the address mark that identifies the following field as an ID (identification) field. In FM format, this field contains 1 byte that is always hex FE. In MFM format, this field contains 4 bytes that are always hex A1A1A1FE.

ID Field

The ID field is made up of the track address, head address, record address, and record length.

The track address contains a hex number from 00 through hex 4A (hex 00 = track 00, hex 01 = track 01, hex 02 = track 02, and so on).

The head address for a diskette 1 is always hex 00. For a diskette 2 and 2D the head address contains either hex 00 or hex 01.

The record address contains a hex number from hex 01 through hex 1A (hex 01 = sector 1, hex 02 = sector 2, and so on).

The record length contains a number from 0 through 3 depending on the number of sectors the track is divided into:

Number	Record Format	Sector Per Track	Record Length
0	FM	26	128 bytes
1	FM	15	256 bytes
2	FM	8	512 bytes
1	MFM	26	256 bytes
2	MFM	15	512 bytes
3	MFM	8	1024 bytes

Note: If any record on a track is damaged, all records on that track will have hex FF recorded as the record length.

CRC

Two CRC (cyclic redundancy check) bytes are generated in the CRC register during a write operation for an ID field or a data field. The bit structure of the CRC byte is determined by an algebraic formula applied to the bit structure of the field being written. These two CRC bytes are written on the diskette immediately following the field. During a write operation, the data written on the diskette is retained in main storage for use during the write verify operation.

During the write verify operation, the data is compared bit for bit with the data in the main storage as it is read from the diskette. If any bit read from the diskette does not compare with the corresponding bit in the main storage, a write verify error occurs. Also, as the data is read from the diskette, two CRC bytes are built in the CRC register. When the two CRC bytes (written on the diskette during the write operation) are read, they are subtracted from the two CRC bytes that were built in the CRC register during the write verify operation. The CRC register is then tested for a content of 0. If the CRC register equals 0, the field was written correctly. If the CRC register does not equal 0, a CRC error occurs.

During a read operation, two CRC bytes are generated in the CRC register for the ID fields and data fields. The bit structure of the CRC bytes is determined by an algebraic formula applied to the bit structure of the field being read. As the field is being read, the two CRC bytes on the diskette are read and compared to the two bytes from the CRC register. If the CRC bytes are exactly the same, the field has been read correctly. If they are not exactly the same, a CRC error occurs.

Gap 2

This gap separates the ID field from the data field. In FM format, gap 2 consists of 11 bytes of hex 4E. In MFM format, gap 2 consists of 22 bytes of hex FF.

AM 2

AM 2 is the address mark that identifies the following field as either a data field or a control field. If the field following the address mark is a data field, AM 2 will contain the following:

FM format = Hex FB
MFM format = Hex A1A1A1FB

If the field following the address mark is a control field, AM 2 will contain the following:

FM format = Hex F8
MFM format = Hex A1A1A1F8

Data Field

The data field contains the data record.

Control Field

The control field contains data to control the reading of that particular record.

Gap 3

Gap 3 separates one sector from another. The following chart shows what is contained in gap 3:

Sector Size	Field Contents in FM	Field Contents in MFM
128 bytes	27 bytes of hex FF	
256 bytes	42 bytes of hex FF	54 bytes of hex
512 bytes	58 bytes of hex FF	84 bytes of hex
1024 bytes		116 bytes of hex

Gap 4

This gap occurs after the last record of the last sector of a track and separates that record from the index pulse. In FM format, this gap contains a variable number of bytes of hex FF. In MFM format, this gap contains a variable number of bytes of hex 4E. The actual number of bytes depends on the speed of the diskette. The length of this field can vary to let the diskette interchange between diskette drives.

Index

An index pulse occurs each time the index hole in the diskette passes the light emitting diode/phototransistor (LED/PTX) of the diskette drive. The index pulse indicates to the diskette control circuitry that sector 1 of that particular track will be the next sector to reach the read/write heads.

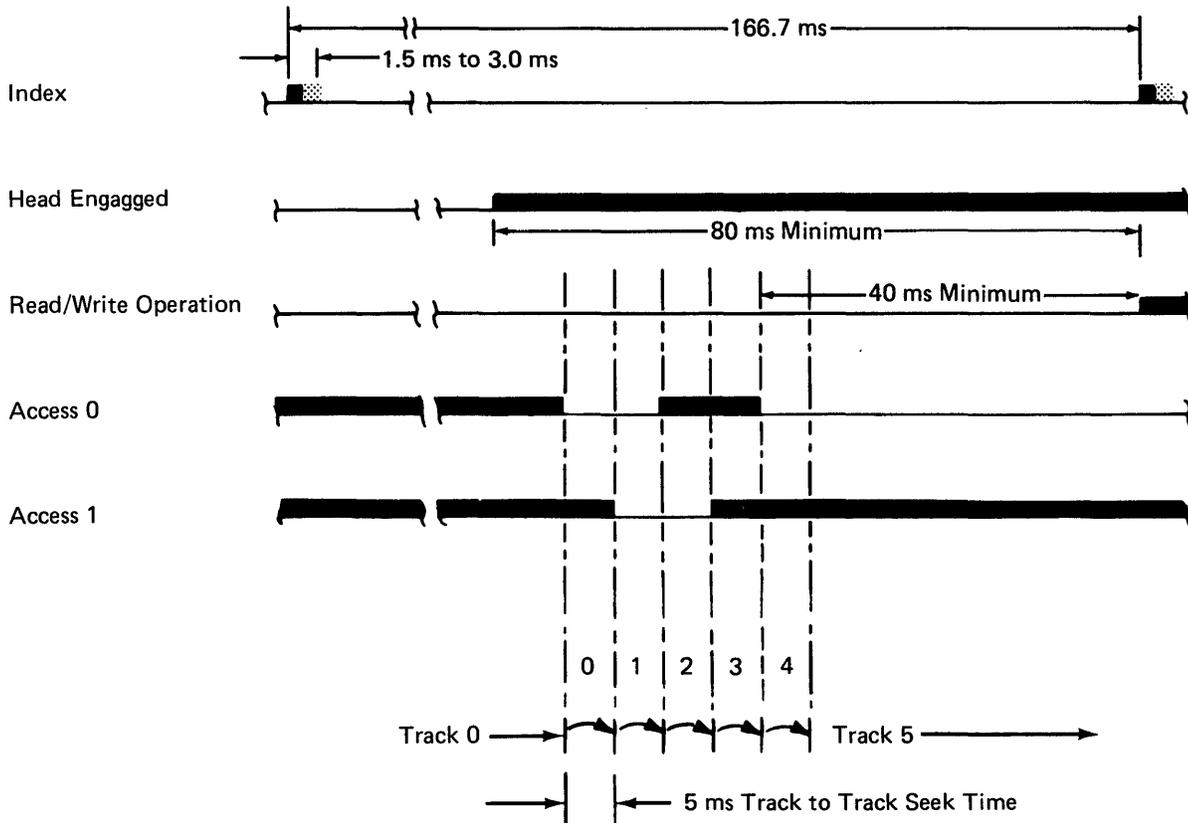
OPERATION

To operate the 31SD and 51TD diskette drives, simply insert a diskette into the diskette drive and close the diskette locking lever. With the system power on, the following occurs: (see *Typical Timing Sequence* in this section).

1. The diskette starts turning. It takes approximately 10 seconds for the diskette to reach operating speed (360 rpm).
2. Index pulses are sensed every revolution (166.7 ms) by the LED/PTX. The type of diskette inserted is identified on the diskette sense line. An active level on the diskette sense line indicates a diskette 2 or a diskette 2D is inserted.
3. Seeking to the selected track is accomplished by alternately activating access line 0 and access line 1. This turns the stepper motor, which moves the read/write heads across the diskette surface. The last access line activated at the time the read/write heads reach the desired track remains activated as long as the heads remain at that track.
4. A Head Load command can be issued before or during a seek operation to activate the head load solenoid. Because of head settling time the read or write operation cannot begin until 80 milliseconds after a head load operation or until 40 milliseconds after a seek operation.
5. In order to reduce the wear to the diskette and the read/write heads, the heads are unloaded after the read/write operation if another command is not issued by the system within eight revolutions of the diskette.

TYPICAL TIMING SEQUENCE

This timing sequence chart shows a seek operation from track 00 to track 05. Track 05 is the track to be read from or written on.



Note: Seeking and head loading are not timed to the index.

Glossary of Terms and Abbreviations

μs: Microsecond.

μcm: Microseconds per centimeter.

A: Both the logic block symbol for the AND function and the abbreviation for ampere.

AC: Alternating current.

access lines: The pulses on these lines turn the stepper motor.

AM: Address mark.

amplifier: An electronic circuit that increases the amplitude of a signal for distribution.

AR: Amplifier.

AR-DIF: See differentiator-amplifier.

bail assembly: (See 330 **10**). A mechanical arm that operates under control of the head load solenoid to load or unload the read/write heads.

block: A collection of records recorded as a unit.

blocking: Combining two or more records into one block.

carriage: (See 330 **18**). The part that carries the read/write heads under control of the stepper motor.

CE: Customer engineer.

characteristics: Electrical, physical, or functional features of a machine which are not specifications.

clamp: A part used to lock another part.

collet: (See 330 **12**). The part that centers and holds the diskette to the drive hub.

CRC: Cyclic redundancy check.

crosstalk: Data bits detected from one track while reading from another track.

DC: Direct current.

DET: See detector.

detector: An electronic circuit that detects a carried signal and converts it to a signal pulse.

differentiator-amplifier: An electronic circuit whose output is a function of the time rate of change in the input signal.

diskette 1: A diskette used for storing data on only one side.

diskette 2: A diskette used for storing data on both sides.

diskette 2D: A diskette used for storing data on both sides with twice the bit density of the diskette 2.

DR: See driver.

drive band: (See 341 **15**). A metal band connected to the stepper motor pulley and the head/carriage assembly.

driver: An electronic circuit that increases the energy of a signal to a sufficient level to drive a predetermined load.

flux: The flow of magnetic force around an object when that object has been magnetized or has electric current flowing through it.

FM: Frequency modulation. (See modulation.)

FRU: Field replaceable unit. A part or an assembly that can be replaced by a CE.

HCP: (See 333 **5**). Head connector pin.

hex: Hexadecimal.

ID: Identification.

inverter: An electronic circuit that inverts a signal (+ to -, or - to +).

I/O CP: (See 333 **2**). Input/output connector pin.

LED: (See 371 **1**). Light emitting diode. An electronic part used as a source of light.

LEDPC: (See 333 **3**). Light emitting diode connector pin.

MFM: Modified frequency modulation. (See modulation.)

MIM: Maintenance information manual.

mm: Millimeter.

modulation: The process of varying the amplitude or frequency of the read/write signals.

ms: Millisecond.

ms/cm: Milliseconds per centimeter.

mV: Millivolt.

NC: Normally closed.

NO: Normally open.

ns: Nanosecond.

phototransistor: (See 375 **11**). An electronic part used to sense the light of an LED.

PTX: See phototransistor.

PTXCP: (See 333 **1**). Phototransistor connector pin.

rpm: Revolutions per minute.

SCP: (See 333 **4**). Solenoid connector pin.

SMCP: (See 333 **6**). Stepper motor connector pin.

solenoid: (See 330 **4**). An electromechanical part that operates the bail assembly to load and unload the read/write heads.

TP: Test point.

V: Volts.

Vac: Volts, alternating current.

Vdc: Volts, direct current.

VFO: Variable frequency oscillator. An electronic circuit used to synchronize the read and write circuits with diskette rotation in FM and MFM recording.

V/cm: Volts per centimeter.

- AC drive belt location 1
- AC drive motor
 - location 1
 - removal
 - with external fan 28
 - with internal fan 30
 - replacement
 - with external fan 28
 - with internal fan 30
- address mark 74, 75
- adjustments
 - drive band 40
 - head gap 21
 - head load bail 22
 - head load solenoid 22
 - head/carriage assembly 12
- AM 1 74
- AM 2 75

- bail
 - adjustment 22
 - location 1
 - removal 24
 - replacement 24
 - service check 18
- beginning of extent 70, 71
- block length field 70, 71
- BOE 70, 71
- bypass indicator field 70, 71

- capacitor
 - location 33
 - removal 32
 - replacement 32
- carriage pressure spring location 1
- collet
 - location 1
 - removal 8
 - replacement 8

- control card
 - connector pins
 - 31SD 4
 - 51TD 6
 - layout
 - 31SD 2
 - 51TD 2
 - location 1
 - removal 56
 - replacement 56
 - control field 75
 - CRC 75
 - creation date field 70, 72

- data field 75
- data recording format
 - fields
 - AM 1 74
 - AM 2 75
 - control field 75
 - CRC 75
 - data field 75
 - gap 1 74
 - gap 2 75
 - gap 3 75
 - gap 4 75
 - ID field 74
 - index 75
 - sync field 74
- data set identifier field 70, 71
- data set organization field 70, 72
- data set security field 70, 71
- diskette description 59
- diskette locking lever location 1
- diskette speed service check 44
- drive band
 - adjustment 40
 - location 39
 - removal 42
 - replacement 42
 - service check 39
- drive belt location 1
- drive fan and pulley
 - location 1
 - removal 34
 - replacement 34
- drive hub location 1
- drive pulley location 1

end of data field 70, 72
end of extent field 70, 71
EOD 70, 72
EOE 70, 71
exchange type indicator field 70, 72
expiration date field 70, 72
extended label area field 66, 67
extent arrangement indicator field 66, 67

flat spring
location 1
removal 8
replacement 8
FM format
principles 62
read data 62
scope charts 63

gap 1 74
gap 2 75
gap 3 75
gap 4 75

head connector
line names 5, 7
location 4, 6
head gap
adjustment 21
service check 20
head load bail
adjustment 22
location 1
removal 24
replacement 24
service check 18
head load solenoid
adjustment 22
idler location 1
location 1
removal 26
replacement 26
service check 18
head/carriage assembly
adjustment 12
location 1
removal 15
replacement 15
service check 10

header label
beginning of extent 70, 71
block length 70, 71
bypass indicator 70, 71
creation date 70, 72
data set identifier 70, 71
data set organization 70, 72
data set security 70, 71
end of data address 70, 72
end of extent 70, 71
exchange type indicator 70, 72
expiration date 70, 72
fields 71
format 71
identifier and number 70, 71
multivolume indicator 70, 72
offset to next record space 70, 72
pad 70, 72
physical record length 70, 71
record attribute 70, 71
record block format 70, 71
record length 70, 72
verify/copy indicator 70, 72
volume sequence indicator 70, 72
write protect indicator 70, 71

I/O interface connector
line names 5, 7
location 4, 6
ID field 74
idler
location 1
removal 26
replacement 26
index field 75
introduction to theory 59

label standard version field 66, 69
LED
location 51
output service check 49
removal 51
replacement 51
LED connector
line names 5, 7
location 4, 6

locations

- AC drive belt 1
- AC drive motor 1
- AC drive pulley 1
- carriage pressure spring 1
- collet 1
- control card 1
- diskette locking lever 1
- drive band 39
- drive hub 1
- flat spring 1
- head connector 4, 6
- head load bail 1
- head load solenoid 1
- head/carriage assembly 1
- I/O interface connector 4, 6
- LED 51
- LED connector 4, 6
- PTX 55
- PTX connector 4, 6
- pulley and clamp 38
- solenoid connector 4, 6
- solenoid idler 1
- spindle pulley 1
- stepper motor 1
- stepper motor connector 4, 6
- thickness gauge clip 1
- timing pin 1

MFM format

- principles 64
- read data 64
- scope charts 65
- multivolume indicator field 70, 72

- offset to next record space field 70, 72
- operation 76

- pad 70, 73

- physical record length field 70, 71
- physical sector length field 66, 67
- pressure pad
 - location 14
 - removal 14
 - replacement 14
 - tool 14

PTX

- amplifier service check 52
 - location 55
 - removal 54
 - replacement 54

PTX connector

- line names 5, 7
- location 4, 6
- pulley and clamp
 - location 38
 - removal 38
 - replacement 38

- record attribute field 70, 71
- record block format field 70, 71
- record length field 70, 72
- removals

- AC drive motor
 - with external fan 28
 - with internal fan 30
- bail 24
- capacitor 32
- collet 8
- control card 56
- drive band 42
- drive fan and pulley 34
- flat spring 8
- head load bail 24
- head load solenoid 26
- head/carriage assembly 15
- idler 26
- LED 51
- pressure pad 14
- PTX 54
- pulley and clamp 38
- solenoid 26
- stepper motor 36

replacements

- AC drive motor
 - with external fan 28
 - with internal fan 30
- bail 24
- capacitor 32
- collet 8
- control card 56
- drive band 42
- drive fan and pulley 34
- flat spring 8
- head load bail 24
- head load solenoid 26
- head/carriage assembly 15
- idler 26
- LED 51
- pressure pad 14
- PTX 54
- pulley and clamp 38
- solenoid 26
- stepper motor 36

- scope charts
 - FM format 63
 - MFM format 65
- sequence code field 66, 68
- service checks
 - diskette speed 44
 - drive band 39
 - head gap 20
 - head load bail 18
 - head load solenoid 18
 - head/carriage assembly 10
 - LED output 49
 - PTX amplifier 52
- solenoid
 - adjustment 22
 - idler location 1
 - location 1
 - removal 26
 - replacement 26
 - service check 18
- solenoid connector
 - line names 5, 7
 - location 4, 6
- special requirements indicator field 66, 67
- spindle pulley location 1
- stepper motor
 - location 1
 - operation 60
 - pulley and clamp
 - removal 38
 - replacement 38
 - removal 36
 - replacement 36
- stepper motor connector
 - line names 5, 7
 - location 4, 6, 14
- stroboscope wheel 47
- sync field 74

- theory 59
- thickness gauge clip location 1
- timing pin location 1
- tools and test equipment 57
- typical timing sequence 77

- verify/copy indicator field 70, 72
- volume label
 - accessibility 66, 67
 - extended label area 66, 67
 - extent arrangement indicator 66, 67
 - fields 67
 - format 67
 - identifier and number 66, 67
 - label standard version 66, 69
 - layout 66
 - owner identification 66, 67
 - pad 66, 69
 - physical record sequence code 66, 68
 - physical sector length 66, 67
 - special requirements indicator 66, 67
 - system identification 66
 - user specified identifier 66, 67
 - volume surface indicator 66, 67
- volume sequence indicator field 70, 72
- volume surface indicator field 66, 67

- write protect indicator field 70, 71

- 31SD
 - control card layout 2
 - control card location 1
- 51TD
 - control card layout 2
 - control card location 1

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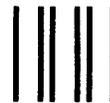
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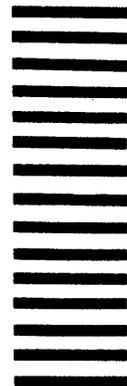


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**IBM 5280
Distributed Data
System
Diskette Drive
Maintenance Information Manual**

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This technical newsletter provides replacement pages and additional information for the subject manual. The replacement pages remain in effect for subsequent revisions unless specifically changed. Pages to be inserted and/or removed are:

7, 8	49, 50
11-24	53, 54
29-34	

A change to the text is indicated by a vertical line to the left of the change. Absence of a vertical line on a page bearing an 'updated' notice means only that previously existing text has been removed or rearranged or that a minor typographical error has been corrected.

Note: Please file this cover letter at the back of the manual to provide a record of changes.

51TD

7 PTX Connector

A01	diskette 1 col (+5 V)
A02	blank
A03	diskette 1 PTX emitter
A04	diskette 2, 2D PTX emitter
A05	diskette 2, 2D col (+5 V)

8 I/O Interface Connector

A01	-5 V
A02	power supply ground
A03 – A18	ground
B01	+5 V
B02	blank
B03	+24 V
B04	+index
B05	+diskette 2 sense
B06	+write/erase sense
B07	+file data
B08	+inner tracks
B09	+erase gate
B10	+access 0
B11	+select head 1
B12	not used
B13	+access 1
B14	+write gate
B15	+head engage
B16	+switch filter
B17	write data
B18	not used

9 LED Connector

A01	diskette 2, 2D ground
A02	blank
A03	diskette 2, 2D ground
A04	blank
A05	diskette 1 ground
A06	diskette 1 anode

10 Solenoid Connector

A01	not used
A02	blank
A03	+head load
A04	-head load

11 Head Connector

A01	not used
A02	blank
A03	head 0 read/write coil
A04	head 0 center tap
A05	head 0 read/write coil
A06	head 0 erase
A07	head 0 erase common
A08	ground
A09	ground
A10	head 1 erase common
A11	head 1 erase
A12	head 1 read/write coil
A13	head 1 center tap
A14	head 1 read/write coil

12 Stepper Motor Connector

A01	+24 V
A02	blank
A03	MC-3
A04	MC-2
A05	MC-1
A06	MC-0

Collet

335 COLLET/FLAT SPRING REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. If the diskette drive was removed from an IBM 5282 or an IBM 5286, remove the mounting bracket on the base of the drive by removing two screws on each side of the mounting bracket. (This bracket is not installed for the other data stations.)
3. Close the diskette locking lever **3**.
4. Loosen the bail lever screw **15**.
5. Push the bail **10** inward slightly and disconnect the bail actuator cable eyelet **17** from the bail lever **16**.
6. Open the diskette locking lever.
7. (51TD) Place a piece of clean paper between the heads, or insert a scratch diskette.
8. Loosen the bail mounting screw **8**.
9. Pull the pivot rod **9** out, then remove the bail and the bail return spring **11** by sliding them out from under the head load arm **1**. (Note the location of the bail return spring between the bail and the diskette guide for replacement.)
10. Remove the screw and nut **13** from the collet actuator rod **12**.

CAUTION

(31SD) Do not let the head hit the pressure pad, or the head could be damaged. (51TD) Do not let the heads hit each other, or the heads could be damaged.

11. Remove the diskette locking lever **3**.
12. Remove the collet actuator roll **6** and the pressure roll **5**.

13. Turn the collet actuator rod **12** up and out of the way.
14. Remove the collet/flat spring assembly **4**.

Replacement

1. Reinstall the collet/flat spring assembly **4**.
2. Reinstall the collet actuator roll **6** and the pressure roll **5**.
3. Turn the collet acuator rod **12** down against the flat spring.
4. Reinstall the diskette locking lever **3** in the open position.
5. Reinstall the screw and the nut **13**. Leave the screw loose.
6. Push the diskette locking lever toward the collet actuator rod until there is a maximum gap **7** of 0.1 millimeter (0.004 in.) between the diskette locking lever and the diskette guide **2**. Tighten the screw and nut **13**.
7. Reinstall the bail **10** on the collet actuator rod **12**. Ensure that the bail return spring **11** is in the correct position. Place the bail **10** under the head load arm **1**. Install the pivot rod **9** and tighten screw **8**.
8. Close the diskette locking lever **3**.
9. Push the bail inward slightly and reconnect the bail actuator cable eyelet **17** to the bail lever **16**. Ensure that the crimp on the eyelet faces out.
10. If the bail actuator cable is twisted, turn the solenoid plunger **14**.
11. Open the diskette locking lever **3**.
12. (51TD) Remove the paper from between the heads, or remove the scratch diskette.
13. Insert and remove a diskette. The diskette should move into and out of the diskette drive smoothly without hitting the collet. If it does not, install a new flat spring.
14. Perform the head gap adjustment (see 345).

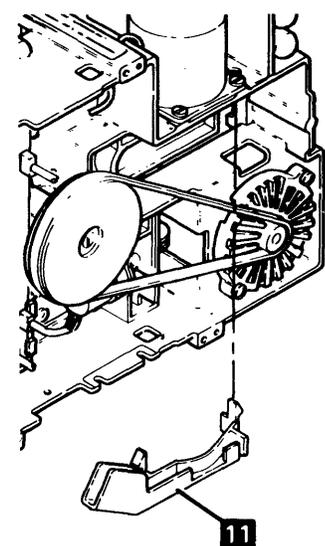
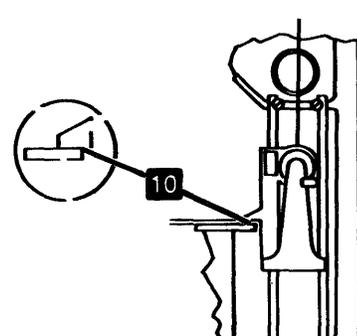
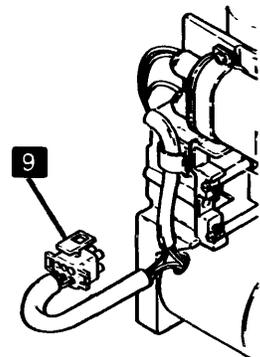
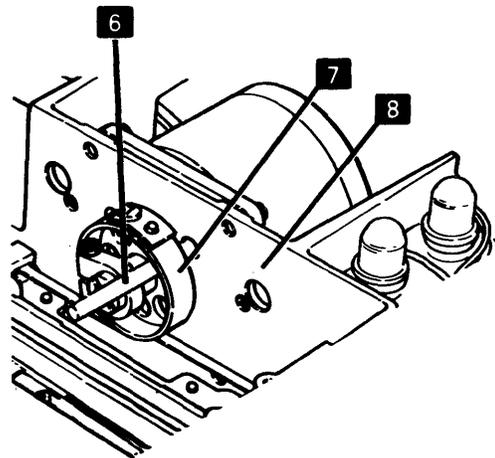
22. Remove the jumper from **2** (ground) to **5** (-disable stepper motor) and the jumper from **1** (ground) to **3** (MC-0).

23. Reinstall the cable guide **11**. (Ensure that the head/carriage assembly moves freely.)

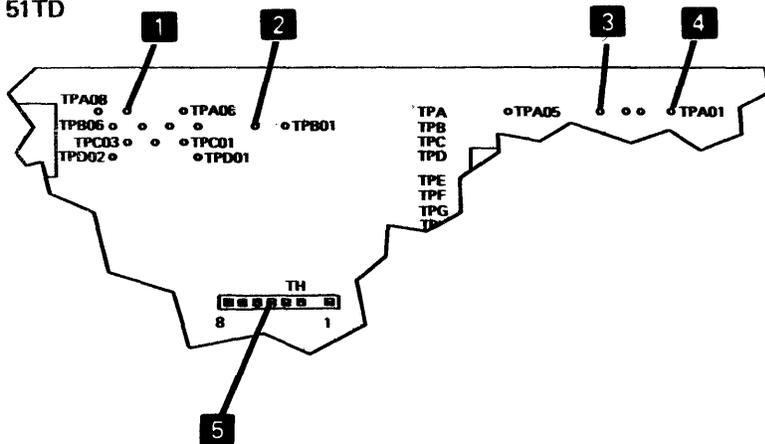
24. If a new head/carriage assembly was installed, go to 344. If a new head/carriage assembly was not installed, proceed with step 25.

25. Reconnect the AC drive motor power cable.

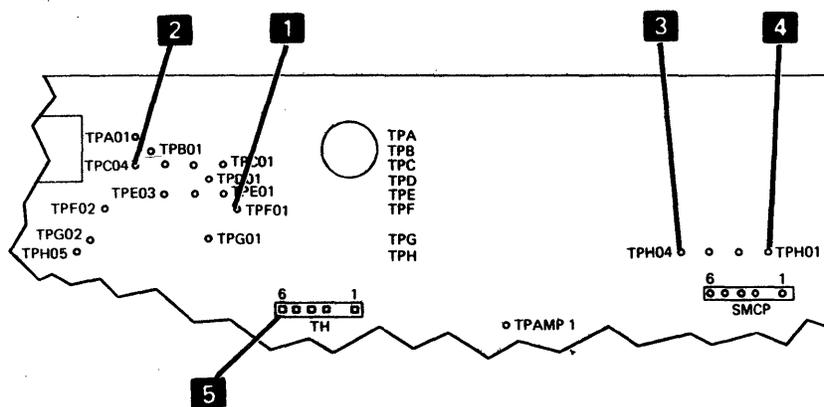
26. Power on.



51TD



31SD



339 HEAD/CARRIAGE ADJUSTMENT

CAUTION

The head/carriage assembly adjustment must be performed with the diskette drive installed (or in the same position as when installed) or the adjustment might not be accurate.

Note: This procedure should not be performed unless paragraphs 363 and 337 have been completed or you were directed to this procedure from another manual.

1. Power off.

DANGER

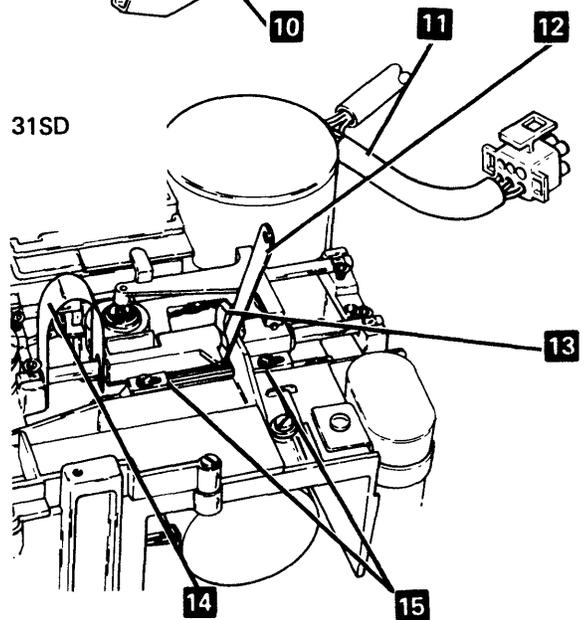
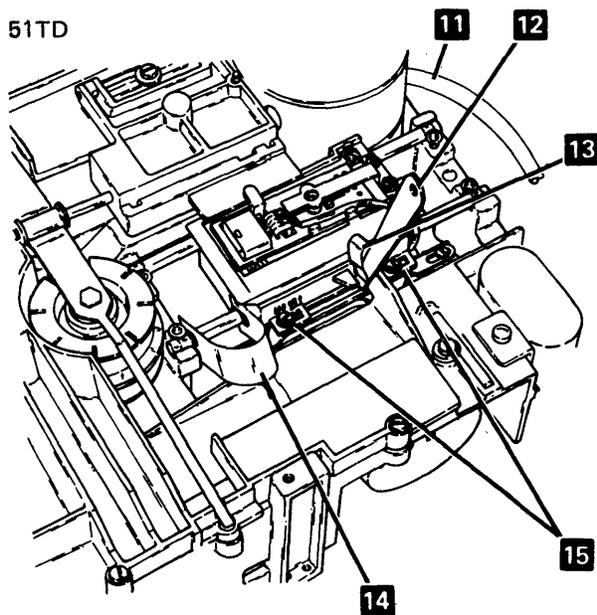
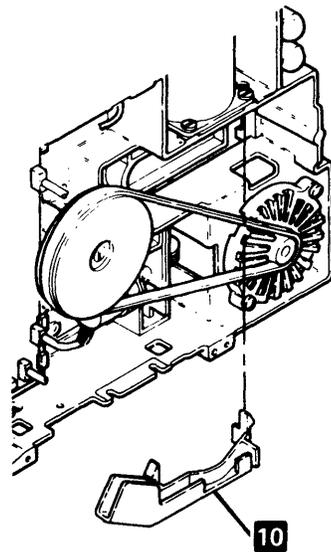
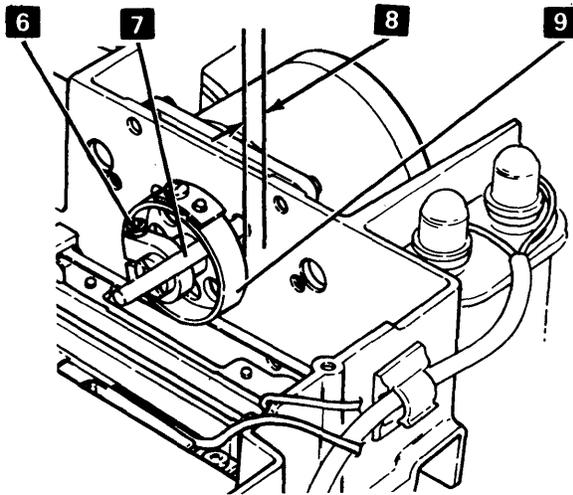
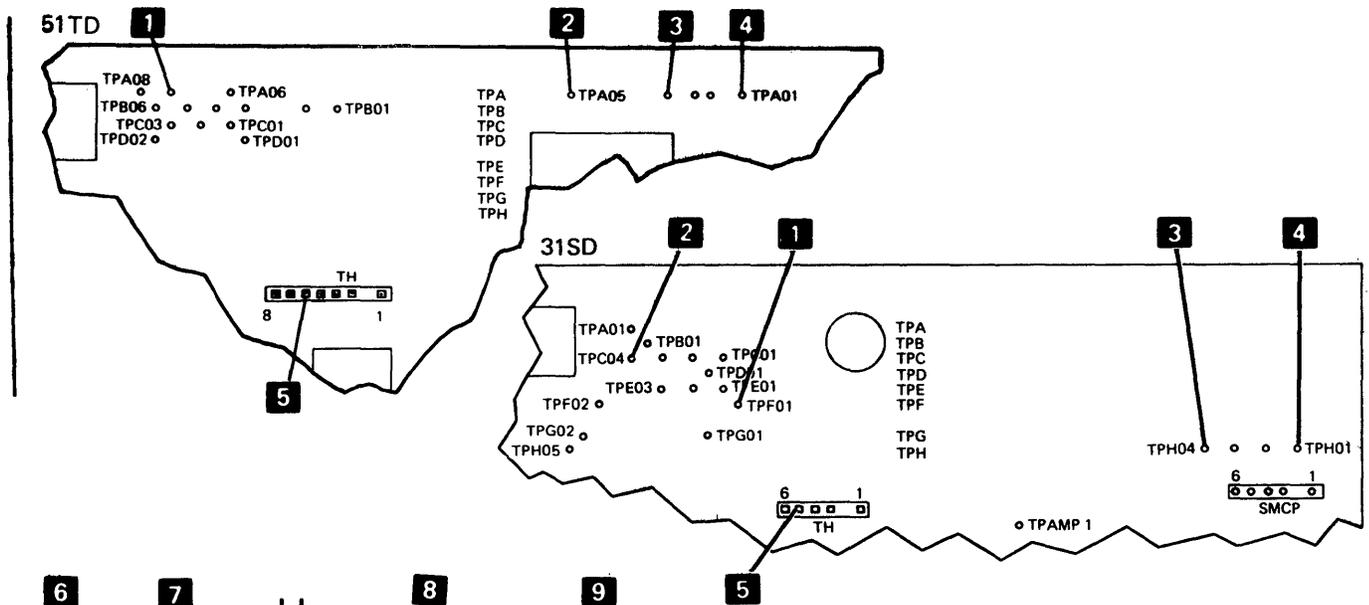
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **11**.
3. Remove the cable guide **10**.
4. Go to 341 step 12.
5. Measure and record the gap **8** between the stepper motor pulley and the casting. The gap is
6. Loosen the clamp screw **6** so the stepper motor shaft can turn inside the pulley.
7. Turn the stepper motor pulley **9** by hand to track 40 and insert the timing pin **7**.
8. Power on.
9. Install a jumper from **2** (ground) to **5** (-disable stepper motor).
10. Install a jumper from **1** (ground) to **3** (MC-0).
11. Set the gap **8** to the same size as the gap recorded in step 5 and tighten the clamp screw. (Ensure that the timing pin passes freely through the stepper motor pulley into the timing hole in the casting.)

12. Remove the timing pin.
13. Loosen the two screws **15** that hold the bracket to the carriage.
14. Remove the jumper end from **3**; and momentarily touch it to **4**.
15. Reinstall the jumper end on **3**.

Note: Steps 13 and 14 set up the required torque condition of the stepper motor for the following steps.

16. Verify that the stepper motor pulley is at track 40 by visually checking that the timing hole in the pulley is aligned with the timing hole in the casting. Use a dental mirror to check. Do not insert a timing pin.
17. Insert thickness gauges **12** totaling 0.508 millimeters (0.020 inch) between the timing pointer on the carriage and the track 40 adjustment surface on the casting. Clamp the thickness gauge **12** to the casting with the retaining clip **13** provided (part 4240632). The clip is attached to the diskette guide. (For location, see 330 **16**.)
18. Slide the head/carriage assembly against the thickness gauge so it just touches but is not forced against the thickness gauge. Insert the carriage pressure spring **14** (part 4240631) between the casting and the carriage to hold the carriage against the thickness gauge. The carriage pressure spring is attached to the diskette guide. (For location, see 330 **15**.)
19. Tighten the two screws that hold the bracket to the carriage.
20. Remove the retaining clip and the carriage pressure spring.
21. Go to 337 step 15.



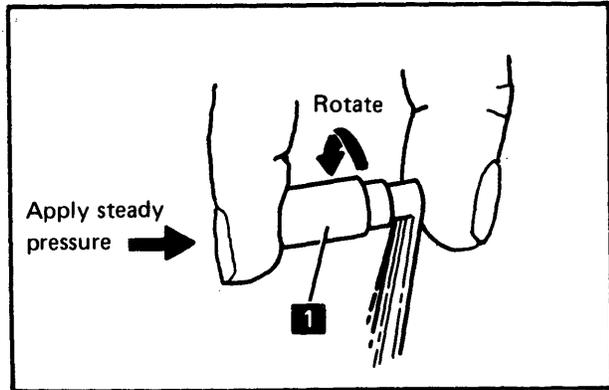
340 PRESSURE PAD REMOVAL AND REPLACEMENT (31SD ONLY)

Removal

1. Move the head load arm **4** away from the read/write head **5**.

CAUTION

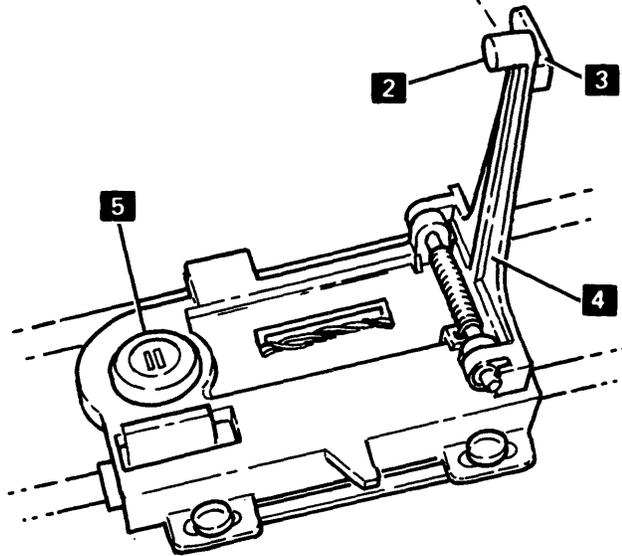
Do not scratch the head load arm.



2. Use a scissor clamp (part 9900233) to pull the pressure pad **2** off the head load arm.

Replacement

1. Clean the pressure pad mounting surface **3** with a lint-free cloth that is moistened with isopropyl-alcohol solvent.
2. Remove the paper cover that protects the adhesive layer on the new pad.
3. Place the new pad in the center of the mounting surface on the head load arm.
4. Lightly press the new pad in place with a clean screwdriver.
5. Use the small end of the pressure pad tool **1** and press the pressure pad onto the head load arm.
6. Turn the pressure pad tool at least one revolution in one direction only.
7. Move the head load arm toward the read/write head.



341 HEAD/CARRIAGE REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Remove the head cable connector **21** from the diskette drive control card **20** and remove the head cable from the cable guide **22**.
3. Remove the cable guide **22**.

CAUTION

The drive band must not be bent or damaged in any way.

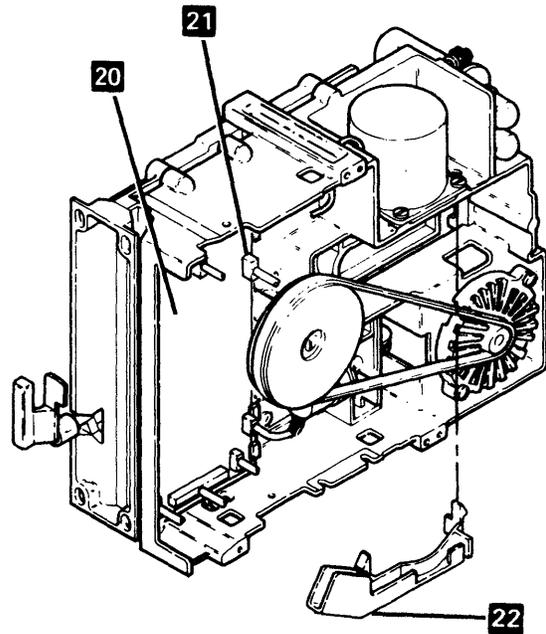
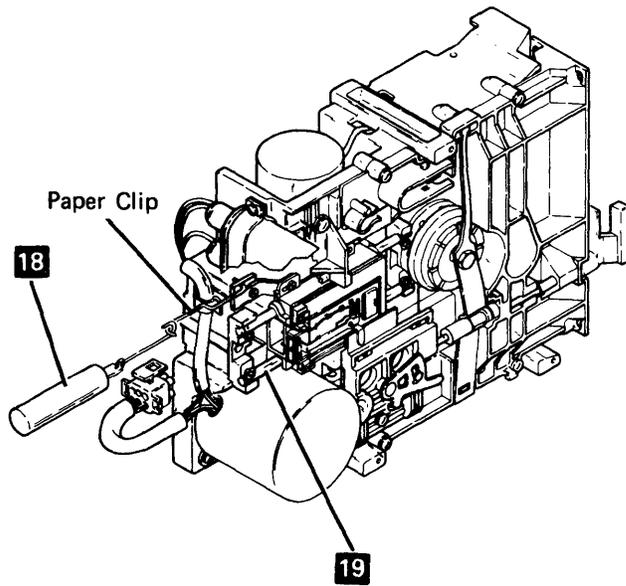
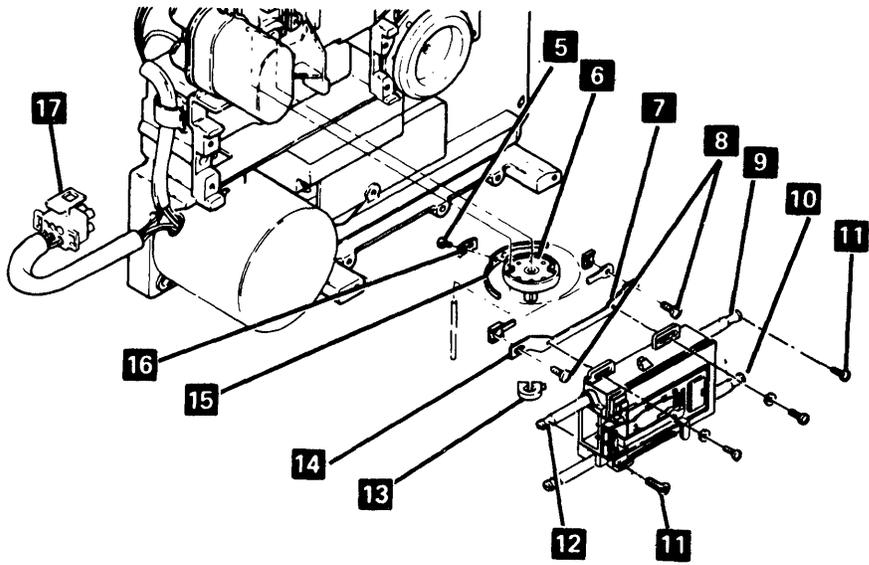
4. Remove the two screws **8** and the screw **5**, then remove the drive band **15**. (Note the position of the drive band and the clamps; they must be in the same position when reinstalled.)
5. Remove the carriage bracket **7** from the carriage.
6. (51TD) Place a piece of clean paper between the heads.
7. Remove the two screws **11** (one on each end of guide rod **9**) and remove guide rod **9**.
8. Lift and turn the head/carriage assembly to remove it from guide rod **10**.

Replacement

CAUTION

When installing the head/carriage assembly, ensure that the bail is under the tab of the carriage arm, the bail return spring is properly installed, and the drive band is not damaged in any way. (51TD) Ensure that a strip of clean paper is inserted between the head surfaces during installation.

1. Reinstall the head/carriage assembly on guide rod **10**. Then place the head/carriage assembly to the lower limit (track 00).
2. Reinstall guide rod **9** and tighten the two screws. Ensure that the guide rod notch **12** is aligned with the screw.
3. Move the head/carriage assembly by hand to track 40.
4. Reinstall the carriage bracket on the carriage with the screws installed in the center of the hole.
5. Connect the welded adapter end of the drive band **14** to the slotted end of the carriage bracket. Use the clamp **16** to install the drive band to the stepper motor pulley. Ensure that the drive band is parallel to the carriage bracket and the edge of the pulley.
6. Block the head/carriage assembly approximately 25 millimeters (1 inch) from the casting **19**.
7. Pull on the welded adapter end of the drive band **14** with 2.5 ± 0.25 pounds of force (use gauge **18**, part 460870) and tighten the band clamping screw. Ensure that the drive band is parallel to the stepper motor pulley edge.
8. Remove the block from between the casting and the head/carriage assembly.
9. (51TD) Remove the paper from between the heads.
10. Move the head/carriage assembly back and forth by hand and ensure that the drive band tracks straight and that the drive band is parallel to the stepper motor pulley edge (see 361).
11. Connect the head cable connector to the diskette drive control card.
12. Turn the stepper motor pulley by hand to track 40 and insert the timing pin.



Head Load Solenoid and Bail

343 SOLENOID AND BAIL SERVICE CHECK

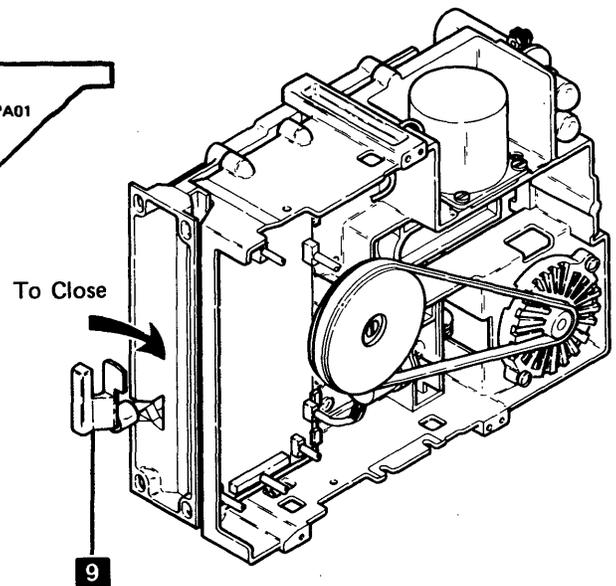
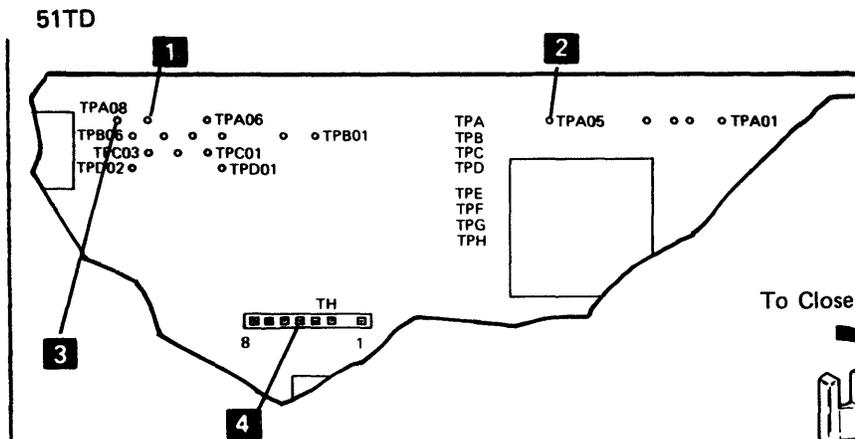
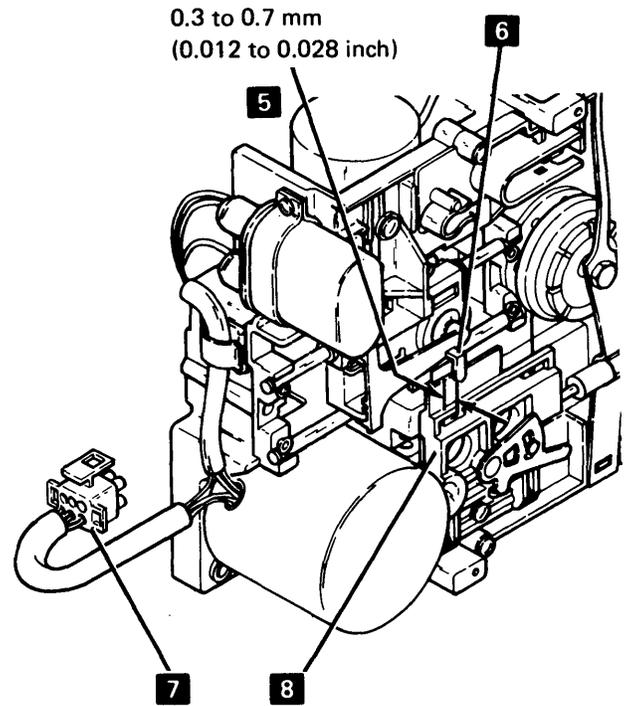
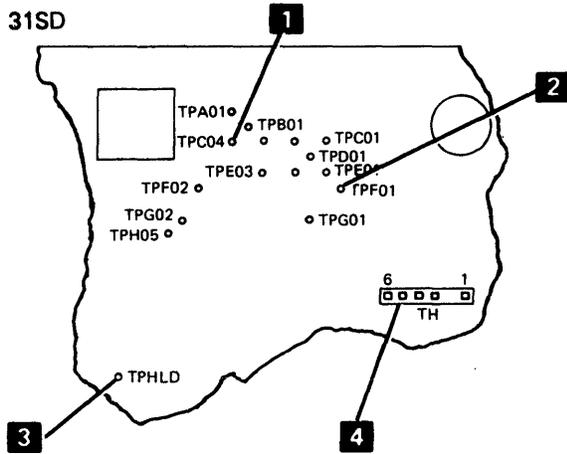
1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

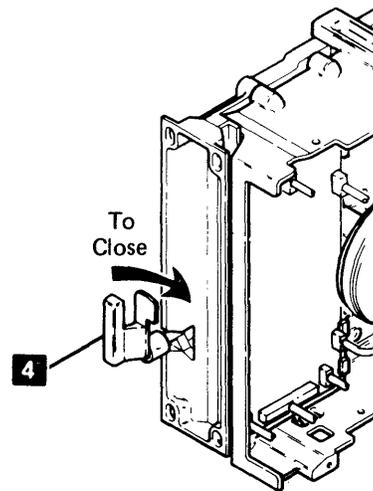
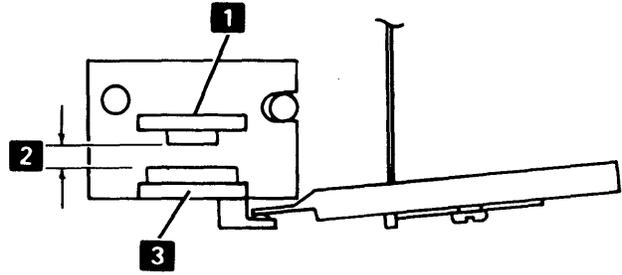
2. Disconnect the AC drive motor power cable **7**.
3. Insert a diskette into the diskette drive and close the diskette locking lever **9**.
4. Power on.
5. Install a jumper from **2** (ground) to **3** (-head load).

6. Install a jumper from **1** (ground) to **4** (-disable stepper motor).
7. Visually check for a 0.3 to 0.7 millimeter (0.012 to 0.028 inch) gap **5** between the bail **8** and the head load arm **6** for all of the carriage travel (track 00 through track 76).
8. If the gap is within the limits, proceed with step 9. If the gap is not within the limits, go to 346, step 7.
9. Remove the jumpers installed in steps 5 and 6.
10. Open the diskette locking lever and remove the diskette.
11. Power off.
12. Reconnect the AC drive motor power cable **7**.



344 HEAD GAP SERVICE CHECK

1. Power off.
2. Close the diskette locking lever **4**.
3. (31SD) Visually check for a gap **2** of 3 to 4 millimeters (0.118 to 0.157 inch) between the head **1** and the head load arm **3**. (51TD) Visually check for a gap **2** of 2 to 3 millimeters (0.079 to 0.118 inch) between the head surfaces **1** and **3**.
4. If the gap is correct, proceed with step 5. If the gap is not correct, go to 345, step 3.
5. Open the diskette locking lever.
6. If a new head/carriage assembly was installed, go to 343.



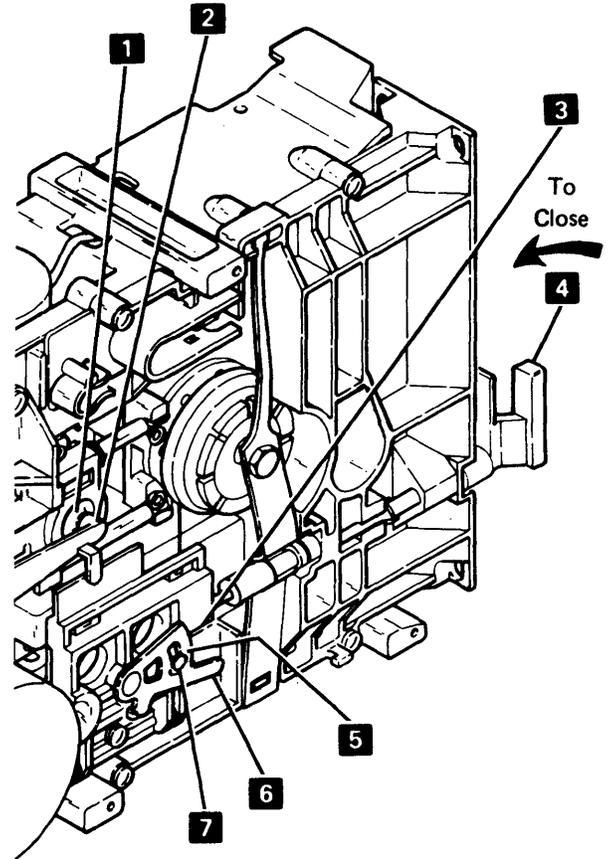
345 HEAD GAP ADJUSTMENT

1. Power off.
2. Close the diskette locking lever **4**.
3. Loosen the bail lever screw **7** just enough so that the bail lever **6** can be adjusted.

CAUTION

(31SD) Do not let the head hit the pressure pad or the head could be damaged. (51TD) Do not let the heads hit each other or the heads could be damaged.

4. (31SD) Move the bail lever slowly until the head load arm **2** just touches the head **1**. (51TD) Move the bail lever until the two heads just touch each other.
5. Note the location of the marks **5** on the bail lever relative to the bail alignment edge **3**.
6. (31SD) Turn the bail lever one and one half marks clockwise. (51TD) Turn the bail lever one mark clockwise.
7. Tighten the bail lever screw.
8. Go to 344, step 3.



346 SOLENOID AND BAIL ADJUSTMENT

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **5**.
3. Power on.
4. Insert a diskette and close the diskette locking lever **8**.
5. Install a jumper from **2** (ground) to **3** (-head load).
6. Install a jumper from **1** (ground) to **4** (-disable stepper motor).

DANGER

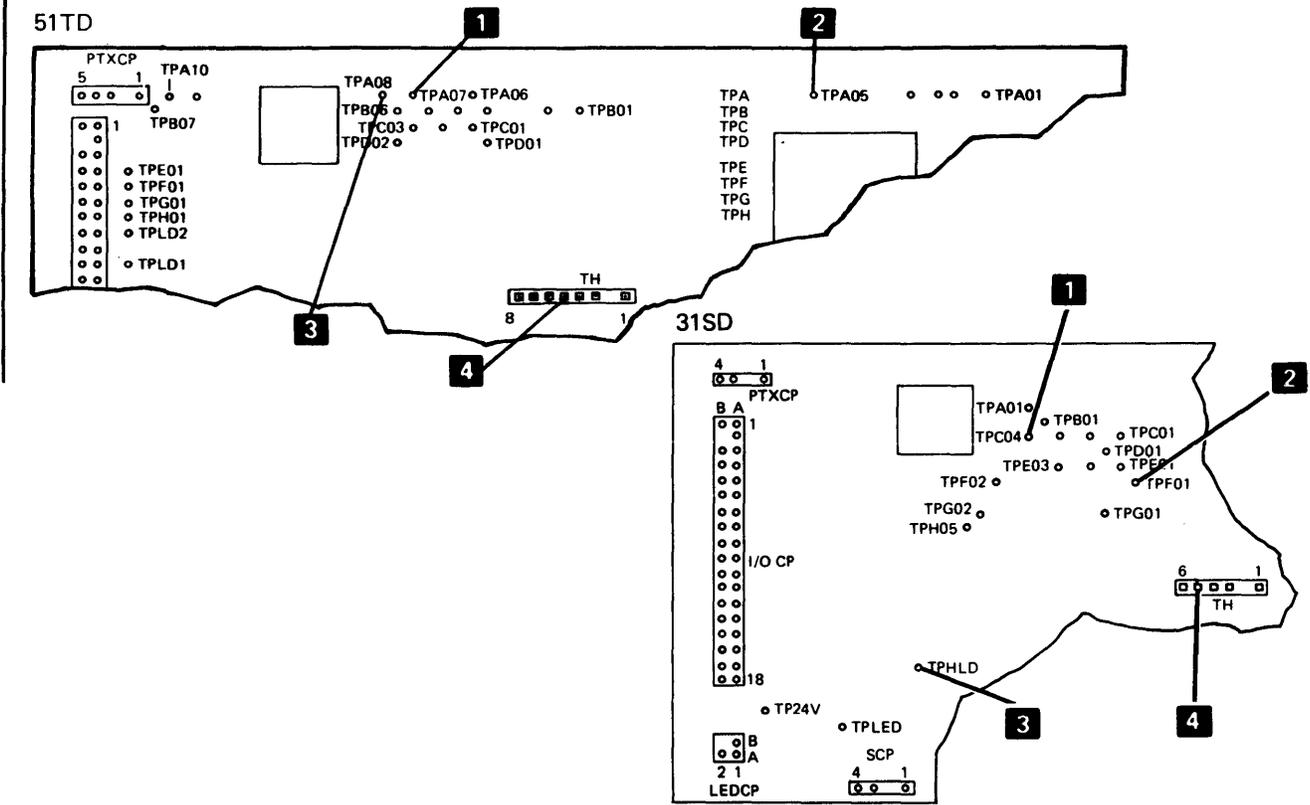
The solenoid case becomes hot after continuous use.

7. Loosen the solenoid locking screw **9**.

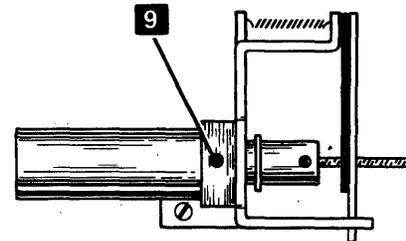
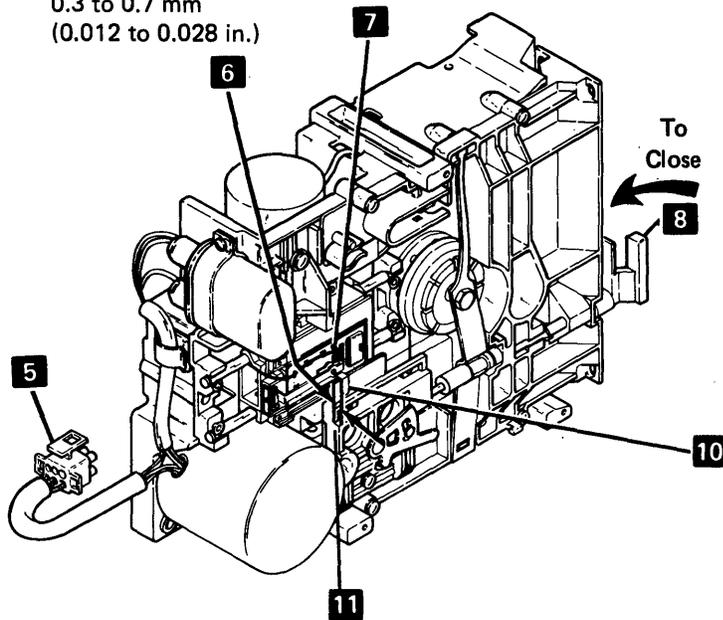
CAUTION

Do not let the solenoid plunger or the bail actuator cable turn.

8. Turn the solenoid to obtain a gap **6** of 0.3 to 0.7 millimeters (0.012 to 0.028 in.) between the head load arm **10** and the bail **11**.
9. Tighten the solenoid locking screw.
10. Move the head/carriage assembly **7** by hand from one end to the other and check the gap **6** at each end of the head/carriage movement.
11. If the gap is not within the limits for all of the head/carriage movement, go back to step 7. If the gap **6** is correct, proceed with step 12.
12. Remove the jumpers installed in steps 5 and 6.
13. Open the diskette locking lever and remove the diskette.
14. Power off.
15. Reconnect the AC drive motor power cable **5**.



0.3 to 0.7 mm
 (0.012 to 0.028 in.)



347 BAIL REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **6**.
3. (51TD) Insert a strip of clean paper between the heads **11** or insert a scratch diskette.
4. Close the diskette locking lever **1**.
5. Loosen the bail lever screw **8**.
6. Push the bail **4** inward slightly and disconnect the bail actuator cable eyelet **10** from the bail lever **9**.
7. Open the diskette locking lever.
8. Loosen the bail mounting screw **2**.

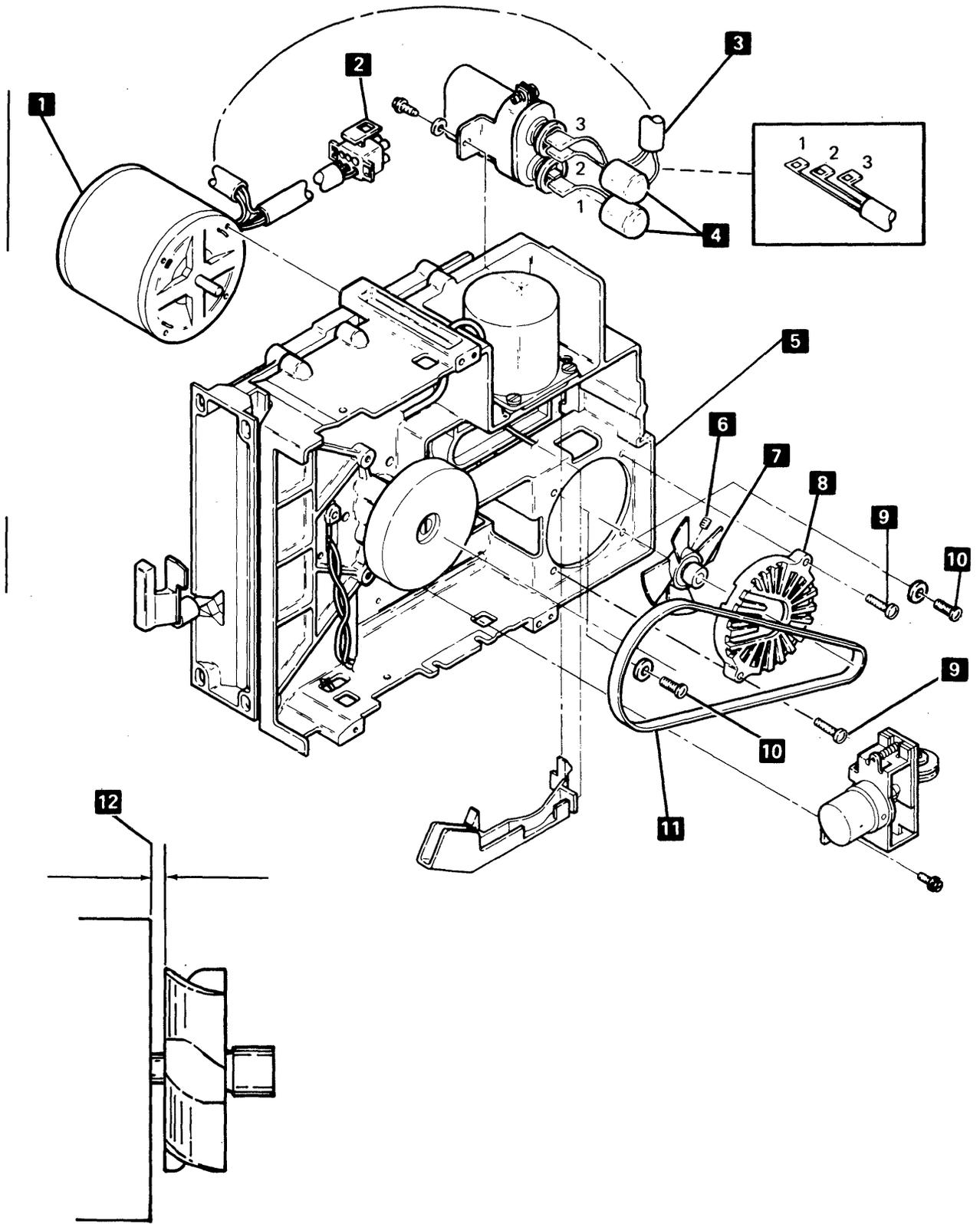
CAUTION

(31SD) Do not let the head hit the pressure pad, or the head could be damaged. (51TD) Do not let the heads hit each other, or the heads could be damaged.

9. Remove the pivot rod **3**, the bail **4**, and the bail return spring **5**. (Note the location of the bail return spring for the replacement procedure.)

Replacement

1. Reinstall the bail return spring, the bail, and the pivot rod.
2. Close the diskette locking lever.
3. Push the bail inward slightly and connect the bail actuator cable eyelet to the bail lever. (Ensure that the cable eyelet crimp is facing out.)
4. If the bail actuator cable is twisted, turn the solenoid plunger **7** by hand until the cable is straight.
5. Open the diskette locking lever.
6. (51TD) Remove the paper from between the heads, or remove the scratch diskette.
7. Perform the head gap adjustment (see 345).



AC Drive Motor with Internal Fan

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **2**.
3. Remove the AC drive motor belt **9**.

DANGER

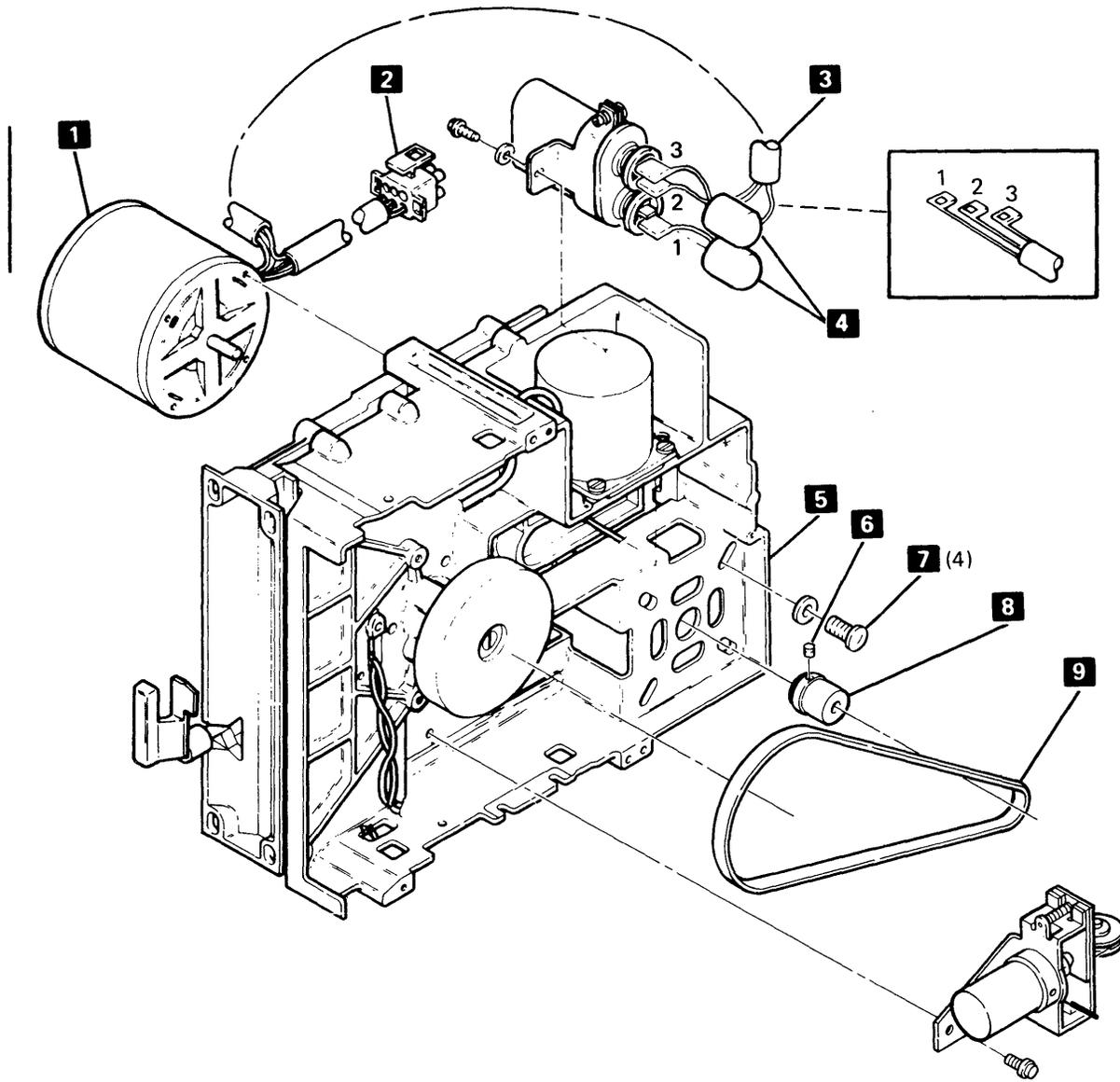
High voltage might be present at the capacitor terminals.

4. Remove the two insulator caps **4** from the capacitor terminals.
5. Discharge the capacitor by jumpering its terminals with a large-bladed screwdriver.
6. Remove the AC drive motor leads **3** from the capacitor terminals.
7. Remove the two insulator caps from the AC drive motor leads.

8. Loosen the setscrew **6**; then remove the AC drive motor pulley **8**.
9. Remove the four AC drive motor mounting screws **7**; then remove the AC drive motor.

Replacement

1. Reinstall the AC drive motor **1** with the four mounting screws **7** (leave the four screws loose).
2. Reinstall the AC drive motor pulley **8**. Ensure that the setscrew **6** is centered on the flat surface of the motor shaft (leave the setscrew loose).
3. Move the AC drive motor pulley **8** toward the AC drive motor until the AC drive motor pulley is in the casting **5**; then tighten the four AC drive motor mounting screws **7**.
4. Move the AC drive motor pulley out of the casting and tighten the setscrew **6** (the allen wrench should be flush with the casting when you tighten the setscrew).
5. Reinstall the AC drive motor leads **3**; note the cable numbers to determine which lead goes on which terminal.
6. Reinstall the two insulator caps **4** on the capacitor terminals.
7. Reinstall the AC drive motor belt **9**.
8. Reconnect the AC drive motor cable **2**.



353 CAPACITOR REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

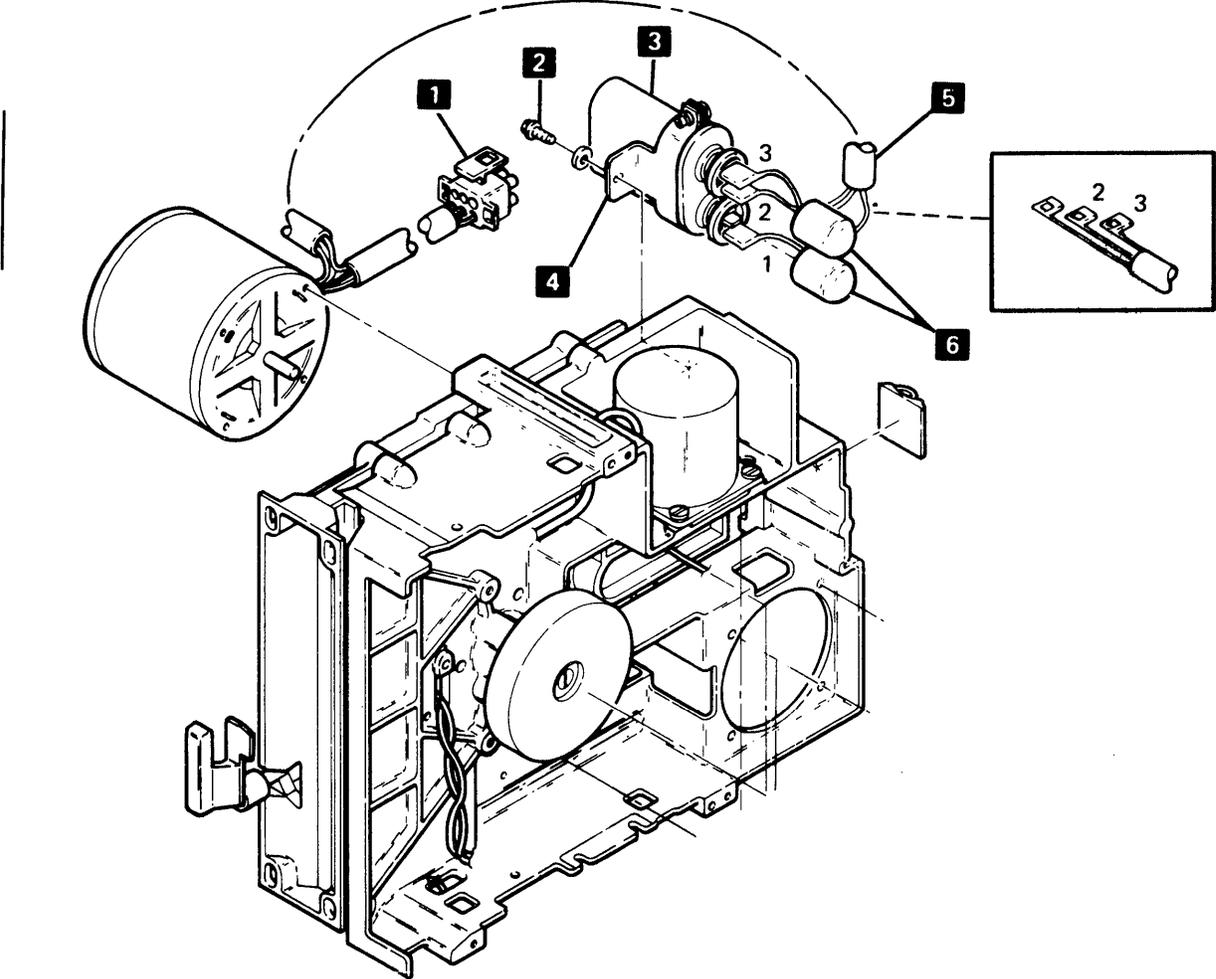
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **1**.
3. Remove the two insulator caps **6** from the capacitor terminals.

4. Discharge the capacitor **3** by jumpering its terminals with a large-bladed screwdriver.
5. Remove the three motor leads **5** from the capacitor terminals.
6. Remove the screw **2**, then remove the capacitor bracket assembly **4**.

Replacement

To reinstall the capacitor, reverse the steps in the removal procedure.



355 DRIVE FAN AND PULLEY REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

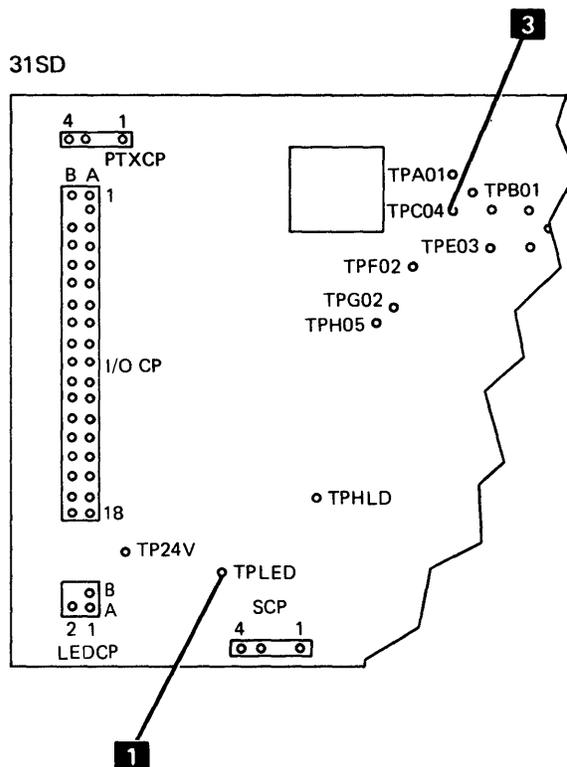
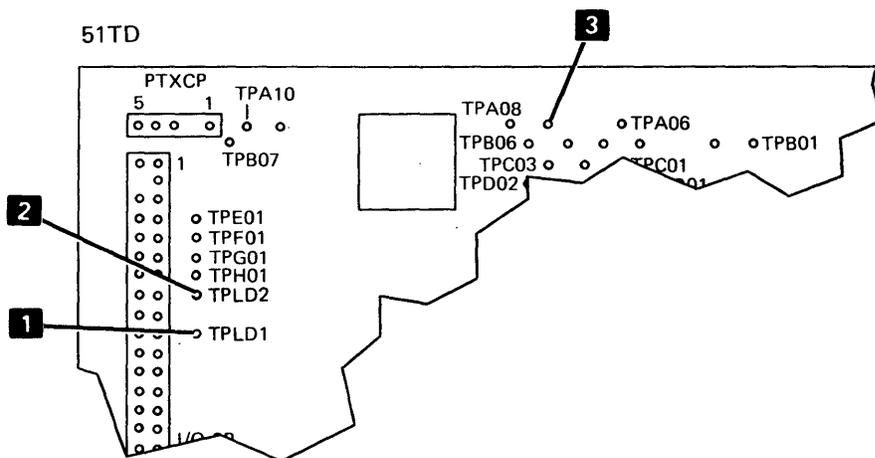
2. Disconnect the AC drive motor power cable **1**.
3. Remove the drive belt **5**.
4. Remove the two fan enclosure mounting screws **6**; then remove the fan enclosure **4**.
5. Loosen the setscrew **2**.
6. Remove the drive fan and pulley **3**.

Replacement

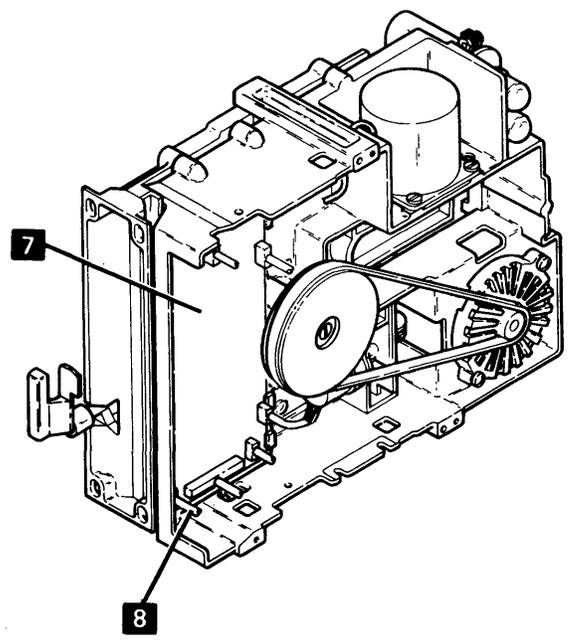
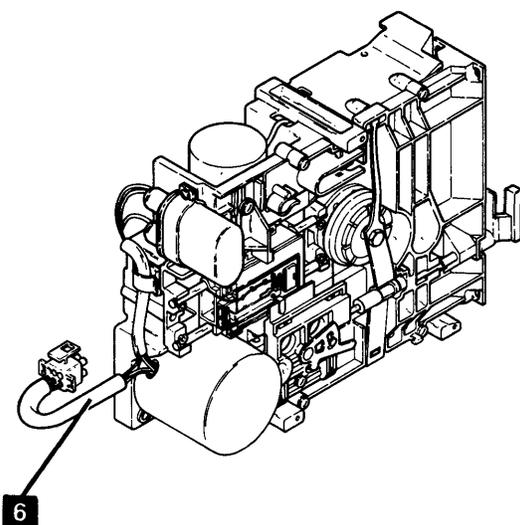
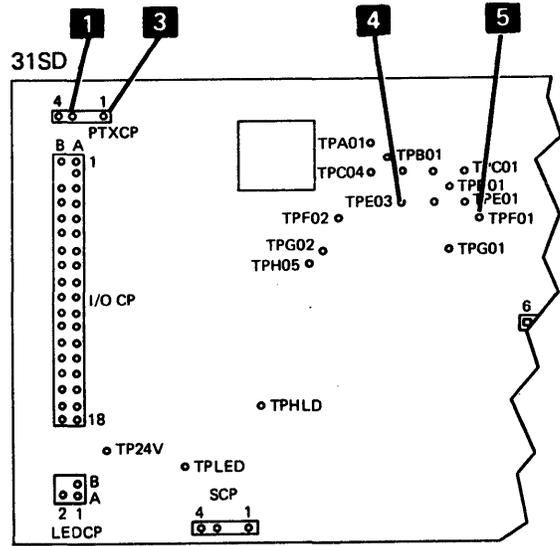
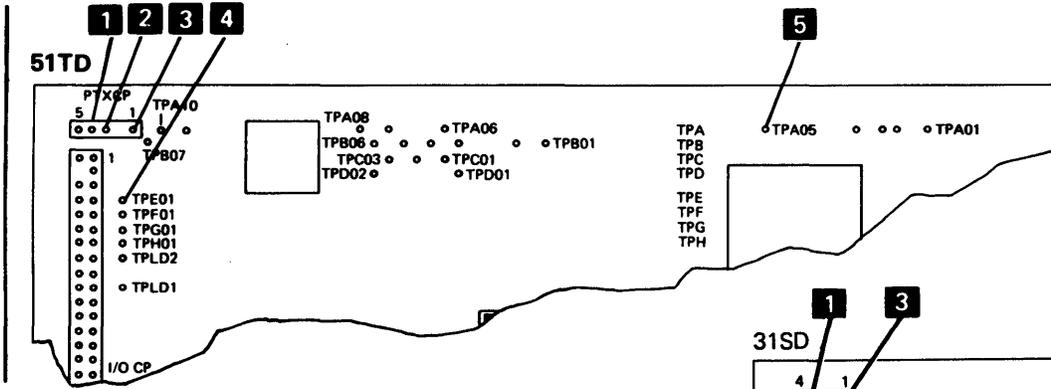
1. Reinstall the drive fan and pulley on the motor shaft with the setscrew **2** centered on the flat surface of the shaft. (Leave the setscrew loose.)
2. Place the drive fan and pulley on the motor shaft with a gap **7** of 0.5 ± 0.1 millimeter (0.020 ± 0.001 inch) between the motor face and the fan hub.
3. Tighten the setscrew.
4. Reinstall the fan enclosure.
5. Reinstall the drive belt.
6. Reconnect the AC drive motor power cable.

369 LED OUTPUT SERVICE CHECK

1. Connect the negative probe of the multimeter to **3** (ground).
2. Set the multimeter scale to 5 Vdc and connect the positive probe to **1** (31SD LED voltage).
3. (31SD) Check for a voltage level of 1 Vdc through 2 Vdc.
4. Move the positive probe to **2** (51TD LED voltage).
5. Check for a voltage level of 1 Vdc through 2 VDC (51TD).



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375 PTX REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Disconnect the LED cable connector **10** from the diskette drive control card **7**. (Note the cable path for replacement.)
3. Close the diskette locking lever **6**.
4. Loosen the bail lever screw **3**.
5. Push the bail **2** inward slightly and disconnect the bail actuator cable eyelet **5** from the bail lever **4**.
6. Open the diskette locking lever **6**.
7. (51TD) Place a piece of clean paper between the heads, or insert a scratch diskette.
8. Remove the four diskette guide screws **15**.

CAUTION

(31SD) Do not let the head hit the pressure pad or the head could be damaged. (51TD) Do not let the heads hit each other or the heads could be damaged.

9. Remove the diskette guide **13** by lifting it up and sliding the bail out from under the head load arm **16**.
10. Remove the remaining cables from the diskette drive control card **7**. (Note the cable connections for the replacement procedure.)
11. Loosen the two retaining screws **9**.
12. Turn the two card retainers **8** out of the way and remove the diskette drive control card **7**.
13. Remove the two PTX mounting screws **12**.
14. Remove the PTX assembly **11**.

Replacement

To reinstall the PTX assembly, reverse the steps in the removal procedure then go to 347, bail replacement procedure, step 2.



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File No.
Previous Newsletters SN20-9590

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X227

**IBM 5280
Distributed Data
System
Diskette Drive
Maintenance Information Manual**

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This technical newsletter provides replacement pages and additional information for the subject manual. The replacement pages remain in effect for subsequent revisions unless specifically changed. Pages to be inserted and/or removed are:

1, 2 38.1, 38.2
9-24 39-42
35-38

A change to the text is indicated by a vertical line to the left of the change. Absence of a vertical line on a page bearing an 'updated' notice means only that previously existing text has been removed or rearranged or that a minor typographical error has been corrected.

Summary of Amendments

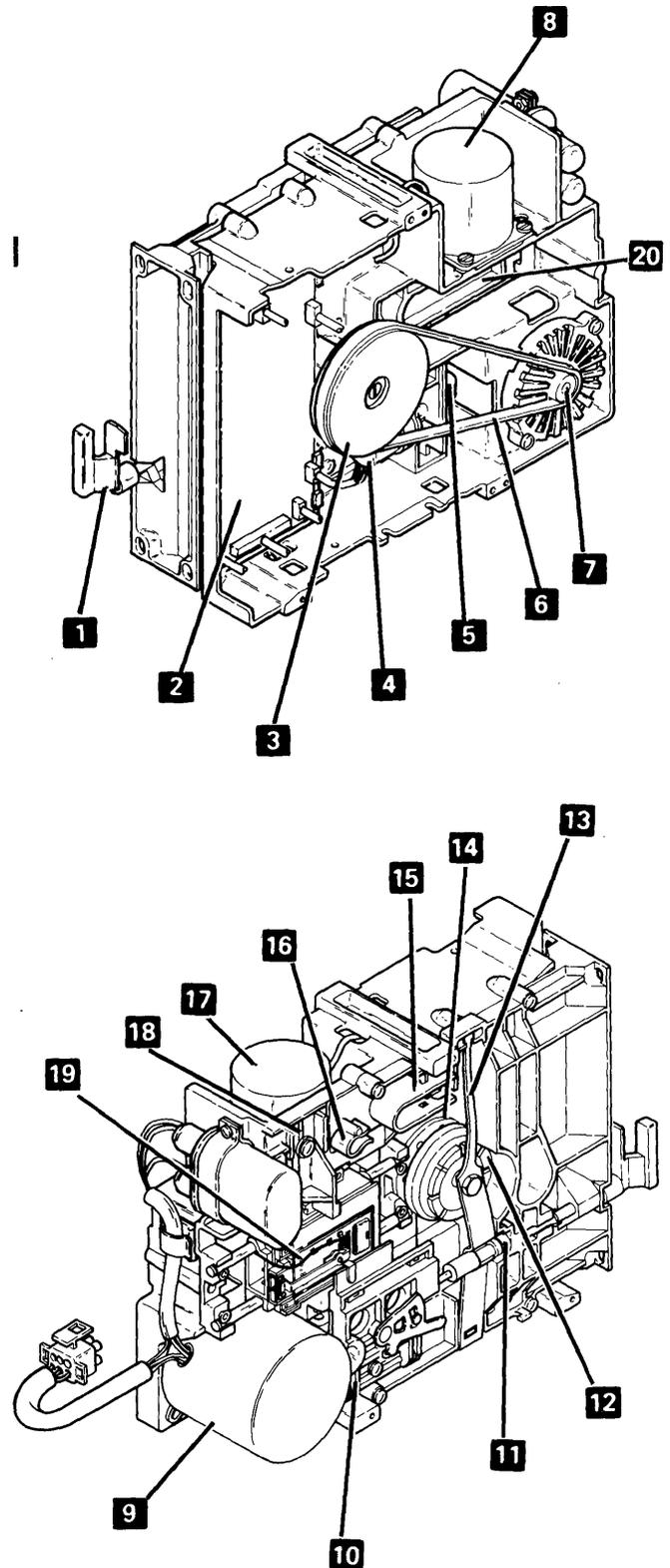
Note: Please file this cover letter at the back of the manual to provide a record of changes.

Maintenance

Locations

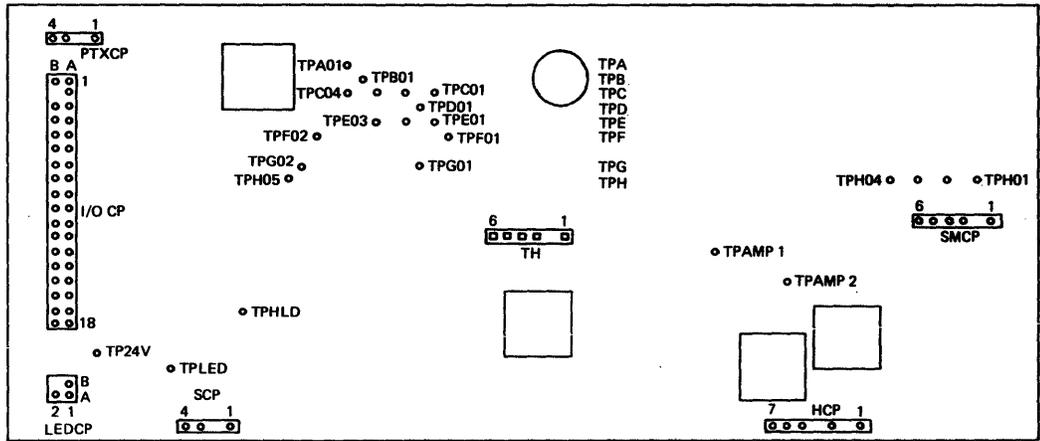
330 DISKETTE DRIVE

- 1** Diskette locking lever
- 2** Diskette drive control card
- 3** Spindle pulley
- 4** Head load solenoid
- 5** Solenoid idler
- 6** AC drive belt
- 7** AC drive pulley (with fan hidden)
- 8** Stepper motor
- 9** AC drive motor
- 10** Head load bail
- 11** Pressure roll
- 12** Collet
- 13** Collet flat spring
- 14** Drive hub
- 15** Carriage pressure spring
- 16** Thickness gauge clip
- 17** Stepper motor
- 18** Timing pin (old)
- 19** Head/carriage assembly
- 20** Timing pin (new)



331 DISKETTE DRIVE CONTROL CARD

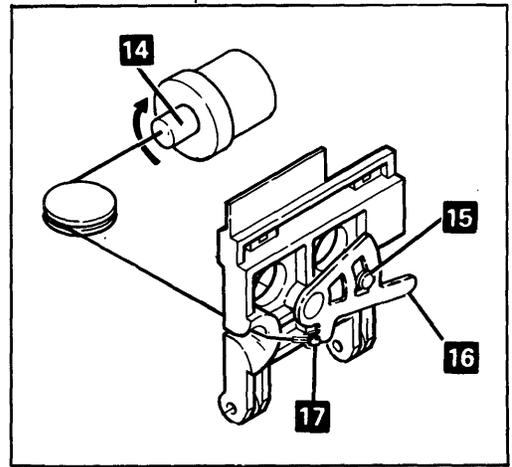
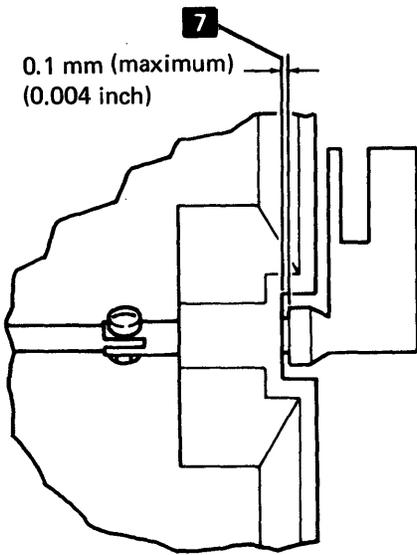
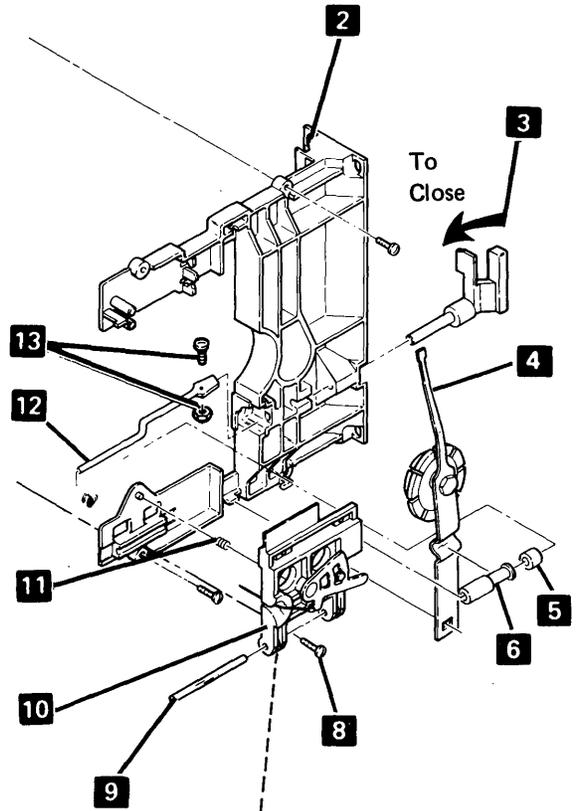
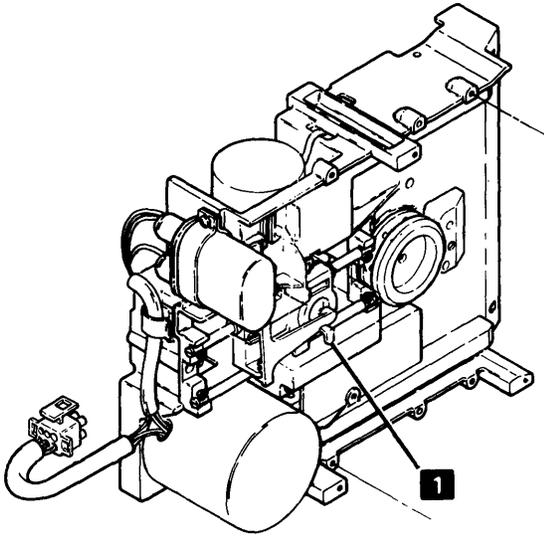
31SD



TH01	Diff Read B
TH02	No Pin
TH03	Diff Read A
TH04	Not Assigned
TH05	-Disable Stepper Motor
TH06	+18 V

TPA01	+5 Vdc
TPB01	-5 Vdc
TPC01	+Access 1
TPC02	31SD PTX
TPC03	Write Data
TPC04	Ground
TPD01	+Inner Tracks
TPE01	+Access 0
TPE02	+Head Engage
TPE03	+Index
TPF01	Ground
TPF02	+Write/Erase Enabled

TPG01	+File Data
TPG02	+Erase Gate
TPH01	MC-3
TPH02	MC-2
TPH03	MC-1
TPH04	MC-0
TPH05	+Write Gate
TPAMP1	Preamp TP1
TPAMP2	Preamp TP2
TPHLD	-Head Load
TP24V	+24 Vdc
TPLED	31SD LED Voltage



Head/Carriage Assembly

337 HEAD/CARRIAGE SERVICE CHECK

CAUTION

The head/carriage service check must be performed with the diskette drive installed (or in the same position as when installed) or the service checks might not be accurate.

1. Go to 361, step 1.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **9**.
3. Remove the cable guide **11**.
4. Turn the stepper motor pulley **7** by hand to track 40 and insert a timing pin **6**. (Ensure that the timing pin goes into the casting **8**.)

CAUTION

The PTX, LED, or diskette drive control card might be damaged if you install jumpers on the wrong test pins.

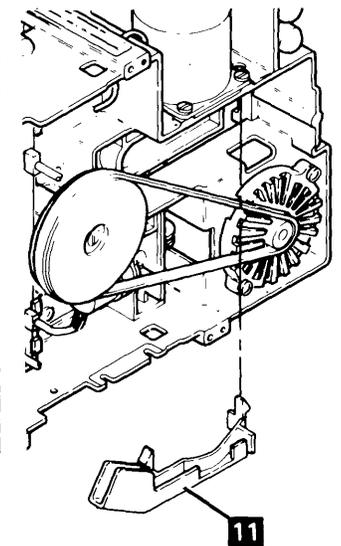
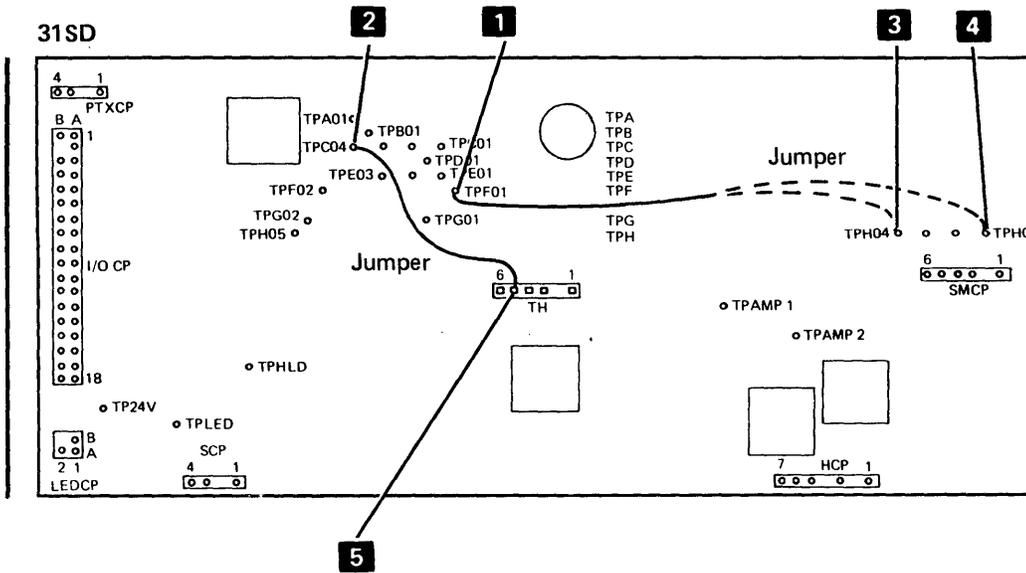
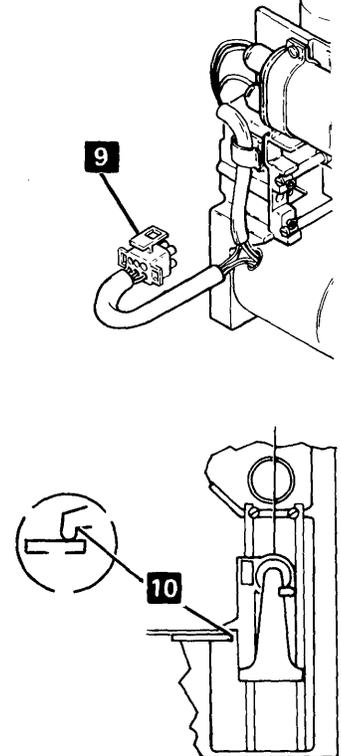
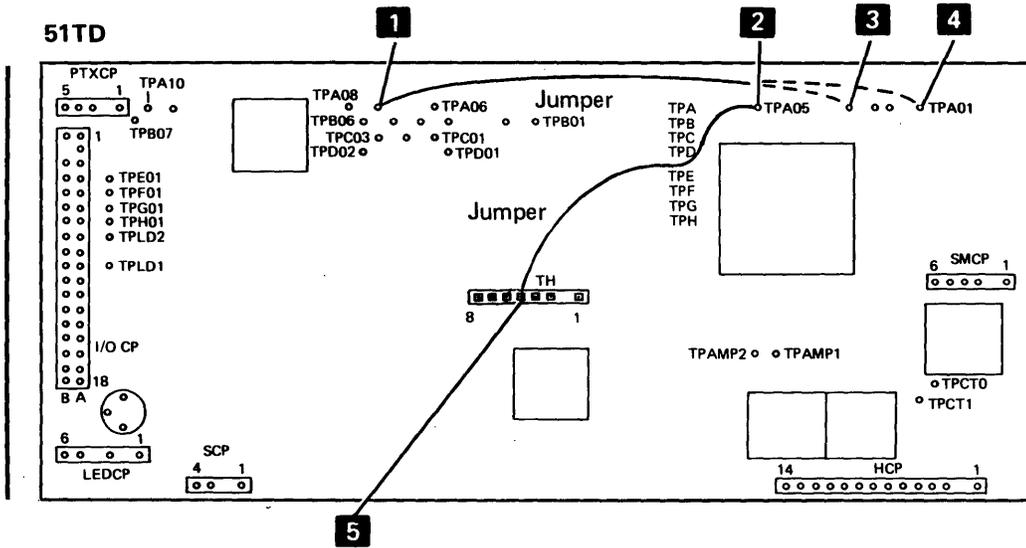
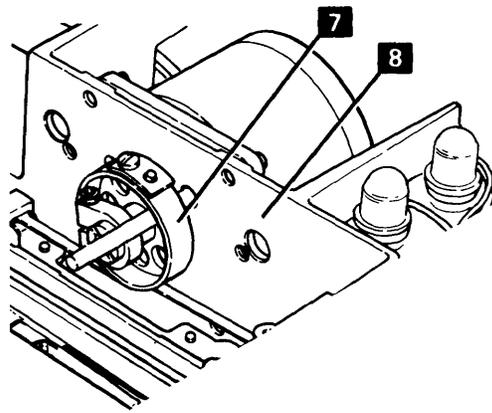
5. Install a jumper from **2** (ground) to **5** (-disable stepper motor).
6. Install a jumper from **1** (ground) to **3** (MC-0) to electrically detent the stepper motor.
7. Power on.
8. Remove and reinsert the timing pin.
9. If the timing pin passes freely through the stepper motor pulley into the timing hole in the casting, go to step 13. If the timing pin does not pass freely through the stepper motor pulley into the timing hole in the casting, proceed with step 10.
10. Remove the timing pin.
11. Power off.

12. Go to 339 step 2.
13. Remove the timing pin.
14. Remove the jumper end from **3** (MC-0) and install it on **4** (MC-3). This moves the stepper motor pulley to track 39.
15. Verify that the stepper motor pulley is at track 39 by visually checking for no gap between the timing pointer and the timing block **10**.
16. Remove the jumper end from **4** (MC-3) and install it on **3** (MC-0). This moves the stepper motor pulley to track 40.
17. Verify that the stepper motor pulley is at track 40 by visually checking that the timing hole in the pulley is aligned with the timing hole in the casting. Use a dental mirror to check. Do not insert the timing pin.
18. Check the gap between the timing pointer and the timing block **10** as follows:
 - a. Insert thickness gauges totaling 0.483 millimeter (0.019 inch) between the timing block and the timing pointer and visually check that the head/carriage assembly does not move.
 - b. Insert thickness gauges totaling 0.533 millimeter (0.021 inch) between the timing block and the timing pointer and visually check that the head/carriage assembly moves slightly.

Note: Because of the torque characteristics of the stepper motor, step 18 can be performed only once. If it is necessary to perform this step again, go back to step 14 of this service check.

19. If the conditions in step 18 are not correct, go to 339, step 8. If the conditions are correct, proceed with step 20.
20. Power off.

21. Remove the jumper from **2** (ground) to **5** (-disable stepper motor) and the jumper from **1** (ground) to **3** (MC-0).
22. Reinstall the cable guide **11**. (Ensure that the head/carriage assembly moves freely.)
23. Go to 344, step 2.



339 HEAD/CARRIAGE ADJUSTMENT

CAUTION

The head/carriage assembly adjustment must be performed with the diskette drive installed (or in the same position as when installed) or the adjustment might not be accurate.

Note: This procedure should not be performed unless paragraphs 363 and 337 have been completed or you were directed to this procedure from another manual.

1. Go to 361, step 1.

DANGER

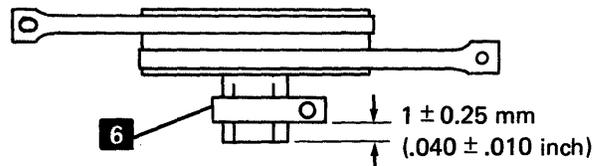
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Measure and record the gap **8** between the stepper motor pulley and the casting. The gap is _____.
3. Loosen the clamp screw **6** so the stepper motor shaft can turn inside the pulley.
4. Move the stepper motor pulley to track 40 by carefully moving the head carriage assembly and inserting the timing pin.
5. Power on.
6. Set the gap **8** to the same size as the gap recorded in step 2 and tighten the clamp screw. (Ensure that the timing pin passes freely through the stepper motor pulley into the timing hole in the casting and that the clamp **6** is positioned 1 ± 0.25 millimeters ($.040 \pm .010$ inches) as shown.)

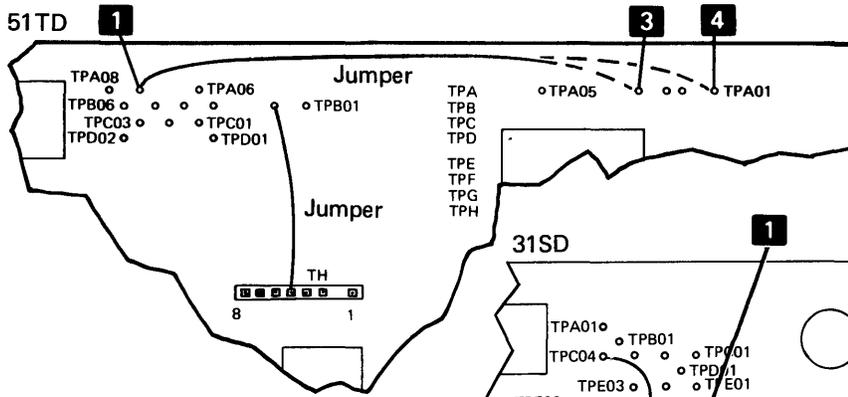
7. Remove the timing pin.
8. Loosen the two screws **15** that hold the bracket to the carriage.
9. Remove the jumper end from **3**; and momentarily touch it to **4**.
10. Reinstall the jumper end on **3**.

Note: Steps 8 and 9 set up the required torque condition of the stepper motor for the following steps.

11. Verify that the stepper motor pulley is at track 40 by visually checking that the timing hole in the pulley is aligned with the timing hole in the casting. Use a dental mirror to check. Do not insert a timing pin.
12. Insert thickness gauges **12** totaling 0.508 millimeters (0.020 inch) between the timing pointer on the carriage and the track 40 adjustment surface on the casting. Clamp the thickness gauge **12** to the casting with the retaining clip **13** provided (part 4240632). The clip is attached to the diskette guide. (For location, see 330 **16**.)
13. Slide the head/carriage assembly against the thickness gauge so it just touches but is not forced against the thickness gauge. Insert the carriage pressure spring **14** (part 4240631) between the casting and the carriage to hold the carriage against the thickness gauge. The carriage pressure spring is attached to the diskette guide. (For location, see 330 **15**.)
14. Tighten the two screws that hold the bracket to the carriage **15**.
15. Remove the retaining clip and the carriage pressure spring.
16. Go to 337 step 20.

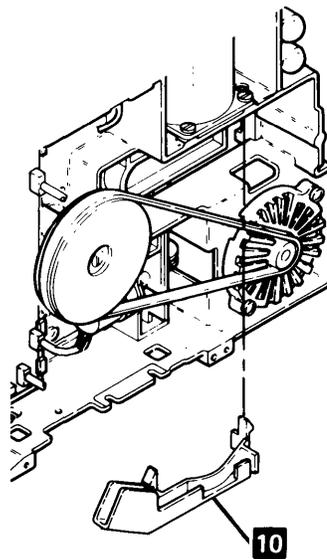
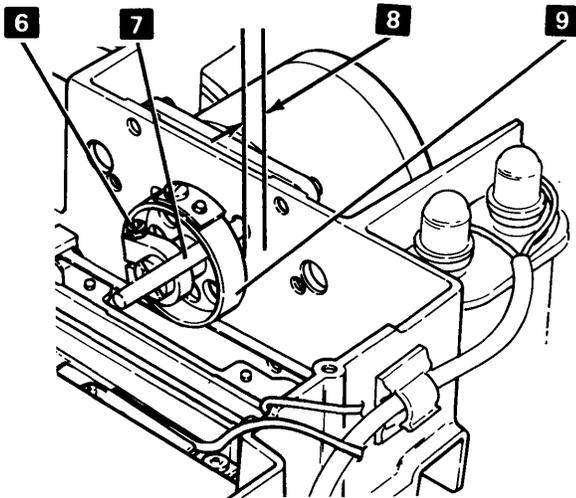
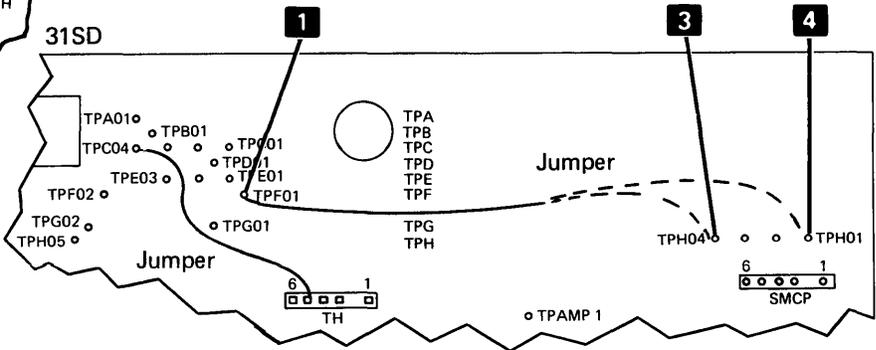


51TD

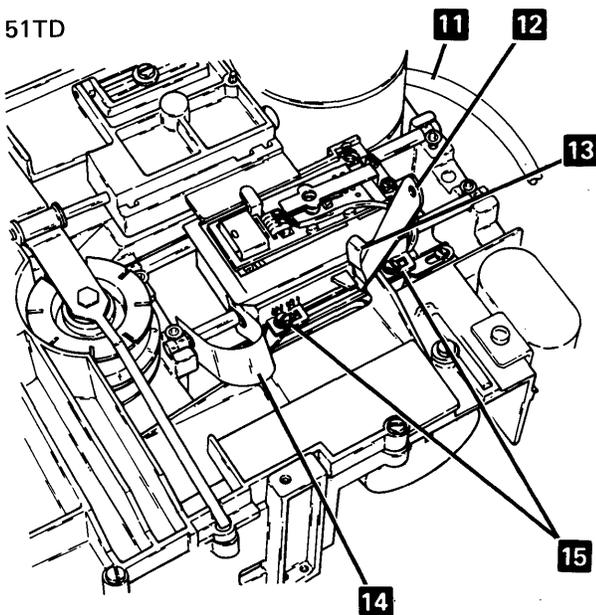


For full card detail, see
 331 (51TD) or 333 (31SD).

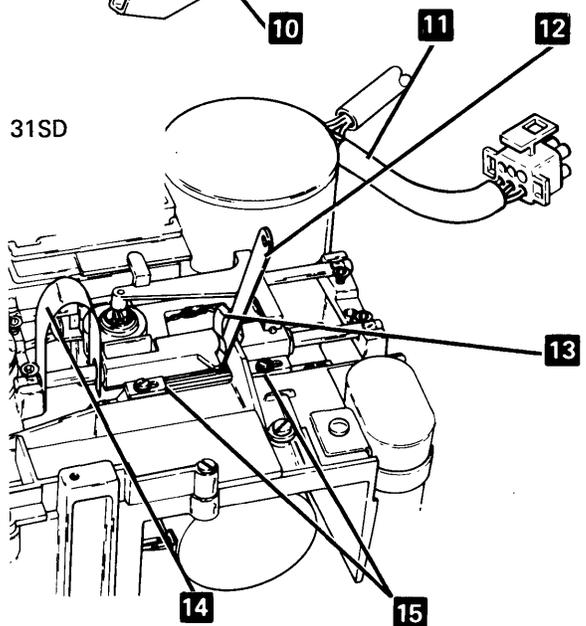
31SD



51TD



31SD



340 PRESSURE PAD REMOVAL AND REPLACEMENT (31SD ONLY)

Removal

1. Move the head load arm **4** away from the read/write head **5**.

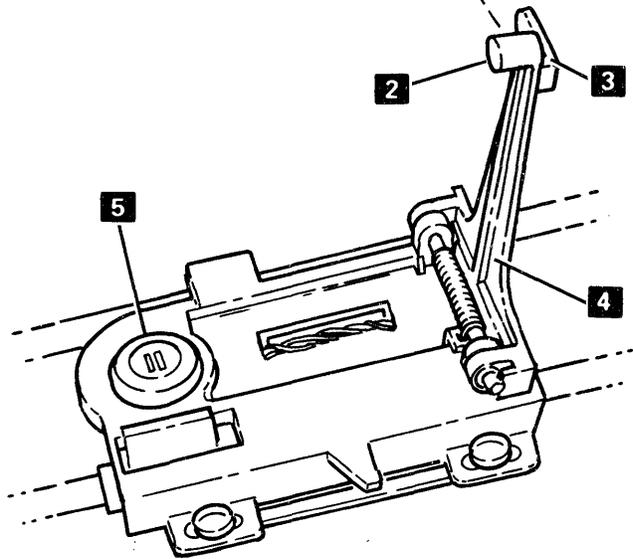
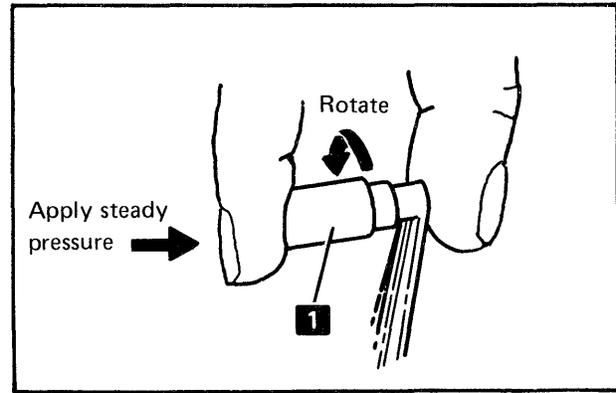
CAUTION

Do not scratch the head load arm.

2. Use a scissor clamp (part 9900233) to pull the pressure pad **2** off the head load arm.

Replacement

1. Clean the pressure pad mounting surface **3** with a lint-free cloth that is moistened with isopropyl-alcohol solvent.
2. Remove the paper cover that protects the adhesive layer on the new pad.
3. Place the new pad in the center of the mounting surface on the head load arm.
4. Lightly press the new pad in place with a clean screwdriver.
5. Use the small end of the pressure pad tool **1** and press the pressure pad onto the head load arm.
6. Turn the pressure pad tool at least one revolution in one direction only.
7. Move the head load arm toward the read/write head.



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341 HEAD/CARRIAGE REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Remove the head cable connector **17** from the diskette drive control card **16** and remove the head cable from the cable guide **18**.
3. Remove the cable guide **18**.

CAUTION

The drive band must not be bent or damaged in any way.

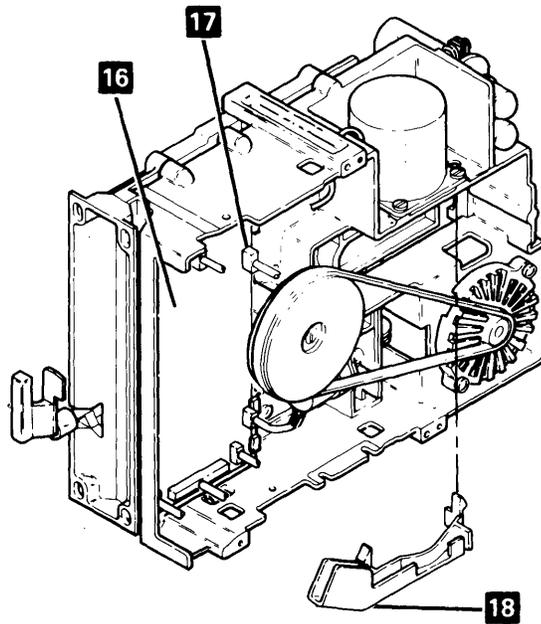
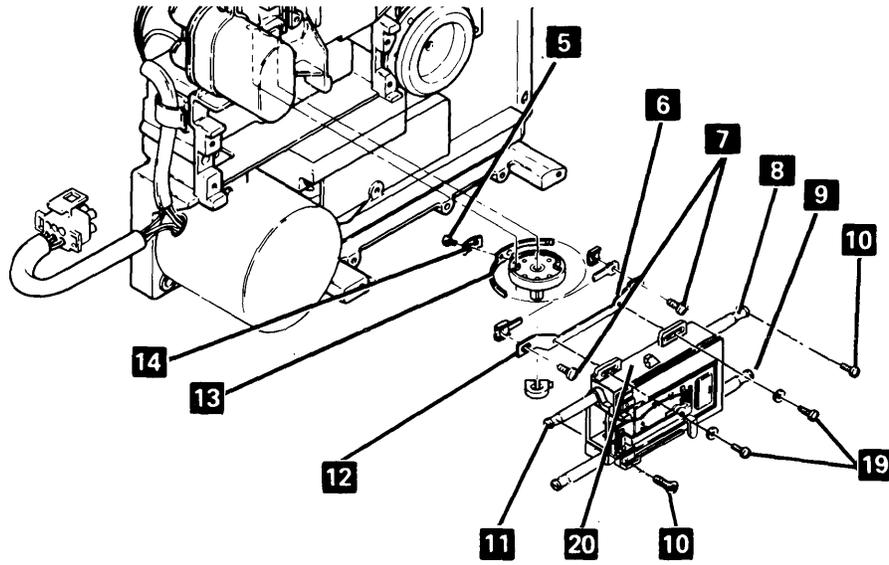
4. Remove the two screws **7** and the screw **5**, then remove the drive band **13**. (Note the position of the drive band and the clamps; they must be in the same position when reinstalled.)
5. Remove the carriage bracket **6** from the carriage.
6. (51TD) Place a piece of clean paper between the heads.
7. Remove the two screws **10** (one on each end of guide rod **8**) and remove guide rod **8**.
8. Lift and turn the head/carriage assembly to remove it from guide rod **9**.

Replacement

CAUTION

When installing the head/carriage assembly, ensure that the bail is under the tab of the carriage arm, the bail return spring is properly installed, and the drive band is not damaged in any way. (51TD) Ensure that a strip of clean paper is inserted between the head surfaces during installation.

1. Reinstall the head/carriage assembly on guide rod **9**. Then place the head/carriage assembly to the lower limit (track 00).
2. Reinstall guide rod **8** and tighten the two screws **10**. Ensure that the guide rod notch **11** is aligned with the screw.
3. Move the head/carriage assembly by hand to track 40.
4. Reinstall the carriage bracket **6** on the carriage **20** with the screws **19** centered in the slots.
5. Connect the welded adapter end of the drive band **12** to the slotted end of the carriage bracket. Use the clamp **14** to install the drive band to the stepper motor pulley. Ensure that the drive band is parallel to the carriage bracket and the edge of the pulley.
6. Go to 363, step 7.



Head Load Solenoid and Bail

343 SOLENOID AND BAIL SERVICE CHECK

1. Go to 344, step 1.

DANGER

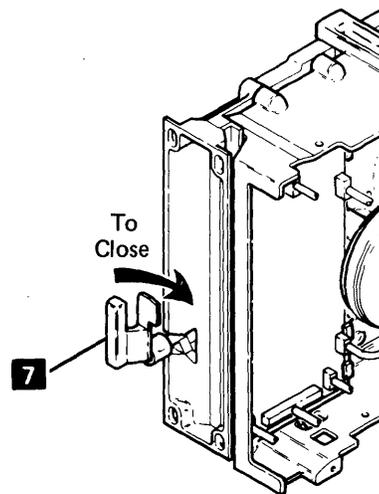
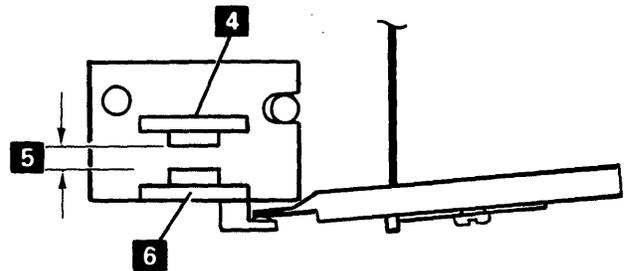
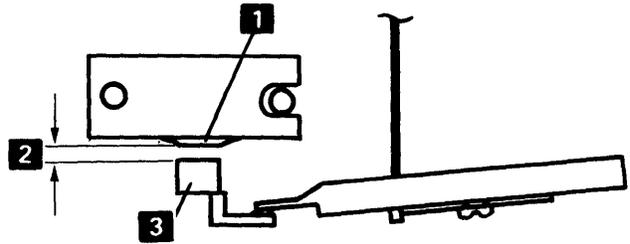
Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **7**.
3. Insert a diskette into the diskette drive and close the diskette locking lever **9**.
4. Install a jumper from **1** (ground) to **3** (-head load).

5. Install a jumper from **2** (ground) to **4** (-disable stepper motor).
6. Power on.
7. Visually check for a 0.3 to 0.7 millimeter (0.012 to 0.028 inch) gap **5** between the bail **8** and the head load arm **6** for all of the carriage travel (track 00 through track 76).
8. If the gap is within the limits, proceed with step 9. If the gap is not within the limits, go to 346, step 2.
9. Remove the jumpers installed in steps 4 and 5.
10. Open the diskette locking lever and remove the diskette.
11. Power off.
12. Reconnect the AC drive motor power cable **7**.
13. End of service check.

344 HEAD GAP SERVICE CHECK

1. Power off.
2. Close the diskette locking lever **7**.
3. (31SD) Visually check for a gap **2** of 3 to 4 millimeters (0.118 to 0.157 inch) between the head **1** and the head load arm **3**. (51TD) Visually check for a gap **5** of 2 to 3 millimeters (0.079 to 0.118 inch) between the head surfaces **4** and **6**.
4. If the gap is correct, proceed with step 5. If the gap is not correct, go to 345, step 2.
5. If you have completed the solenoid and bail adjustment (346), this completes the service checks, if not, open the diskette locking lever **7** and go to 343, step 2.

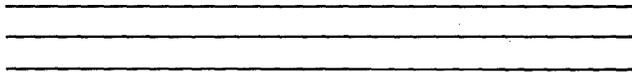


345 HEAD GAP ADJUSTMENT

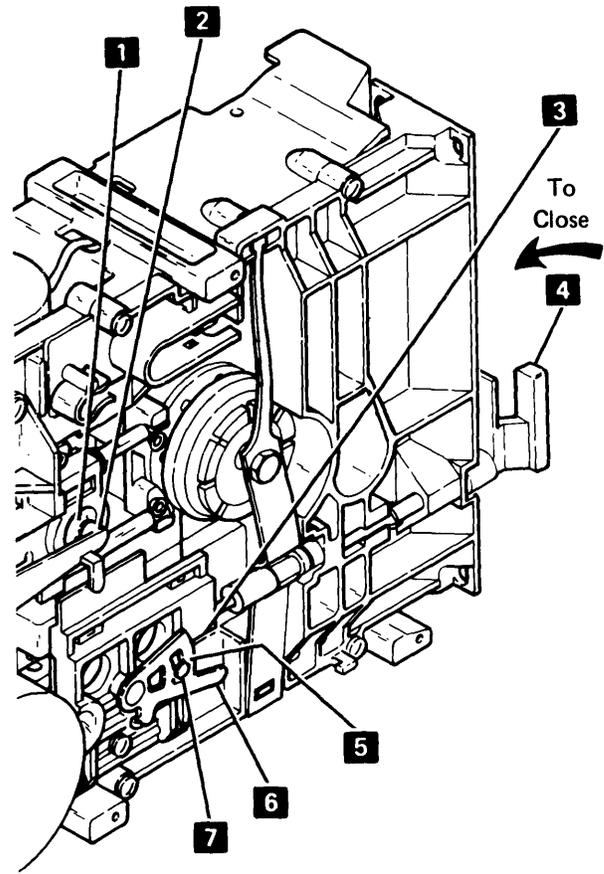
1. Go to 344, step 1.
2. Loosen the bail lever screw **7** just enough so that the bail lever **6** can be adjusted.

CAUTION

(31SD) Do not let the head hit the pressure pad or the head could be damaged. (51TD) Do not let the heads hit each other or the heads could be damaged.



3. (31SD) Move the bail lever slowly until the head load arm **2** just touches the head **1**. (51TD) Move the bail lever until the two heads just touch each other.
4. Note the location of the marks **5** on the bail lever relative to the bail alignment edge **3**.
5. (31SD) Turn the bail lever approximately one and one half marks clockwise to provide the 3 to 4 millimeters (0.12 to 0.16 inches) between the head and the head load arm. (51TD) turn the bail lever approximately 3/4 of a mark to provide the 2 to 3 millimeters (0.08 to 0.12 inches) gap between the head surfaces.
6. Tighten the bail lever screw **7**.
7. Go to 343, step 2.



346 SOLENOID AND BAIL ADJUSTMENT

1. Go to 344, step 1.

DANGER

The solenoid case becomes hot after continuous use.

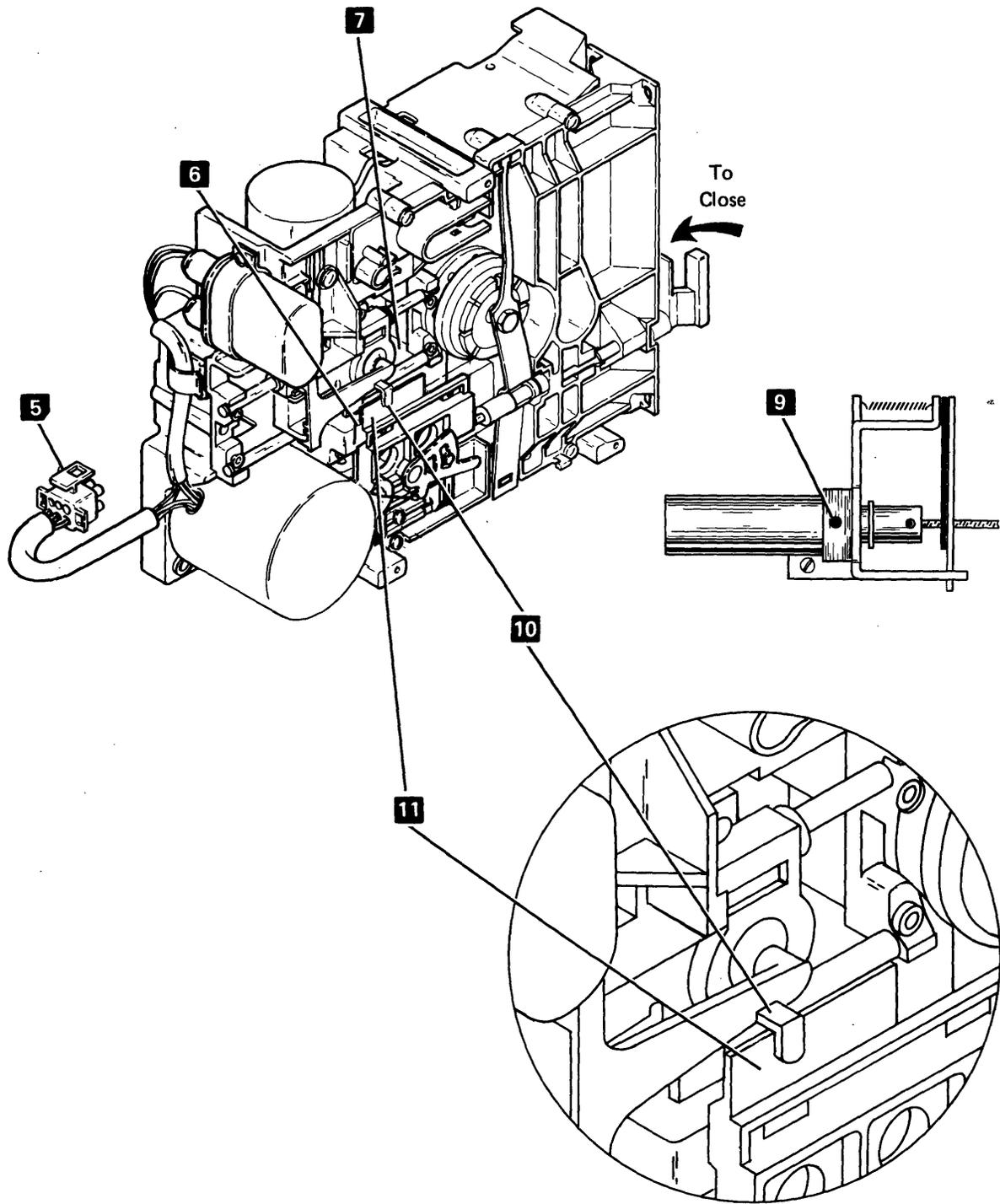
2. Loosen the solenoid locking screw **9**.

CAUTION

Do not let the solenoid plunger or the bail actuator cable turn.

3. Turn the solenoid to obtain a gap of 0.3 to 0.7 millimeters (0.012 to 0.028 in.) between the head load arm **10** and the bail **11**.
4. Tighten the solenoid locking screw.

5. Move the head/carriage assembly **7** by hand from one end to the other and check the gap at each end of the head/carriage movement.
6. If the gap is not within the limits for all of the head/carriage movement, go back to step 2. If the gap **6** is correct, proceed with step 7.
7. Remove the jumpers installed in the service check (343).
8. Open the diskette locking lever and remove the diskette.
9. Power off.
10. Reconnect the AC drive motor power cable **5**.
11. Recheck the head gap adjustment. Go to 344, step 2.



347 BAIL REMOVAL AND REPLACEMENT

Removal

1. Power off.

DANGER

Capacitor discharge voltage might be present at the socket when the AC drive motor power cable is disconnected.

2. Disconnect the AC drive motor power cable **6**.
3. (51TD) Insert a strip of clean paper between the heads **11** or insert a scratch diskette.
4. Close the diskette locking lever **1**.
5. Loosen the bail lever screw **8**.
6. Push the bail **4** inward slightly and disconnect the bail actuator cable eyelet **10** from the bail lever **9**.
7. Open the diskette locking lever.
8. Loosen the bail mounting screw **2**.

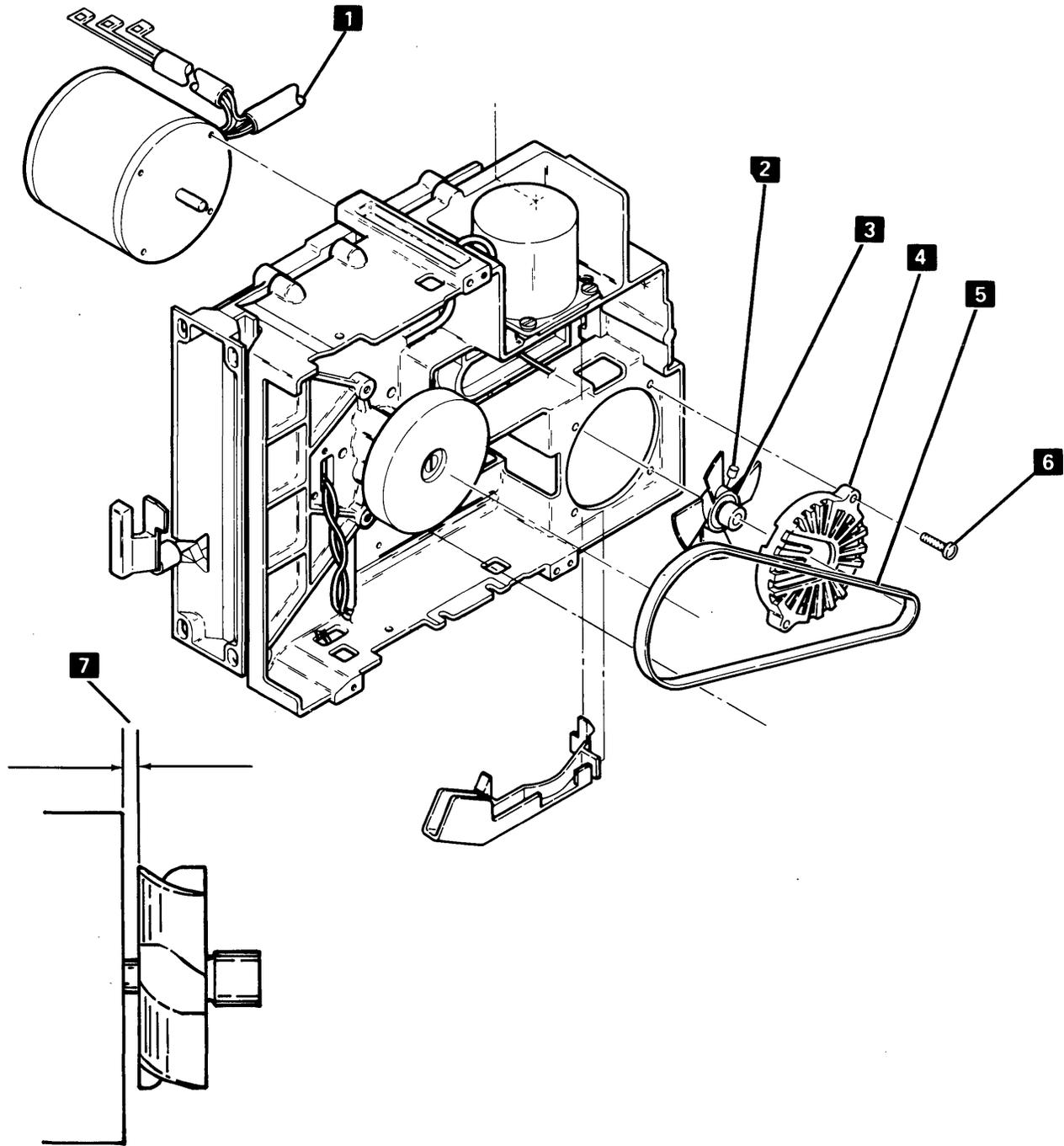
CAUTION

(31SD) Do not let the head hit the pressure pad, or the head could be damaged. (51TD) Do not let the heads hit each other, or the heads could be damaged.

9. Remove the pivot rod **3**, the bail **4**, and the bail return spring **5**. (Note the location of the bail return spring for the replacement procedure.)

Replacement

1. Reinstall the bail return spring, the bail, and the pivot rod.
2. Close the diskette locking lever.
3. Push the bail inward slightly and connect the bail actuator cable eyelet to the bail lever. (Ensure that the cable eyelet crimp is facing out.)
4. If the bail actuator cable is twisted, turn the solenoid plunger **7** by hand until the cable is straight.
5. Open the diskette locking lever.
6. (51TD) Remove the paper from between the heads, or remove the scratch diskette.
7. Perform the head gap adjustment (see 345).



Stepper Drive

357 STEPPER MOTOR REMOVAL AND REPLACEMENT

Removal

1. Power off.
2. Disconnect the head cable connector **12** from the diskette drive control card **10** and remove the head cable from the cable guide **15**.
3. Remove the cable guide **15**.

CAUTION

The drive band assembly can be easily damaged. Do not bend, dent or scratch the drive band.

4. Remove the three screws **5**, **6**, and **9** and the clamps **1** and **3** that attach the drive band **8** to the stepper motor pulley **2** and carriage bracket **4**. (Note the position of the drive band and clamps for the replacement procedure).
5. Remove the drive band.
6. Measure and record the gap **17** between the stepper motor pulley and casting.
The gap is _____.
7. Move the stepper motor pulley **2** by hand to track 40 and insert the timing pin **18**.
8. Loosen the screw **16** and remove the stepper motor pulley **2** and the clamp **7**.
9. Disconnect the stepper motor cable connector **11** from the diskette drive control card.

10. While holding the pulley and timing pin, remove the stepper motor mounting screws **14**.
11. Remove the stepper motor **13**.

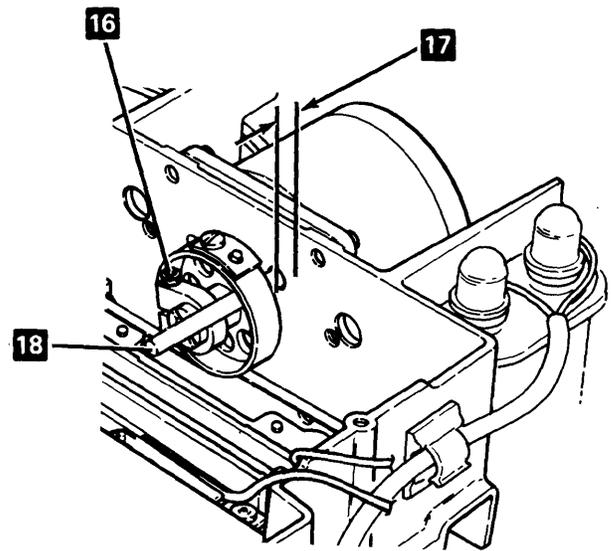
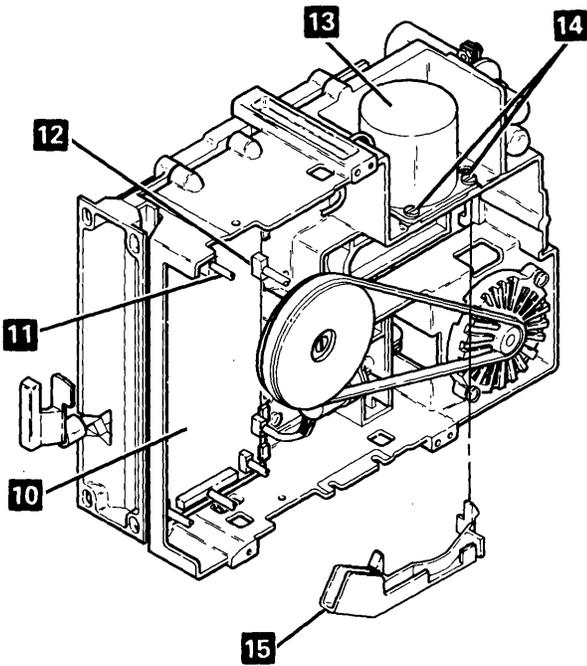
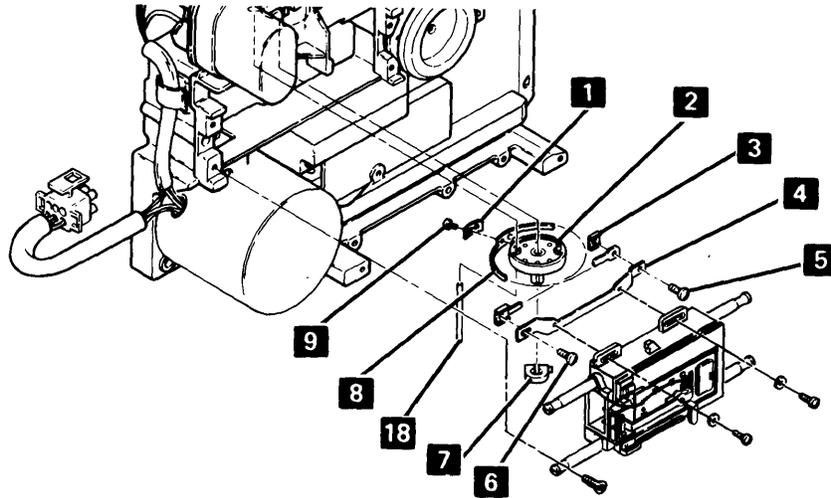
Replacement

1. Reinstall the stepper motor by using the mounting screws. (Ensure that the stepper motor cable faces toward the diskette drive control card **10**.)
2. Reconnect the stepper motor cable connector **11** to the diskette drive control card **10**.
3. Reinstall the stepper motor pulley and the clamp. (Adjust the gap **17** to the dimension recorded in the removal procedure step 6.)

CAUTION

The drive band assembly can be easily damaged. Do not bend, dent, or scratch the drive band.

4. Go to 365, step 1 (Drive Band Replacement).



359 STEPPER MOTOR PULLEY AND CLAMP REMOVAL AND REPLACEMENT

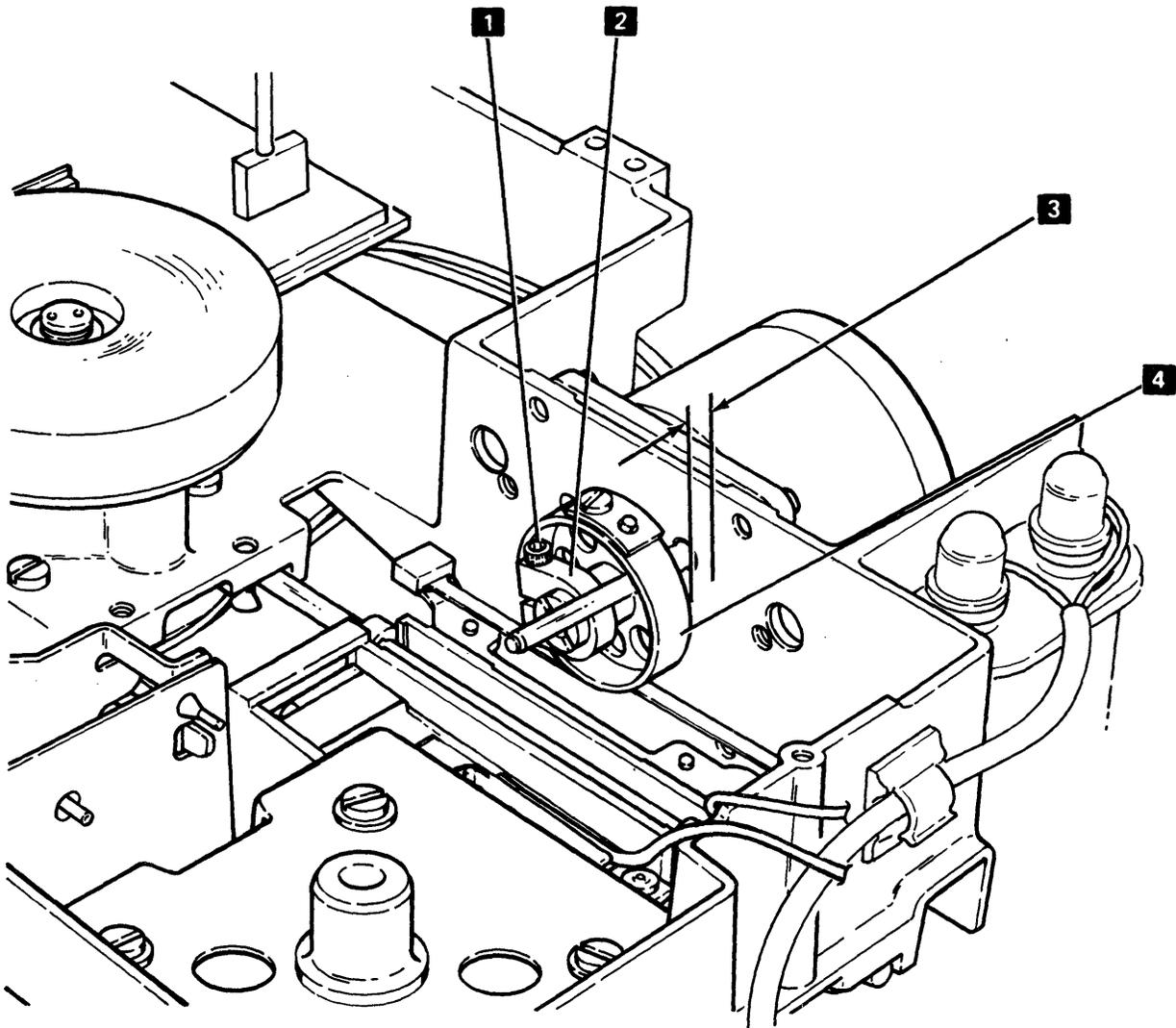
Removal

1. Power off.
2. Remove the drive band (see 365).
3. Measure and record the gap **3** between the stepper motor pulley and the casting.
The gap is _____.
4. Loosen the clamp screw **1** and remove the pulley **4** and the clamp **2**.

Replacement

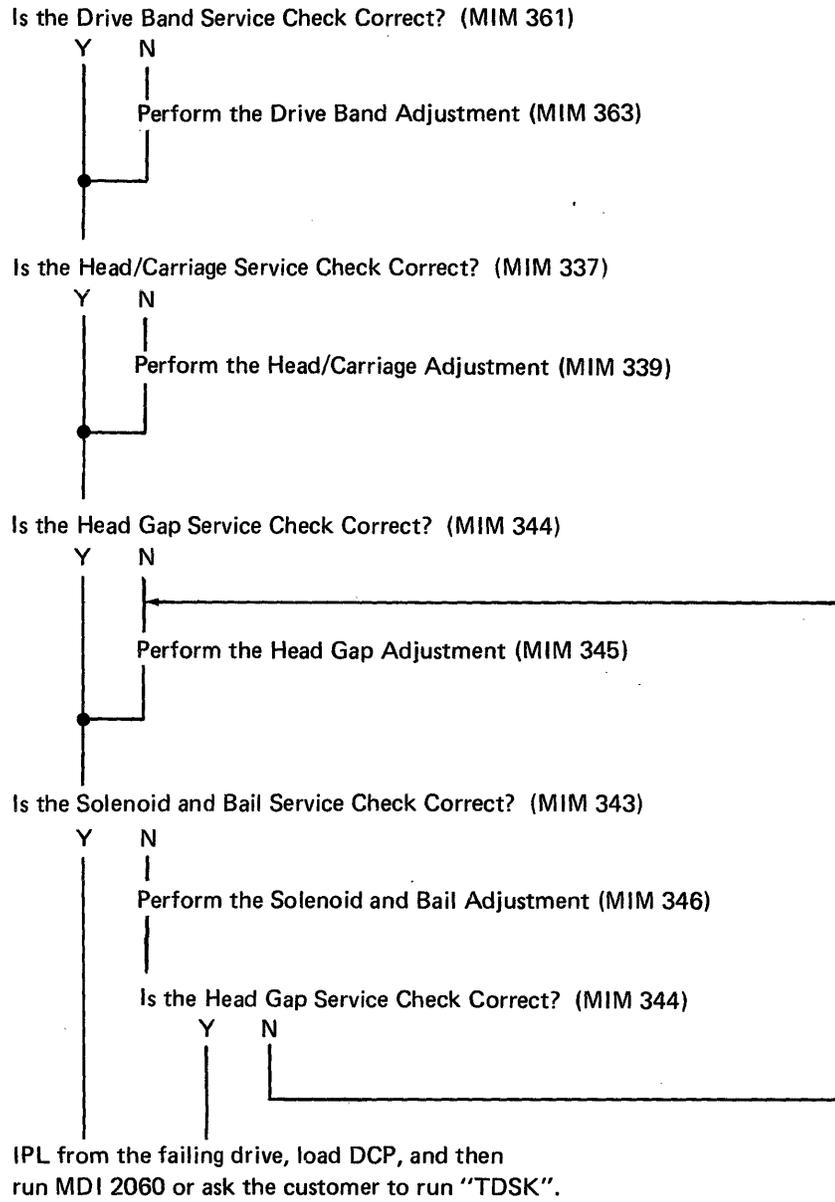
To reinstall the stepper motor pulley and clamp, observe the following exceptions and reverse the steps in the removal procedure.

1. When reinstalling the pulley and clamp, set the gap **3** to the same gap as recorded in step 3 of the removal procedure. (Ensure that the clamp is even with the end of the stepper motor shaft.)
2. After the replacement procedure is completed, go to 341, head carriage replacement procedure, step 5.



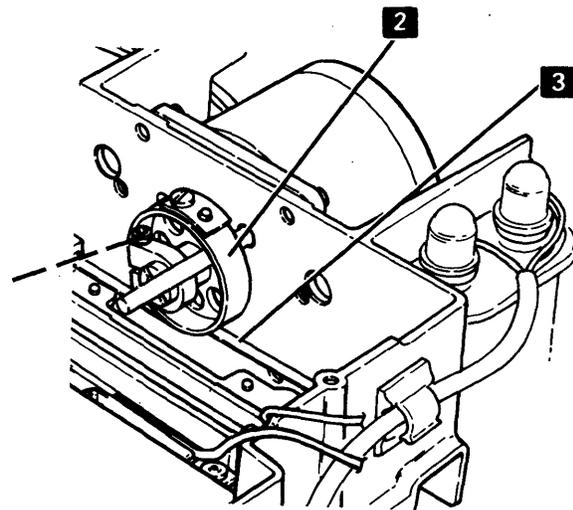
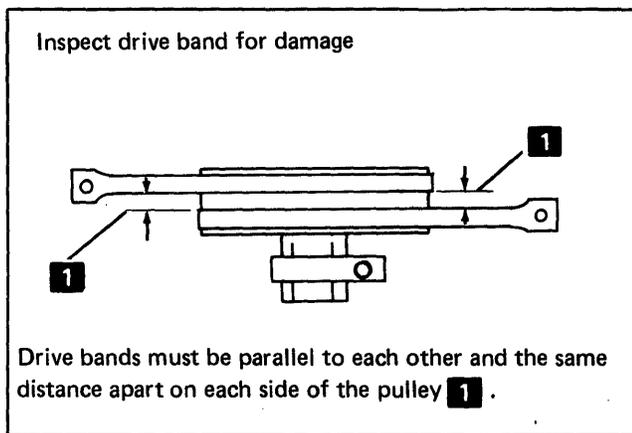
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READ/WRITE PROBLEM FLOW CHART



361 DRIVE BAND SERVICE CHECK

1. Power off.
2. If the drive band shows signs of damage, install a new drive band (see 365).
3. Turn the stepper motor pulley **2** by hand between tracks 00 and 76.
4. If the drive bands **3** are not parallel to each other **1**, go to 363, step 2.
5. If the drive bands are parallel **1**, go to 337, step 2.



363 DRIVE BAND ADJUSTMENT

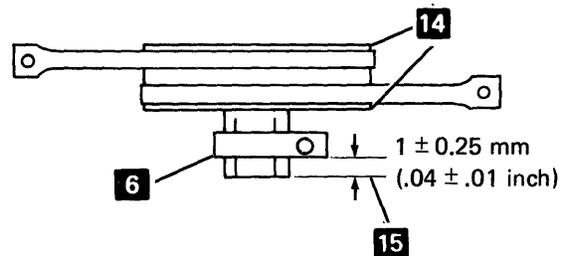
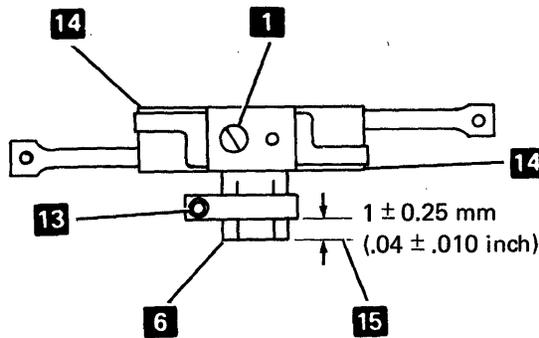
1. Go to 361, step 1.
2. Disconnect the head cable connector **8** from the diskette drive control card **9** and remove the head cable from the cable guide **10**.
3. Remove the cable guide **10**.

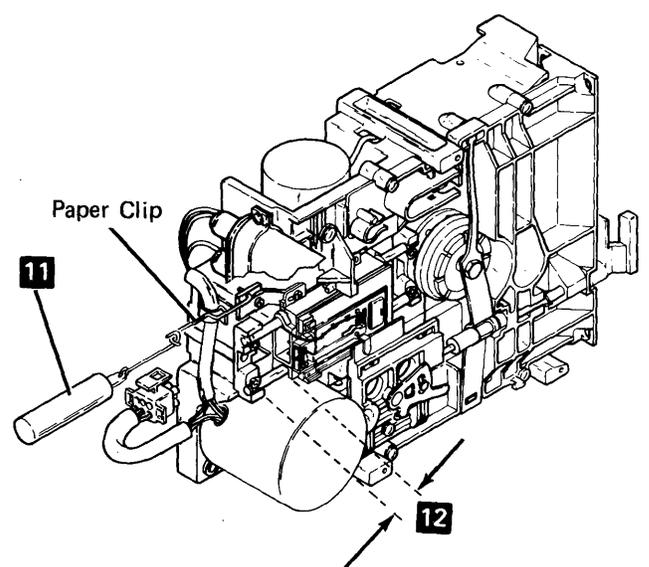
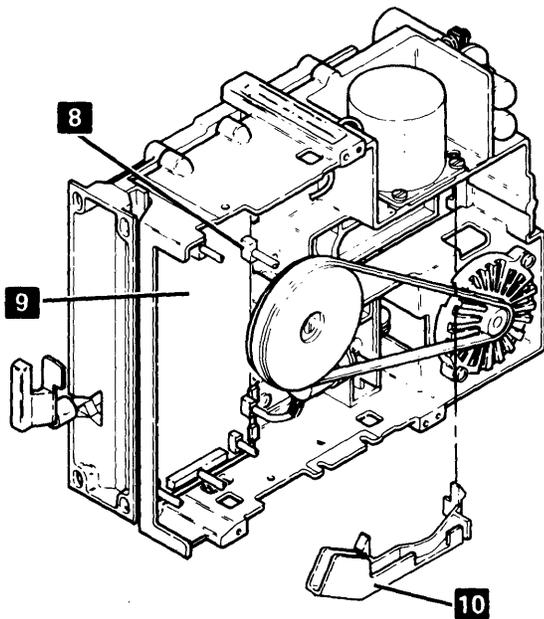
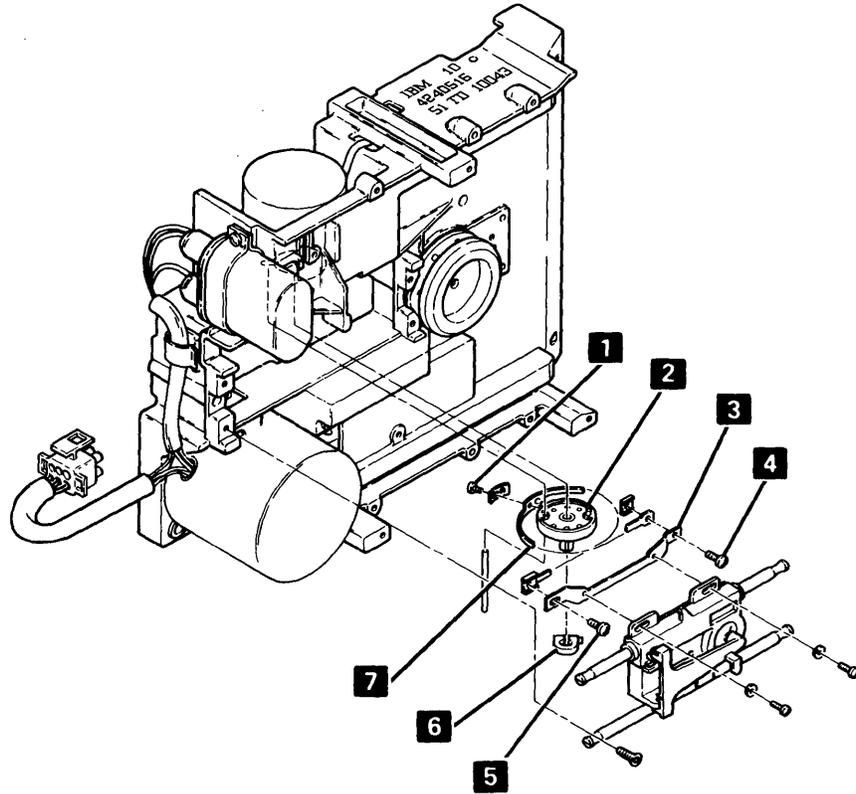
CAUTION

The drive band assembly can be easily damaged. Do not bend, dent, or scratch the drive band.

4. Loosen the three mounting screws **1**, **4**, and **5** that attach the drive band **7** to the pulley **2** and the carriage bracket **3**.
5. Tighten the screw **4**. Ensure that the drive band is parallel to the carriage bracket when the screw is tight.

6. Tighten screw **1**. Ensure that the drive band is parallel to both edges **14** of the pulley.
7. Block the head/carriage about 25 millimeters (1 inch) from the end of the casting **12**.
8. Use the force gauge **11** (part 460870) to pull on the loose end of the drive band with 1.1 ± 0.11 kilograms (2.5 ± 0.25 pounds) of force and tighten the screw **5**. Ensure that the drive band remains parallel to the carriage bracket. If the drive band does not remain parallel to the carriage bracket, continue with step 9. If it is parallel, go to step 10.
9. Loosen the drive pulley clamp **6** screw and move the carriage by hand back and forth at least 4 times. This will align the pulley with the drive band. Then position the drive pulley clamp as shown **15** and tighten the clamp screw **13**.
10. Go to 337, step 2.





365 DRIVE BAND REMOVAL AND REPLACEMENT

Removal

CAUTION

The drive band can be easily damaged. Do not bend, dent, or scratch the drive band.

1. Power off.
2. Disconnect the head cable connector **11** from the diskette drive control card **12** and remove the head cable from the cable guide **13**.
3. Remove the cable guide **13**.
4. Remove the three screws **5**, **6**, and **10** and the clamps **1** and **3** that attach the drive band **9** to the stepper motor pulley **2** and the carriage bracket **4**. (Note the position of the drive band and clamps for the replacement procedure.)
5. Remove the drive band.

Replacement

CAUTION

The drive band can be easily damaged. Do not bend, dent, or scratch the drive band.

1. Use the screw **6** to attach the end of the drive band with the welded adapter **8** to the end **7** of the carriage bracket. Do not tighten the screw.
2. Use the screw **10** and the clamp **1** to attach the drive band **9** to the stepper motor pulley **2**. The drive band must be parallel to the edge of the pulley.
3. Use the screw **5** and the clamp **3** to attach the other end of the drive band to the carriage bracket. The drive band must be parallel to the carriage bracket.
4. Go to 363, step 7.



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