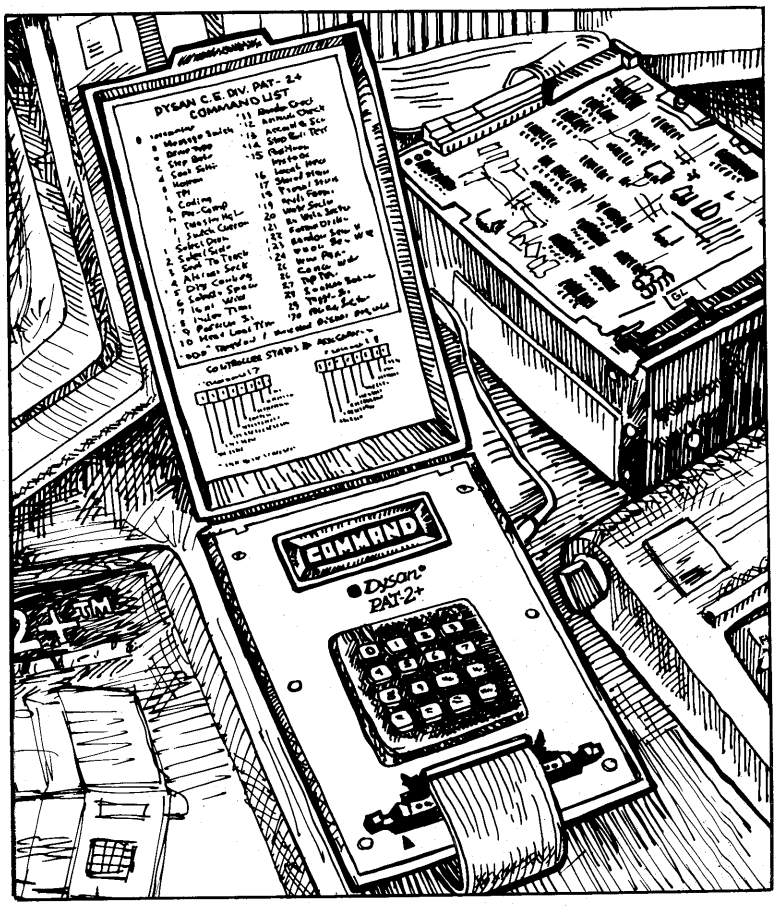
PAT-2+

Performance & Alignment Tester

Dysan®

CE Division



PAT-2+™

Performance & Alignment Tester

Dysan® *CE Division*

The Performance and Alignment Tester (PAT–2+) for flexible disc drives provides a simple yet comprehensive way to verify drive performance and identify problems.

This manual explains how to set up and use the PAT–2 + to perform over thirty drive tests. The manual is divided into eight sections. Section 1 introduces you to the tester's features and applications. Section 2 provides simple instructions for connecting the tester to a drive. Section 3 explains how to set up testing parameters. Sections 4, 5 and 6 explain how to perform the Sequence Tests, Alignment Tests and Read/Write Tests. Section 7 provides information for using the Utilities, and Section 8 explains how to use the PAT–2+ with Dysan's AADs and data discs to troubleshoot drive problems.

For clarity, all information that appears on the tester's easy-to-read LED display is printed in burgundy in this manual.

Appendix A contains a short glossary explaining terms as they are used in this manual.

Appendix B provides a technical reference organized in a series of tables.

Appendix C contains technical information specifically about Dysan's diagnostic and alignment discs.

Appendix D provides ordering information for Dysan's Performance and Alignment Tester (PAT–2+) and accessories.

1

Dysan's Performance and Alignment Tester (PAT–2+) is a highly sophisticated, self-prompting test instrument for servicing 8 inch, 5¼ inch and 3½ inch standard interface flexible disc drives. (PAT adaptors are available for many non-standard drives. See Appendix D of this manual for information.)

You can use the PAT–2+ as an evaluation tool for analyzing drive alignment and performance characteristics. With Dysan's Digital Diagnostic Diskette (DDD), Dysan's Analog Alignment Diskette (AAD) or a data disc, this tester provides benefits no other technique can offer.

- It performs a greater variety of tests than conventional methods allow.
- It is fast and easy to use.
- It determines the drive's operating margin.
- It ensures data interchangeability between drives.
- It reduces costs.
- It minimizes the need for system disassembly in most cases.
- It is portable and does not require the use of additional equipment.

The PAT–2+ tests drive mechanics and electronics as a system, using digital data like that encountered in actual field applications. You can quickly perform the following evaluations on assembled drive systems.

- Radial alignment
- Head positioner linearity
- Disc eccentricity
- Index timing

- Disc rotational speed
- Head positioner skew
- Head azimuth alignment

Periodic use of Dysan's tester measures degradation in the operating margin, allowing you to schedule preventive maintenance more efficiently.

You do not need special technical training or additional test equipment to operate the PAT–2+. Generally, there is no need to access drive electronics test points. Because an oscilloscope is not required, test results are not subject to your visual interpretation. You can read test results and message prompts in plain English on the tester's LED display. The quick reference guide printed above the control panel provides convenient access to operating information.

When used with an Analog Alignment Diskette, Dysan's tester can also serve as a simple drive exerciser to position the drive head.

⊡ DDD

Dysan's Digital Diagnostic Diskette (DDD) is a reference disc for evaluating a drive's overall alignment and performance. Appendix C of this manual contains additional information about the DDD.

⊡ AAD

The Analog Alignment Diskette (AAD) is a precision measurement tool for adjusting mechanisms and recording heads in flexible disc drives. The AAD is particularly suited for the initial alignment of new drives and drive realignment after replacement of major components. It requires an oscilloscope, access to drive circuitry test points and a user with some servicing experience. Appendix C of this manual contains additional information about the AAD.

Data Discs

You can use any normal, soft-sectored, error-free disc as a data disc. The instructions in this manual indicate when it is appropriate to use one. For example: the Read/Write Tests, the Locate Head Test and the Accordion Test require data discs.

Operating Considerations

Ideally, drives should be aligned under environmentally controlled conditions, but this is not always possible. The average office environment should not significantly affect evaluations made of the drive's operating margin. You can use the PAT–2+ and the DDD to analyze operating margins under various environmental conditions. (See Appendix C for additional information.)

The Performance and Alignment Tester (PAT–2+) is a precision instrument designed for servicing a wide variety of drives. The basic measurement made by the tester is detection of a read failure. When a drive cannot successfully read any given data pattern on the DDD, the tester reports a read failure.

Dysan does not specify tolerance limits for any measurement. The drive manufacturer is the final authority for establishing drive performance specifications. You should use this performance criteria accordingly.

Before you read further, check your tester package to see that you have:

- One 34-pin flat data cable (for 5¼ inch and microfloppy drives).
- One 50-pin flat data cable (for 8 inch drives).
- A power supply that provides power to the tester. (Power supplies are available from Dysan in both 110 volt and 220 volt versions (each ± 10%).
- Adaptor plugs for testers ordered with 220 volt (± 10%) power supplies.
- One pad of data logging sheets. (Use these for recording test results obtained with the DDD.)

How to Use the PAT-2+

Dysan recommends that you follow these steps:

1. Connect the PAT-2+ to the drive you are testing. (See Section 2 of this manual.)
2. Choose setup parameters with Command 0. Select the drive to test with Command 1, and the disc side(s) to test with Command 2. (See Section 3 of this manual.)
3. Run the Sequence Tests to determine the overall condition of the drive. The PAT-2+ uses the DDD for these tests. (See Section 4 of this manual.)
4. Run separately any alignment test that failed in the Sequence series. (See Section 5 of this manual.)
5. Run Read/Write tests to check the drive's overall data handling performance. Use data discs with the PAT-2+ for read/write testing. (See Section 6 of this manual.)
6. Run additional tests as needed. (See Section 7 "Utilities" and Section 8 "Drive Troubleshooting.") An AAD with an oscilloscope may be required.

Keyboard Description

Figure 1 illustrates the tester's keyboard. Table 1 describes the 16 keys and their functions.

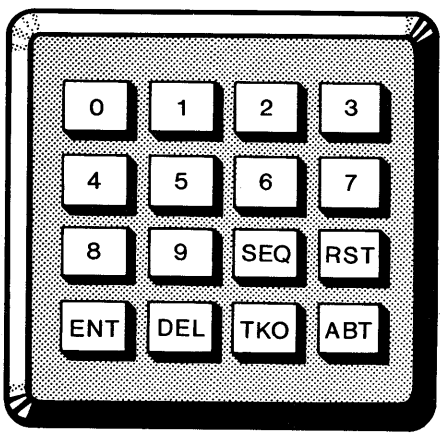


FIGURE 1 ▣ The keyboard

TABLE 1 ⊡ The keyboard and key functions

Keys	Function
0–9	Enter numeric data, select parameter values and allow you to choose how test results are displayed. (For example, display RPM or milliseconds per revolution for the Spindle Speed Test.)
SEQ (SEQUENCE)	With the DDD, starts a pre-selected sequence of six diagnostic tests: Diskette Centering, Spindle Speed, Index Pulse Width, Index Timing, Radial Alignment, and Azimuth Alignment.
RST (RESET)	Resets the tester to the start-up mode. Displays the PAT–2 + sign-on message.
ENT (ENTER)	Completes keyboard entries and stores displayed information in memory. Terminates a scrolling message and advances to the next Command or prompt.
DEL (DELETE)	Deletes the last numeric keyboard entry. For example: if you enter the number 10 instead of 9, press DEL twice to delete the two digits in the number 10.
TK0 (TRACK 0)	Pressing TK0 at the "COMMAND" prompt steps the head to the home sensor position and clears the track counter to zero. TK0 operates only when "COMMAND" is displayed.
ABT (ABORT)	Pressing ABT stops any operation and returns you to COMMAND mode. Pressing ABT before an operation is complete cancels it.

2

This section of the manual explains how to set up for drive testing with the PAT–2+. For proper installation you need a power supply suitable for the drive(s) to be tested. Setup involves these basic procedures:

- Inspect drive(s)
- Compare data cables for compatibility
- Connect appropriate cables to tester and drive(s)
- Connect tester and drive(s) to suitable power supply

Setup Procedures

1. **Mechanically inspect your drive.** Does the disc drive door latch open and close correctly? Do the centering cone and spindle clamp correctly? Using a data disc, manually rotate the spindle drive mechanism and verify that the disc rotates smoothly.
2. **Verify the drive's compatibility with the PAT–2+.** See Appendix B of this manual for pin assignments for 34-pin and 50-pin connectors. The connector pin assignments supported by the PAT–2+ are stated in Tables B-1 and B-2.
3. **Verify** proper input line termination, drive select jumpers and options on each drive with the drive manufacturer's installation instructions. If termination on the drive is improper, borrow the appropriate termination from another drive.
4. **Connect the flat data cable** (supplied in your tester package) **to the drive.** Match PIN #1 on the cable connector to PIN #1 on the drive's PC board. The colored stripe along the edge of the cable identifies PIN #1.

5. **Connect the data cable to the PAT–2+** by matching PIN #1 on the cable connector to PIN #1 on the tester (a triangle marks the connector).

   When inserting the cable, keep cable ejectors in the DOWN position (as in Figure 2). When properly connected, cable ejectors are in the UP position.

6. **Connect power supply cable(s) to drive(s),** checking for proper voltages.
7. **Connect the PAT–2+ to its power supply,** and plug it into an electrical outlet.

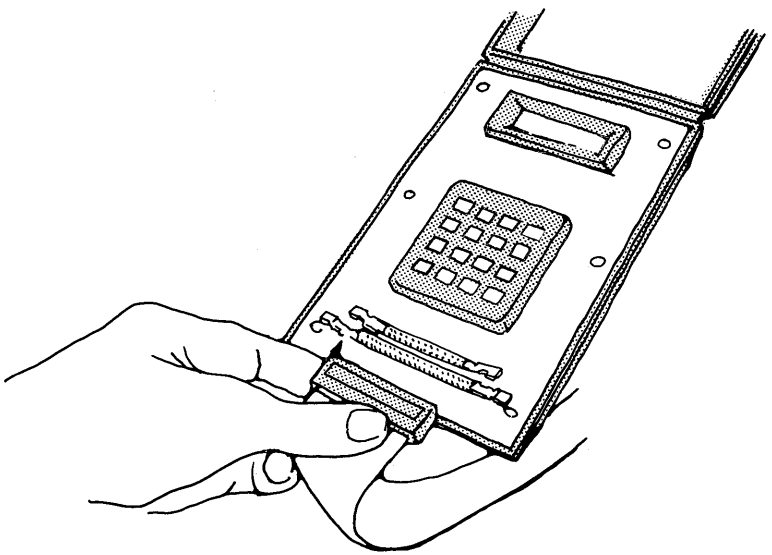


FIGURE 2 ⊡ Connecting cable to PAT–2+

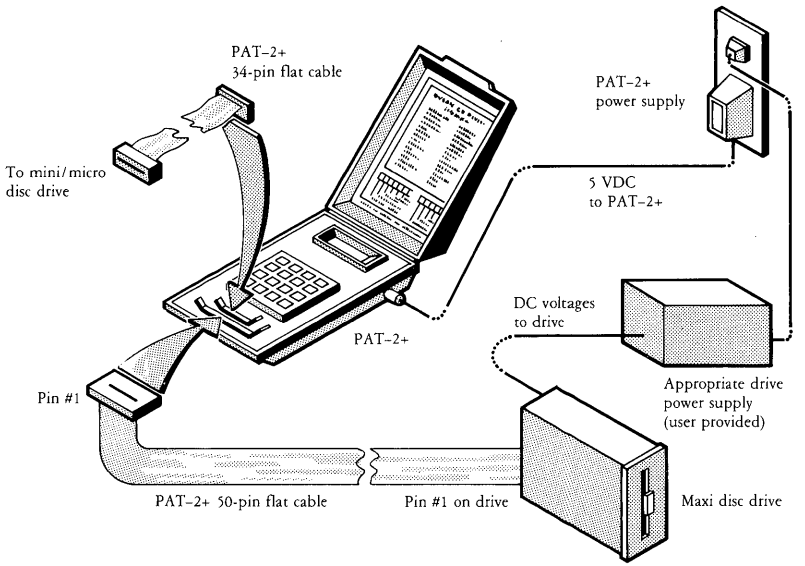


FIGURE 3 ⊡ Setting up the PAT–2+

⊡ Starting Up

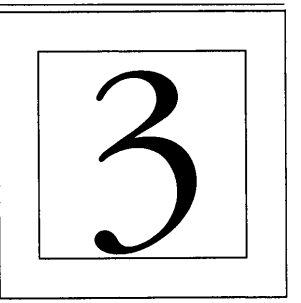
When properly connected, the tester displays this message: MEM OK.

If this message does not appear, check the power supply connections and try again.

If the LED display remains empty, or if the message "BAD RAM" or "BAD ROM" appears, return your tester to Dysan. (Refer to "Service Information" in this manual for shipping instructions.)

Immediately following the "MEM OK" message, a properly operating tester displays this scrolling sign-on message: PAT–2+ DYSAN CE DIVISION. . . with a version number (VER X.X).

Now you are ready to proceed to Section 3 of this manual.



This section of the manual explains how to use Commands 0, 1 and 2 to set up drive testing parameters.

⊡ Setup Parameters (Command 0)

Command 0 allows you to review or change any of the testing default parameters that the PAT–2+ uses. Table 2 lists these parameters by drive type.

TABLE 2 ⊡ Setup Parameters by drive type

PAT–2+ Parameters	Default Values		
MESSAGE SWITCH	ON	ON	ON
DRIVE TYPE	MAXI 8	MINI 5	MICRO 3.5
STEP RATE	10 msec	6 msec	6 msec
SEEK SETTLE	15 msec	15 msec	15 msec
RETRIES	0	0	0
TRACKS PER INCH	48 360*	48 300*	135 300*
CODING	MFM	MFM	MFM
PRE-COMPENSATION	Track 43	Track 0	Track 60
TRANSFER RATE	500 kHz	250 kHz	250 kHz
SWITCH CURRENT	Track 60	NA	NA
*RPM			

The tester uses these default values unless you change them. Any new values you enter now are stored in non-volatile memory and become the current default parameters.

If you make a mistake while entering a value, this error message appears: **INVALID**

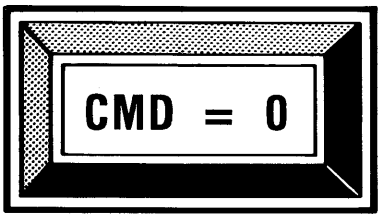
The tester's default parameters are suitable in most cases. However, you may want to refer to your drive service manual for the manufacturer's specifications.

⊡ Selecting Command 0

Press **ENT** or **ABT** to go to COMMAND mode. (You must be in this mode to use any of the tester's commands.)

At the COMMAND prompt press **0.**

The next display shows that you have selected Command 0.



Press **ENT.**

The message SETUP PARAMETERS scrolls once across the display.

Next this parameter prompt appears: MSG ON.

⊡ Message Switch

The message switch parameter controls the display of command titles only. It does not affect the display of messages or prompts. When you enter a command with the switch ON, the command title scrolls across the display and stops at the first prompt. When the switch is OFF, only the prompt appears. Until you are familiar with the PAT–2+ commands, leave the message switch on. (Table B-3 in Appendix B of this manual lists commands by number and title.)

Press **ENT** for ON.
Or, press **0** for OFF.
Press **ENT** to store your selection.

Pressing **ENT** once also brings up the next parameter prompt.

⊡ Drive Type

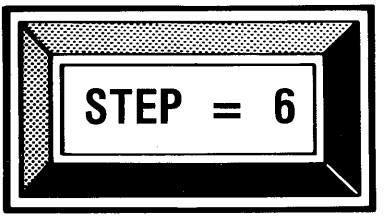
Use this parameter to select the drive type to test. The PAT–2+ offers these options: MAXI 8 selects 8 inch
MINI 5 selects 5¼ inch
MICRO 3.5 selects 3½ inch

Press **ENT** to keep the parameter displayed.
Or, press **0** to make a new selection. Press **ENT** to store your selection.

Pressing **ENT** also brings up the next parameter prompt.

⊡ Step Rate

Step rate (sometimes called "seek time") represents the time it takes the drive to move the read/write head(s) to the next track. Step rate values range from 0 to 99 milliseconds in increments of one millisecond. Pressing **0** selects a rate of 750 microseconds. The larger the step rate value, the more slowly the drive positions the head(s). The smaller the rate, the faster the positioning. If you do not specify a rate within the drive's capability, the drive may position itself to an incorrect track location.

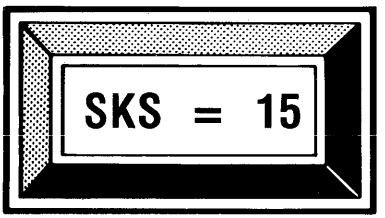


Press **ENT** to keep the parameter displayed.
Or, enter a new step rate (0–99).
Press **ENT** to store your selection.

Pressing **ENT** also brings up the next parameter prompt.

⊡ Seek Settle (SKS)

Seek settle time is the period of time necessary for the head to stabilize after seeking to a track prior to a read or write operation. Seek settle values range from 0 to 999 milliseconds in increments of one millisecond.



Press **ENT** to keep the parameter displayed.
Or, enter a new seek settle time (0–999).
Press **ENT** to store your selection.

Pressing **ENT** also brings up the next parameter prompt.

⊡ Retries (RETRY)

The retry parameter sets the number of times the PAT–2+ tries to retrieve data on a disc after an error is detected. If the tester cannot retrieve the data, it reports a read or write failure. Because each retry requires one complete disc revolution, a large retry value may slow down testing. Selecting 0 retries results in the most rigorous drive testing.

Press **ENT** to keep the parameter displayed.
Or, enter the number of retries desired (0–99).
Press **ENT** to store your selection.

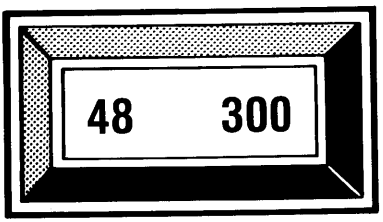
Pressing **ENT** also brings up the next prompt.

⊡ Tracks Per Inch (TPI)

Table 3 lists the TPI and RPM default values that the PAT–2+ uses for testing. Generally these values are appropriate, but you can compare them with your drive manufacturer's specifications.

TABLE 3 ⊡ TPI and RPM by drive type

8 Inch Drive		5¼ Inch Drive		3½ Inch Drive	
TPI	**RPM**	**TPI**	**RPM**	**TPI**	**RPM**
48	360	48	300	135	300
96	360	96	300	135	600
		96	360	67.5	300
		100	300	67.5	600

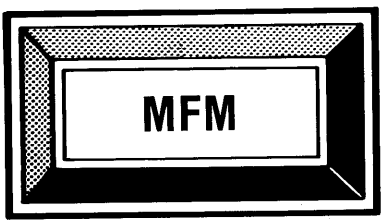


Press **ENT** to keep the parameter displayed. Or, press **0** to make an alternate selection. Press **ENT** to store your selection.

Pressing **ENT** also brings up the next parameter prompt.

⊡ Encoding

The encoding parameter selects either double density (MFM) or single density (FM) coding. This parameter applies to both the diagnostic and data discs you use with the PAT–2+ .

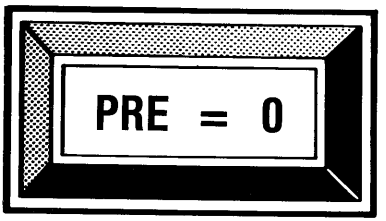


Press **ENT** to keep the parameter displayed. Or, press **0** to make an alternate selection. Press **ENT** to store your selection.

Pressing **ENT** also brings up the next parameter prompt.

⊡ Pre-Compensation

The pre-compensation parameter sets the beginning track on the disc where the tester compensates for increased bit density. As the head moves toward the spindle, the track diameters become smaller and the data bits are closer together. This crowding results in a mislocation of the bits called bit shift. Pre-compensation predicts which data patterns cause bit shift and adjusts the data bit timing to compensate for it. The tester was set at the factory to provide a pre-compensation value of 200 nanoseconds.



Press **ENT** to keep the parameter displayed. Or, enter the track number where pre-compensation begins (0–255). If you do not not want pre-compensation, enter a track number that is at least one track greater than the last track on the drive. Press **ENT** to store your selection.

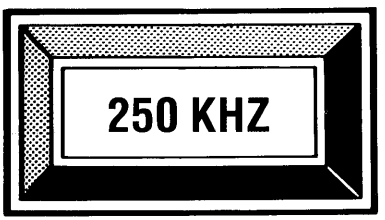
Pressing **ENT** also brings up the next parameter prompt.

⊡ Transfer Rate

The transfer rate parameter selects the rate at which data is transferred from the drive to the tester. Transfer rate is measured in kilohertz (kHz) per second. (This value may be indicated by some drive manufacturers in bits per second.) Table 4 lists the default values that the PAT–2+ uses.

TABLE 4 ⊡ Transfer Rate values by drive type

			Transfer Rate (kHz)			
			Normal		Alternate	
Drive Type	**TPI**	**RPM**	**FM**	**MFM**	**FM**	**MFM**
MAXI 8	48	360	250	500	125	250
	96	360	250	500	125	250
MINI 5	48	300	125	250	250	500
	96	300	125	250	250	500
	100	300	125	250	250	500
	96	360	250	500	125	250
MICRO 3.5	135	300	125	250	250	500
	135	600	250	500	125	250
	67.5	300	125	250	250	500



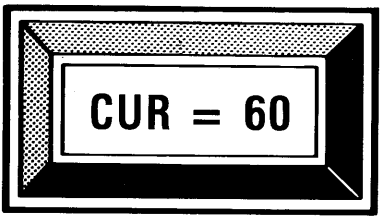
Press **ENT** to keep the parameter displayed. Or, press **0** to select an alternate value. Press **ENT** to store your selection.

If you are testing a 5¼ inch or a 3½ inch drive, transfer rate is the last parameter to set up. Pressing **ENT** also returns you to COMMAND mode. Now skip to "Before You Test" at the end of this chapter.

If you are setting up parameters for testing an 8 inch drive, one last prompt appears on the display.

⊡ Switch Current

The switch current parameter prompt appears only if you specified MAXI 8 as the drive type parameter. Switch current selects the beginning track on a disc where the drive will switch to a lower write current. On some drives, reduced write current improves the readback performance on the inner tracks. Only drives using interface Pin #2 to switch current support this parameter. If your drive does not support the switch current parameter, press **ENT** to select the track number displayed, as there will be no effect on the drive.



Press **ENT** to keep the parameter displayed. Or, enter the track number (0–255) where the drive will switch to lower write current. Press **ENT** to store your selection.

Pressing **ENT** also returns you to COMMAND mode. Prior to using any new commands, read "Before You Test."

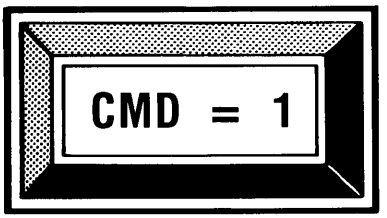
⊡ Before You Test

Select the drive and disc side to test with Commands 1 and 2.

⊡ Select Drive (Command 1)

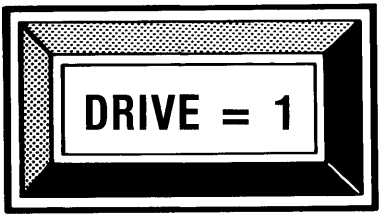
Command 1 selects the drive you specify and positions the head to track 0.

You should still be in COMMAND mode. If not, press **ABT.** At the COMMAND prompt, press **1.**



Press **ENT.**

The message SELECT DRIVE scrolls once across the display and this prompt appears:



Press **ENT** to keep the parameter displayed. Or, make another selection.* Choose 1–4 for 5¼ inch drives; 1–5 for 8 inch; or 1–4 for 3½ inch. Press **ENT** to store your selection.

*Generally the tester's default values for drive selection are appropriate. If the PAT–2+ displays the message **"NOT-RDY"** (not ready), check your drive service manual to determine how the drive is addressed. You can also do this by using Command 28 (Sequence Selects). (Refer to Section 8 of this manual.)

Table 5 explains error messages for Command 1.

Press **ABT** to return to COMMAND mode.

TABLE 5 ⊡ Error messages reported for Select Drive (Command 1)

Message	Explanation
INVALID	You pressed the wrong key or selected an incorrect drive number. Check drive specifications and enter the correct number.
NOT HOME	The drive cannot position the read/write head to track 0; the drive cannot locate the track 0 sensor; you did not put a disc into the drive; or the drive is not working properly. Recheck the setup parameters (Command 0). Make sure you put a disc into the drive.
NOT-RDY!	(Not Ready) The cables are not connected properly; the drive select options are incorrect; or there is no disc in the drive.

⊡ Select Side (Command 2)

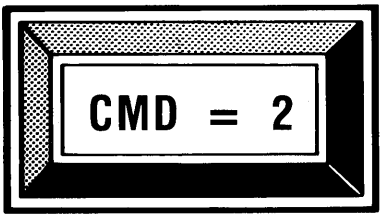
This command selects the disc side(s) to test. Table 6 explains how to use Command 2.

TABLE 6 ⊡ Side number options for 1- and 2-sided discs

Side Number	Explanation
0	Selects a one-sided disc or side 0 of a two-sided disc.
1	Selects side 1 of a two-sided disc.
2	Selects and allows testing of both sides of a two-sided disc. On appropriate tests, allows you to change sides during testing by pressing **0** for side 0 and **1** for side 1.

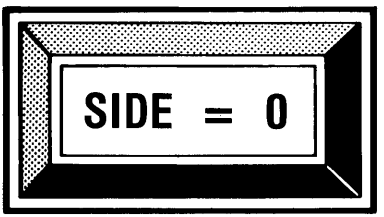
You should still be in COMMAND mode. If not, press **ABT.**

At the COMMAND prompt press **2.**



Press **ENT.**

The message SELECT SIDE scrolls once across the display. Next, this prompt appears:



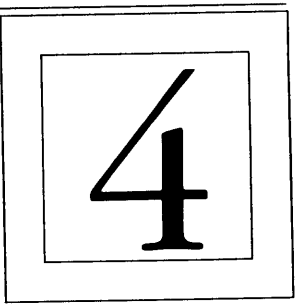
Press **ENT** to keep the parameter displayed. Or, enter an alternate number (from Table 6). Press **ENT** to store your selection.

There is one error message for Command 2: "**INVALID.**" This message appears when you press the wrong key or when you select an incorrect side number. Enter the correct number and continue.

When you have made your drive and side selections, press **ABT** to return to COMMAND mode.

Now test the drive for electrical or mechanical problems with a data disc before you use your diagnostic or alignment disc(s). Put your data disc into the drive.

1. Check the drive's exercise capability with Command 4 (Alternate Seek). (See Section 7 of this manual.)
2. Check the drive's read/write data handling capabilities with Command 22 (Format Diskette). (See Section 6 of this manual.)
3. Inspect your data disc for physical damage.



4

This section explains how the PAT–2+ uses the DDD to check the overall condition of the flexible disc drive you are testing. Six separate, pre-selected diagnostic tests are performed. Table 7 lists the Command title and number for each test and describes test functions.

TABLE 7 ⊡ The Sequence Tests

Command Title & No.		Test Function
DISKETTE CENTERING	5	Checks the drive hub's ability to clamp and center the disc correctly.
SPINDLE SPEED	6	Measures the rotational speed of a disc in revolutions per minute (RPM) or milliseconds per revolution (MS).
INDEX WIDTH	7	Measures the width of the index pulse.
INDEX TIMING	8	Measures the time between the leading edge of the index pulse and a reference point on the DDD.
RADIAL ALIGNMENT CHECK	11	Measures the read/write head's position relative to the center of the track.
AZIMUTH ALIGNMENT CHECK	12	Measures how well the read/write head can read data that has been increasingly rotated on the track both clockwise and counterclockwise.

When a test fails in the Sequence series, run it individually by entering its Command number. For example: if the Radial Alignment Check fails, use Command 11 to run an individual radial check. (See Section 5 of this manual.)

If you are testing a two-sided drive, use Command 2 (Side Select) before you press the SEQ key. Option 2 in Command 2 lets you toggle between sides while running any Sequence Test *except* Spindle Speed and Index Width. Press **0** for side 0; press **1** for side 1. (See Section 3 of this manual.)

▣ Using the SEQ Key and Commands

To run the Sequence Tests you must be in COMMAND mode. If you want to stop the SEQ operation at any time, press **ABT.** Sequence Tests require a DDD. (See Appendix B, Table B-4 for the correct DDD model number to use.) (The illustrations in this section are examples of displays for a 5¼ inch 48 tpi drive with the tester's message switch ON.)

At the COMMAND prompt, press **TK0** to home the drive to track 0. Pressing **SEQ** begins the series of tests. Pressing **ENT** steps you through each test and brings up test results on the display. Use your data logging sheets to record these results. It is recommended that you check all test results against the drive manufacturer's specifications. Be aware that the parameter setup you selected in Command 0 automatically dictates both the track locations and the range of readings for the Sequence Tests.

Press **SEQ** to begin testing. The following messages scroll across the display:

Command Title:	SEQUENCE TESTS
DDD Model Number:	DYSAN 508–400

▣ Diskette Centering

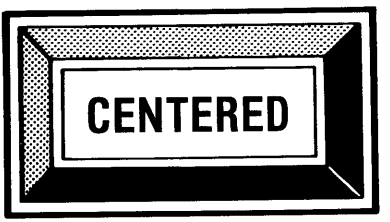
The display continues with:

Test Command Title:	CENTERING OF DISKETTE CHECK
Track Number:	TRK = 21

If you selected the side-toggling option with Command 2, the display also shows the Side Number: SIDE = 0.

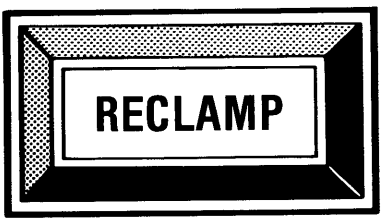
Use the **0** and **1** keys to toggle to either side of the disc during this test. The tester displays which side it is checking before it displays the test results.

When there are no errors to report, the PAT–2+ displays this result for the Centering Check:



The drive passed the centering test. Press **ENT** to proceed to the next test.

The PAT–2+ displays several error messages for the Centering Check.



Open and close the drive door and retry the test. If the "RECLAMP" message persists, the drive may have a head alignment problem. (See Command 11 in Section 5 of this manual.)

Additional error messages are: **+CK RAD, –CK RAD,** and **RD–ERROR.** ("Error Messages" at the end of this section of the manual provides brief explanations.) If the tester reports an error for the Centering Check, correct the problem before proceeding.

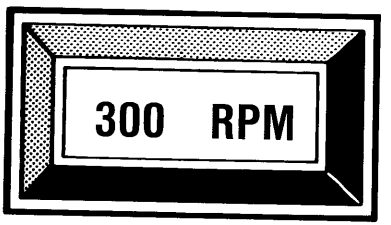
When the test result reads "CENTERED," press **ENT** to continue.

⊡ Spindle Speed

Pressing **ENT** brings up the next test Command title: SPINDLE SPEED CHECK.

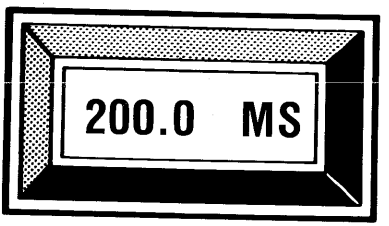
The PAT–2+ reports speed in revolutions per minute (RPM) or in milliseconds per revolution (MS).

When the tester displays RPM:



Press **1** to display speed in milliseconds.

When the tester displays speed in milliseconds:



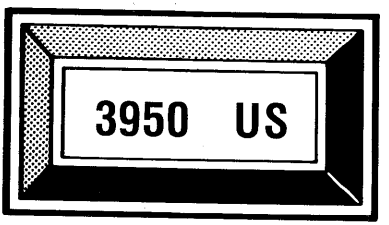
Press **0** to display speed in RPM.

The **0** and **1** keys toggle between the RPM and MS displays.

Press **ENT** to continue.

⊡ Index Width

Pressing **ENT** brings up the next test Command title: INDEX PULSE WIDTH CHECK. The PAT–2+ displays an average reading in microseconds. For example:



Press **ENT** to continue.

⊡ Index Timing

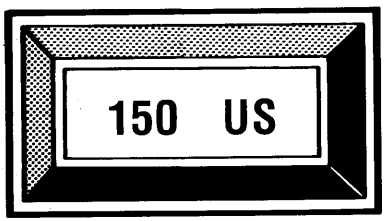
Pressing **ENT** brings up the next test Command title: INDEX TO DATA MARK CHECK.

This test measures the time from the leading edge of the index pulse to a reference point on the DDD. It runs on two tracks and reports an average of readings in microseconds. (Readings should be between 100 and 300 μs, as most drives are designed with field specifications for the index to data mark time of 200 ±100 μs.)

The first test is performed at track 0 (the outside index timing track). The second test is performed at the inside timing track. Track numbers are displayed as they are tested. For example, TRK = 0.

If you selected the side-toggling option with Command 2, use the **0** and **1** keys to run the index timing test on alternate sides of your drive. The display indicates which side the tester is checking. For example: SIDE = 0, TRK = 0.

The first display represents the average index timing (from several readings) at the outside test track. For example:



Press **ENT** for a reading at the inside test track.

The second display represents the average index timing (from several readings) at the inside test track. For example: SIDE = 0, TRK = 34, 188 US.

Press **ENT** to proceed to the next test.

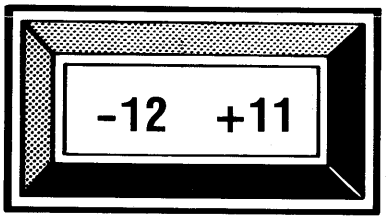
⊡ Radial Alignment Check

Pressing **ENT** brings up the next test Command title: RADIAL ALIGNMENT CHECK.

The PAT–2+ uses the DDD's three Progressive Offset Tracks to check the drive's radial alignment. Checking on three tracks indicates how consistent alignment is across the disc's surface, showing errors in drive carriage linearity. Track numbers are displayed as they are tested.

If you selected the side-toggling option with Command 2, use the **0** and **1** keys to test radial alignment on alternate sides of your drive. The display indicates which side you selected.

The PAT–2+ reports the negative and positive radial offset values read at each test track (outside, middle and inside) and displays these readings in milli-inches. (See "Command 11" in Section 5 of this manual for additional information.) The first display indicates the reading taken at the outside test track. For example, TRK = 0, SIDE = 0, then:



Press **ENT** to display the results of the middle track reading and again for the inside track reading.

Press **ENT** to advance to the next test.

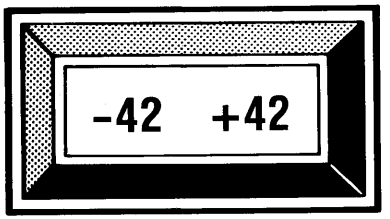
⊡ Azimuth Alignment Check

Pressing **ENT** brings up the next test Command title: AZIMUTH ALIGNMENT CHECK.

Azimuth alignment testing is available with these DDDs: 48 tpi, 67.5 tpi and 96 tpi *(at 360 rpm only)*. If the DDD you are using does not contain an Azimuth Rotation Track, the PAT–2+ returns you to COMMAND mode. Otherwise, the tester displays the track number it is checking.

If you selected the side-toggling option with Command 2, use the **0** and **1** keys to test alternate sides of your drive. The tester displays the side you selected.

The PAT–2+ reads the negative and positive azimuth rotation values and reports them in minutes of one degree. (See "Command 12" in Section 5 of this manual for additional information.)



Pressing **ENT** returns you to COMMAND mode.

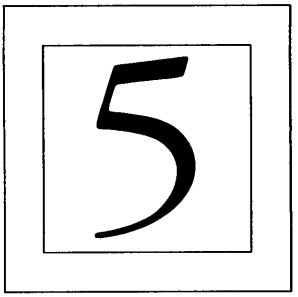
Error Messages

When an error is reported, check that all cables are connected securely and properly. Is the disc in the drive with the label side up? Is the drive door completely closed? Are you using the correct DDD model? Have you selected the correct values for all parameters?

Table 8 lists the error messages reported for the Sequence Tests, indicates the Command number(s) of tests to which they apply and provides brief explanations.

TABLE 8 ◻ Error messages reported for the Sequence Tests

Message	CMD #	Explanation
+CK RAD -CK RAD	5 5	The drive read only one side of the track centerline. The drive has a head alignment problem. (See NOTE below.)
ID-ERROR	8 & 9	The drive could not read the first sector ID mark. The index sensor may need adjustment. (Follow the drive manufacturer's instructions.)
NOT-RDY!	5,6,7, 8,11 & 12	(Not Ready) The cables are not connected properly; the drive select options are incorrect; or there is no disc in the drive.
RECLAMP	5	The disc is not centered correctly. Check disc's center hole for damage. Retry the test. If message persists, drive may have a clamping or a head alignment problem. (See NOTE below.)
RD-ERROR	5,8, 9,11 & 12	(Read Error) The drive has a head alignment problem and cannot read the alignment track (see NOTE below); or you are using the wrong disc; or your setup parameters are incorrect.
REQ-DDD	5,8, 9,11 & 12	(Requires DDD) Put the correct DDD model into the drive; home the drive to track 0 by pressing TK0 at the COMMAND prompt.
NOTE: To correct a head alignment problem, press **ABT** and go to Command 11, RADIAL CHECK (see Section 5 of this manual). Use of an Analog Alignment Diskette (AAD) and an oscilloscope is recommended for adjustment operations. (See Section 7 of this manual.)		



This section explains how to run individual alignment tests similar to the tests performed in the Sequence series. Table 9 lists the Alignment Tests by Command title and number.

TABLE 9 ⊡ Alignment Tests

Command Title	Command Number
DISK CENTERING	#5
SPINDLE SPEED	#6
INDEX WIDTH	#7
INDEX TIMING	#8
POSITIONER SKEW	#9
HEAD LOAD TIME	#10
RADIAL CHECK	#11
AZIMUTH CHECK	#12
POSITIONER HYSTERESIS	#15

By running tests one at a time, you can check specific parameters of a drive's performance with the DDD (required for all tests except Spindle Speed and Index Width). (See Appendix B, Table B-4 for the correct DDD model number to use.) Record test results on your data logging sheets. It is recommended that you check all results against the drive manufacturer's specifications.

Before you run other alignment tests, run the Disk Centering test to ensure a good clamp. If you are testing a two-sided drive, Command 2 allows you to toggle between sides of a two-sided disc while a test is running. (See Section 3 of this manual.)

To run any of the individual Alignment Tests you must be in COMMAND mode. If you want to stop an operation at any time, press **ABT.**

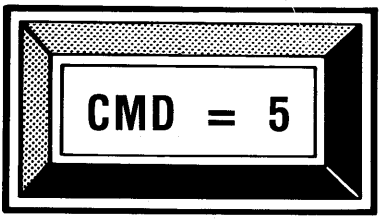
(The illustrations in this section are examples of displays for a 5¼ inch 48 tpi drive with the tester's message switch ON.)

At the COMMAND prompt, press **TK0** to home the drive to track 0.

⊡ Diskette Centering Check (Command 5)

The Disk Centering test verifies the drive's ability to clamp and center a disc correctly. The test runs on the DDD's three Alternate Offset Tracks. (See Appendix C, Table C-1 for track locations. Your DDD data sheet also provides this information.)

Put your DDD into the drive you want to test. At the COMMAND prompt, press **5.**



Press **ENT.**

The test Command title, CENTERING OF DISKETTE CHECK, scrolls once across the display and stops at the first prompt.

If you selected the side-toggling option with Command 2, the display shows the Side Number: SIDE = 0. Use the **0** and **1** keys to toggle to either side of the disc during this test.

When the tester displays the prompt for track number:

Enter the first Alternate Offset Track number specified for your DDD. Press **ENT** to run the centering test on that track.

If the tester reports a message other than "**CENTERED**," correct the problem before proceeding. Otherwise, press **ENT** to continue.

Enter the second Alternate Offset Track number and press **ENT** to test centering on that track. If the drive passes the test, enter the third track number and press **ENT** to test for proper centering.

Press **ABT** to return to the COMMAND prompt.

Table 10 lists the error messages reported for the Disk Centering test and provides a brief explanation for each.

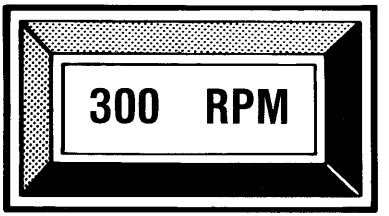
TABLE 10 ⊡ Error messages reported for Centering of Diskette Check (Command 5)

Message	Explanation
+CK RD −CK RD	The drive read only one side of track centerline. Check Radial Alignment (Command 11). (See NOTE below.)
INVALID	You entered a track number greater than 255.
NOT-RDY!	(Not Ready) The cables are not connected properly; the drive select options are incorrect; or there is no disc in the drive.
-ERROR	(Read Error). The tester could not read data from the track selected. Verify that your parameters are correct.
RECLAMP	The disc is not centered correctly. Check the disc's center hole for damage. Retry the test. If this message persists, the drive may have a clamping or a head alignment problem. (See NOTE below.)
REQ-DDD	(Requires DDD). Put the required DDD into the drive and home the drive to track 0 by pressing **TK0** at the COMMAND prompt. Retry the test.
NOTE: To adjust head alignment, press **ABT** and go to Command 11 (Radial Check). Use of an AAD and an oscilloscope is recommended for adjustment operations. (See Section 7 of this manual.)	

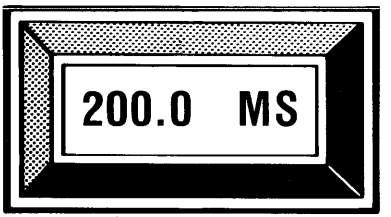
⊡ Spindle Speed Check (Command 6)

Spindle speed is determined by measuring the time between index pulses, with a measurement accuracy of ±200 μsec. Speed is reported in revolutions per minute (RPM) and milliseconds per revolution (MS).

Put a soft-sectored data disc into the drive you want to test. At the COMMAND prompt, press **6** and then **ENT.** The test Command title, SPINDLE SPEED CHECK, scrolls across the display and stops at the current RPM reading.



If you want a time reading, press **1** for speed in milliseconds.



MS = (60/RPM) × 1000

Use the **0** and **1** keys to toggle between the MS and RPM displays.

Press **ABT** to return to the COMMAND prompt.

The PAT–2+ reports two error messages for the Spindle Speed Check: **INVALID** and **NOT-RDY!** Table 11 provides explanations.

TABLE 11 ⊡ Error messages reported for Spindle Speed Check (Command 6) and Index Pulse Width Check (Command 7)

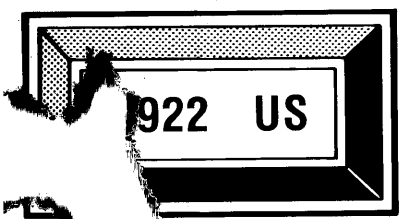
Message	Explanation
INVALID	You pressed the wrong key.
NOT-RDY!	(Not Ready) The cables are not connected properly; the drive select options are incorrect; or there is no disc in the drive.

⊡ Index Pulse Width Check (Command 7)

This test measures the width of the index pulse signal and displays the results in microseconds. Each time the disc rotates one full revolution, the drive sends a pulse signal to the tester. The PAT-2+ computes and displays an average of several readings. It continues to display readings until you press **ABT.**

Put a soft-sectored data disc into the drive you want to test. At the COMMAND prompt, press **7** and then **ENT.** The test Command title, INDEX PULSE WIDTH CHECK, scrolls across the display followed by the message BUSY. (When the tester is collecting and processing data, it reports "BUSY.")

The next display shows index pulse width in microseconds (US). The following is an *example* of *a possible* reading.



If the tester continues to display the message **"BUSY,"** it did not receive an index pulse from the drive. Either the drive select options are incorrect, or the drive is malfunctioning. Check that the drive's spindle is turning.

Press **ABT** to return to the COMMAND prompt.

The PAT–2+ reports one error message for the Index Pulse Width Check: **NOT-RDY!** Table 11 in this section of the manual provides an explanation.

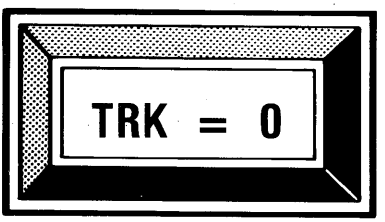
⊡ Index To Data Mark Check (Command 8)

The Index to Data Mark Check (for index timing) measures the time from the leading edge of the index pulse to the first sector ID mark on the DDD and displays it in microseconds. This test uses the DDD's Index Format Tracks. (See Appendix C, Table C-2 for track locations. Your DDD data sheet also provides this information.) The PAT–2+ computes and displays an average of several readings taken at each track.

Put your DDD into the drive you want to test. At the COMMAND prompt, press **8** and then **ENT.** The test Command title, INDEX TO DATA MARK CHECK, scrolls across the display.

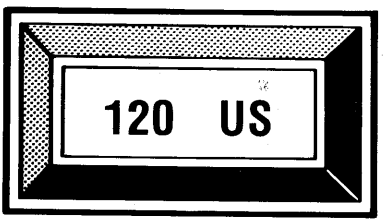
If you selected the side-toggling option with Command 2, use the **0** and **1** keys to test alternate sides of your drive. The display indicates which side you selected.

The first timing test is performed at track 0 (the outer DDD reference track). At the track number prompt:



Press **ENT** if the track number displayed is 0. Or, enter **0** and press **ENT.**

The PAT–2+ displays an average reading in microseconds (US). For example:



The index to data mark *typically* is set at 200 ±100 μs. Press **ENT** to select the next track.

When the tester displays: TRK = 0, enter the number for the inner Index Format Track (from Appendix C, Table C-2). For example, **TRK = 34.** Press **ENT** to display an average reading in microseconds. (For example, **137 US.**)

Press **ABT** to return to the COMMAND prompt.

Table 12 lists the error messages reported for the index timing test and provides a brief explanation for each.

TABLE 12 ⊡ Error messages reported for Index To Data Mark Check (Command 8) and Head Skew Check (Command 9)

Message	Explanation
ID-ERROR	The drive could not read the first sector ID mark. The index sensor may need adjustment. (Follow the drive manufacturer's instructions.)
INVALID	You entered a track number greater than 255.
NOT-RDY!	(Not Ready) The cables are not connected properly; the drive select options are incorrect; or there is no disc in the drive.
RD-ERROR	(Read Error). The tester could not read data from the track selected. Check that the track number is correct. Check that your setup parameters are correct.
EQ-DDD	(Requires DDD). Put the required DDD into the drive. Home the drive to track 0 by pressing TK0 at the COMMAND prompt. Check that the track number is correct.

d Skew Check (Command 9)

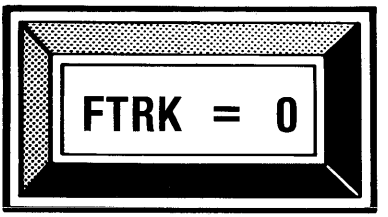
st measures the drive's ability to position the head alo radial path through the center of the disc. Head posit w is the difference in index timing between the outer and the inner Index Format Tracks on the DDD. (See Appendix C, Table C-2 for track locations. Your DDD data sheet also provides this information.)

The PAT–2+ reads index timing on both the outer DDD reference track (first track) and the inner reference track. It computes the difference between the two readings and displays the result in microseconds.

Put your DDD into the drive you want to test. At the COMMAND prompt, press **9** and then **ENT.** The test Command title, SKEW OF HEAD CHECK, scrolls across the display.

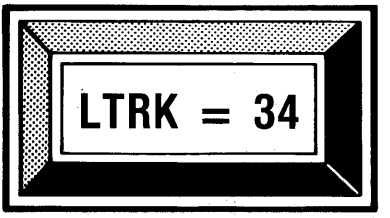
If you selected the side-toggling option with Command 2, use the **0** and **1** keys to test alternate sides of your drive. The display indicates which side you selected.

When the tester displays the prompt for first track:



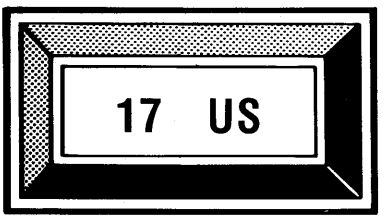
Press **ENT** if the track number displayed is 0. Or, enter **0** and press **ENT.**

When the tester displays the prompt for last track:



Press **ENT** if the track number displayed is valid, or enter the correct Index Format inner track number from Appendix C. Press **ENT.**

The tester displays the difference in index timing between the two tracks in microseconds (US).



(Indicates head positioner skew.)

Press **ABT** to return to the COMMAND prompt.

Table 12 lists the error messages reported for the head skew test and provides a brief explanation for each.

▣ Head Load Timing Test (Command 10)

This test measures the time from the beginning of head load (leading edge of index) until the tester reads valid sector ID.

The drive you are testing must have a head load solenoid. On 5¼ inch and 3½ inch drives, there must also be a separate head load line on Pin #4 of the interface. Drives must be jumpered correctly.

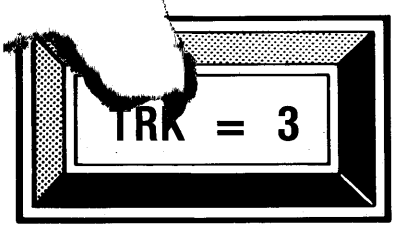
The PAT–2+ takes readings on the DDD's Timing Tracks (see Appendix C, Table C-3 for track locations) and displays the results in milliseconds. (Your DDD data sheet also provides track locations.)

Very short incorrect readings are possible because some two-sided drives may be able to read valid data without the head load solenoid energized. This occurs when the disc contacts Head 0 without the assistance of the pressure provided by head 1 and the head pressure pad.

Put the DDD into the drive. At the COMMAND prompt, enter the number **10** and press **ENT.** The test Command title, LOAD TIMING TEST, scrolls across the display.

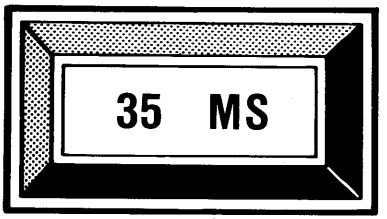
If you selected the side-toggling option with Command 2, press the 0 and 1 keys to test alternate sides of your drive. The display indicates which side you selected.

Then the tester displays the timing track prompt:



Press **ENT** if the track number displayed is valid or enter the correct Timing Track number from Appendix C.

Press **ENT** for the head load time in milliseconds (MS).



Press **ENT** to return to the TRK prompt.

To take a reading on the second Timing Trac
track number and press **ENT** for the time in mil

Press **ABT** to return to the COMMAND pro

Table 13 lists and explains the error messages repo
the Head Load Timing Test.

TABLE 13 ⊡ Error messages reported for Head Load Timing (Command 10)

Message	Explanation
INVALID	You entered an incorrect track number or you pressed the wrong key.
NO-TIME!	The drive could not read the DDD's timing track. Enter a valid track number and retry the test. If this message recurs, the drive may be damaged.
NOT-RDY!	(Not Ready) The cables are not connected properly; the drive select options are set, or there is no disc in the drive.

⊡ Radial Alignment Check (Command 11)

The test for radial (or head) alignment measures the drive's ability to position the read/write head on the track centerline. Accurate read/write head alignment ensures disc interchangeability between drives. The radial test also gives an indication of the head's read sensitivity (discussed later in this section).

The PAT–2+ uses the DDD to evaluate how well the drive can read misaligned data. The DDD contains several Progressive Offset Tracks written with track and sector ID information on the track centerline. Data fields are radially displaced from the track centerline both away from (–) and toward (+) the spindle. (See Appendix C, Table C-4 for track locations. Your DDD data sheet also provides this information.)

A properly aligned drive can read sectors that are equally offset in opposite directions [(–) and (+)]. Unsymmetrical [illegible]cate radial misalignment.

[illegible] radial alignment at several track locations [illegible] consistent alignment is across the surface of the [illegible]g errors in the drive positioner's linearity.

[illegible]ffset Values

[illegible]Test [illegible]ts are displayed as negative (–) and positive (+) radial offset values. These values indicate the number of milli-inches the head can read away from or toward the spindle. A [illegible]ive that returns symmetrical offset values (–10 +10, for example) shows optimal alignment. A drive that returns (for [illegible]ample) –7 +13, indicates an alignment problem. The head [illegible]n read data 7 milli-inches off the track centerline away from [illegible]e spindle and 13 milli-inches off track centerline toward the [illegible]indle. This indicates that the head is offset toward the [illegible]dle, and you should move it back. (See Appendix C, Table [illegible]r a range of offset values. Your DDD data sheet also [illegible] this information.)

[illegible]l Delta

[illegible]ifference between the negative and positive offset [illegible]rted is the Radial Delta. The Radial Delta shows the [illegible]and direction of read/write head displacement from [illegible]e. A delta of 6 indicates greater misalignment than [illegible]f 3.

A drive that shows a slight misalignment may be usable. It is up to you to determine the value of delta that indicates an alignment problem. Use of an Analog Alignment Diskette (AAD) and an oscilloscope is recommended for drive alignment operations. (See Section 7 of this manual.)

⊡ Read Sensitivity

In addition to reporting head alignment information, the radial test indicates the read sensitivity of the drive head. Read sensitivity affects the radial offset values reported. As a sector is further displaced from track centerline, the amount of signal under the head decreases.

For example (given two drives of the same manufacture and model number): If Drive A returns offset values of –11 +11 and Drive B returns –9 +9, both drives are properly (centered on track). But the drive that returns the is able to read data further off track centerline. T Drive A has a greater read sensitivity than Drive B

Several factors can influence read sensitivity.

- Normal wear on the DDD can reduce the signal (amplitude) it produces.
- Amplitude is normally lower on the inner explains why inner track readings may be lower than outer track readings.
- Amplitude is occasionally lower on side 1 as compared to side 0.
- The offset values returned can vary (by one or two dig from one DDD to another. The causes of variation are the unique interaction between a specific DDD and dr (head-to-disc compliance, for example); and manufacturing tolerances in DDDs.
- A build-up of dirt or oxide on the read/write head reduce the read signal. Manufacturing tolerances read/write head, as well as in the drive's read electronics, can have similar effects.
- The drive's location in the computer system ca significantly affect read sensitivity. A nearby C switching power supply can produce interferen read/write head. Often the result is *lower* o offset values, particularly on the inner track amplitudes generated from the disc are lo