well as normal ASCII text files. The public domain Xmodem file transfer protocol is provided. Xmodem allows file transfer with error detection and correction.

Files can be sent to other computers or sent from them to the Macintosh with the communications module. If you are receiving a file, you can read it directly into a Jazz worksheet, word processing document, or database file. A unique function of this file downloading is Jazz's capability to parse the data. This allows you to set user-defined characters in the file you're receiving to be interpreted by Jazz for special purposes, such as row and column separators in worksheets or field and record separators in databases.

The Jazz database manager will be instantly familiar to anyone who has used 1-2-3 or Symphony. It is the same kind of memory-resident, spreadsheet-style database, in which rows represent records and columns represent fields within the records. Each database may have up to 100 fields. The total number of records allowed is dependent upon free memory and the size of each field. For example, when we created a new database file (with no other windows open), Jazz handled the approximately 1,000 records composed of eight fields of varying lengths without a hitch.

To ease the process of data entry and reporting with the database, Lotus has included a forms function in Jazz. Forms provides a nifty way to enter, validate, access, and print out data. It also provides some limited query commands. Forms also takes advantage of the Macintosh's graphics, allowing you to vary the fonts, font sizes, and styles.

Although you can move data entry fields around on the form and resize them, don't expect to create your forms in a free-form, Macpaint style. We thought the forms function was straightforward, but it is more reminiscent of the IBM PC than of the Macintosh.

A complete query by criteria capability is provided in the database module. This works like the query feature in 1-2-3. You search through the database by specifying up to three criteria in a special window.

An automated report function is available from within the database manager module in addition to the word processing module's mail-merge capability. Reports can be printed easily in this manner after you've had some trial-and-error practice at report design and printing. The use of custom-printed forms is also supported.

The Jazz word processing module uses the Macwrite ruler method of setting margins, line spacing, line formatting, tabs, and decimal tabs. We never had to refer to the manual when using the word processor because of our experience using Macwrite. The usual commands for font, font size, and font style selection are available in the Jazz word processor, as are find and search commands. One nice feature of Jazz is the capability to set a zero left margin and handle text lines up to 15 inches wide so that extra-wide worksheets can be incorporated into memos.

The graphics that Jazz produces should be satisfactory for most business uses, and thanks to the Macintosh they are a distinct cut above 1-2-3's. You can plot scattergrams, bar charts, pie charts, percentage charts, line charts, and area charts. Within these graphs, you can select several styles. For example, you can plot overlapped bar charts, stacked bar charts, stock market charts, and exploded pie charts.

You can customize your graphs in several ways, including adding text annotations, legends, arrows, and other information or flipping the orientation of the axes (horizontal or vertical). Text is available in the usual variety of fonts, styles, and sizes.

Data for your graph is taken from an opened worksheet. The process of creating a graph is so simple and straightforward that you'll become annoyed at other programs that take more steps to do it. All you do is highlight the data to be graphed in your worksheet, open a graphics window, pull down the plot menu, and highlight the type of graph you want.

We were able to create graphs quickly, customize them, paste static and Hotview versions of them into documents for word processing, and print them using both an Imagewriter and a Laserwriter. Although Jazz doesn't have all the features of Microsoft Chart, its graphics more than make up for that with its ease of use, speed, and accessibility.

Jazz's program disk is packed to the limit and requires a separate start-up disk containing the Finder and system files, plus a small file containing error messages, leaving about 140K for data on this disk. Unlike 1-2-3 and Symphony, Jazz stores each of its module's files separately. The program begs to be used on a hard disk, despite its key disk copy protection scheme.

The printed documentation is a good effort. The program is supplied with a quick-reference guide, a primer, and a handbook (reference manual). Each of these is slickly produced on glossy paper and is spiral-bound. Each document is well-written and indexed, although we'd like to see more information on some of the modules.

On-line documentation, however, is another matter. There isn't any. Lotus obviously believes that the easy-to-use Macintosh interface obviates the need for on-line help. We disagree. This is a serious omission in an otherwise first-rate product.

Jazz does an excellent job of protecting you from your mistakes. Our best efforts to trip up the program were always handled properly, with error or warning messages displayed in dialog boxes. The printed documentation also supports troubleshooting for problems you might run across.

Lotus maintains a technical hot line. We found the phone line to be very useful and the staff competent and helpful. The number is often busy, however, and we were put on hold for uncomfortably long periods several of the times we called, which is expensive because the number is not toll free. Replacement program disks are also available to registered owners.

Jazz is a genuinely useful program and provides excellent integration of functions. It takes good advantage of the Mac's interface and graphics capability. Each of its modules is moderately powerful and should meet the needs of a number of owners of small businesses and middle managers in larger corporations. The price of $595 is a bit steep, but discounts are already available. Give Jazz a try. You may find it plays just the tune you were looking for. □

MASS STORAGE

Reliability Is Hard Disk Key

COMPARING THREE AT DRIVES SHOWS TWO THAT CAN TAKE IT AND ONE — SUPPLIED BY IBM — THAT CAN'T TAKE IT AT ALL

BY BERNIE ZILBERGELD
Review Board

With the introduction of its Personal Computer AT last year, IBM established a new standard of mass storage for microcomputers: fast-access hard disk drives of 20 megabytes (more or less). These disks cut access time from 30 to 70 milliseconds (compared to the IBM PC XT and compatibles), doing almost as much to speed up operations as the more powerful processor used in the AT.

But it didn't take long for problems to

Bernie Zilbergeld is a practicing psychologist, author of several psychology books, and an experienced microcomputer user.

COMPARATIVE SPEEDS OF HARD DISK DRIVES

	Load	Save
Miniscribe	12	32
Core	12	34
CMI	13	38
PC XT (hard disk)	36	91

Benchmarks loading and saving 214,000-byte Word Perfect file (65 single-spaced pages), in seconds.

surface. According to everyone but IBM, the hard disk drives supplied as standard in the AT are unreliable, destroying data and requiring many trips to service centers for reformatting and exchanges.

Without acknowledging that a problem exists, IBM has started manufacturing its own hard disk drives for the AT and contracted with another vendor, Seagate, for additional ones. Soon, the buyer of any Enhanced AT won't be sure whose hard disk is in the machine: IBM's, Seagate's, or Computer Memories Inc.'s (CMI) original model that IBM bought.

Meanwhile, word has gone out in magazines and in showrooms: Buy an unenhanced AT and add your own hard disk drive. A number of such disk drives have become available for those who choose this option. With the help of two technicians — Bob Hurley and Jon Gordon of Berkeley Computer Systems in Berkeley, California — we tested two of these alternative drives, one from Core International and one from Miniscribe, comparing them with the CMI drive in our AT. We wanted to review the drive manufactured by IBM, but the company consistently refused to allow *InfoWorld* to obtain a unit for review.

The three disks have a number of things in common. All can store about 20 megabytes of data, manufacturers' numbers to the contrary. All come complete and use the AT's disk controller card; no additional cards or accessories are needed to get them going. All come with a one-year warranty, a time limit you should look for when shopping for such equipment.

Because they are predominantly manufacturer-installed drives, the CMI and Miniscribe drive manuals do not give you instructions on installing the drives in your computer. This is not a problem for those buying the drive already installed, or if the dealer agrees to perform the installation. Others, however, will need help getting the drives into their computers. Once installed, you simply follow the instructions for AT setup in IBM's manual. Core International's drive comes in a kit designed to be installed by you, the only kit in the three drives tested. (The drive itself is made by Control Data, which has a long history in the hard disk business.)

We were skeptical of Core's three-page installation instruction guide (which is all the documentation Core provides), and sure

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REPORT CARD

CM-6426

	Poor	Fair	Good	Excellent
Performance	☑	☐	☐	☐
Documentation	☐	☑	☐	☐
Ease of Use	☐	☐	☑	☐
Setup	☐	☑	☐	☐
Serviceability	☑	☐	☐	☐

SUMMARY

CMI's CM-6426 hard disk drive, which has been supplied as original equipment on the IBM PC AT, proved an unreliable unit in our tests. Even normal office jostling can lead to drive failures, and such failures on this drive can be quite damaging to data. We do not recommend its use.

PRODUCT DETAILS

List price, $1,595. Unit tested is internally installed in IBM PC AT and other computers. Provides 21 megabytes of hard disk storage. Manufactured by Computer Memories Inc., 9216 Eton Ave., Chatsworth, CA 91311; (818) 709-6445.

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REPORT CARD

AT PLUS 20

	Poor	Fair	Good	Excellent
Performance	☐	☐	☐	☑
Documentation	☐	☐	☑	☐
Ease of Use	☐	☐	☑	☐
Setup	☐	☐	☑	☐
Serviceability	☐	☐	☑	☐

SUMMARY

Core's AT Plus 20 hard disk drive is built like a Sherman tank, offering exceptional performance and reliability. Even novices should be able to install the kit, and technical support is good. It is more expensive than the other satisfactory unit tested.

PRODUCT DETAILS

List price, $1,595. Unit tested is internally installed in IBM PC AT and other computers. Provides 21 megabytes of hard disk storage. Manufactured by Control Data Corp., distributed by Core International Inc., 542 S.E. Fifth Ave., Delray Beach, FL 33444; (305) 276-3929.

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REPORT CARD

MINISCRIBE 6032

	Poor	Fair	Good	Excellent
Performance	☐	☐	☐	☑
Documentation	☐	☑	☐	☐
Ease of Use	☐	☐	☑	☐
Setup	☐	☑	☐	☐
Serviceability	☐	☐	☑	☐

SUMMARY

Reliable and fast, the Miniscribe 6032 can easily withstand normal office abuse without damage to data. The manual is overly technical and does not give the average user enough installation information. Company support is good, though, and the price is reasonable.

PRODUCT DETAILS

List price, $1,165. Unit tested is internally installed in IBM PC AT and other computers. Provides 21 megabytes of hard disk storage. Manufactured by Miniscribe Corp., 1861 Lefthand Circle, Longmont, CO 80501; (303) 651-6000.

enough, a few things weren't clear. For instance, there was nothing to indicate which end was the front of the drive, and it was unclear where to find the "locating key" on the cables. Nonetheless, a novice user installed the disk correctly in 30 minutes with no prompting. More technically minded users may feel slighted, however, by not having more information on how the drive is built and operates. The CMI and Miniscribe manuals provide an abundance of technical information, more than most users will need.

Just as most internal hard disks are not meant to be installed by their buyers, neither are they intended to be repaired by buyers. In fact, you will void the warranty on all of the units we tested if you open the casing. If problems develop, the drive must be returned to the company from which you purchased the drive. If you buy the Core kit directly from Core, you can get technical assistance by phone; if that doesn't suffice, the drive has to be shipped back to the manufacturer in Florida at your expense. It will be returned prepaid. Because most CMI and Miniscribe drives as well as some of the Core drives will be bought from dealers, the quality of service that can be expected will vary greatly.

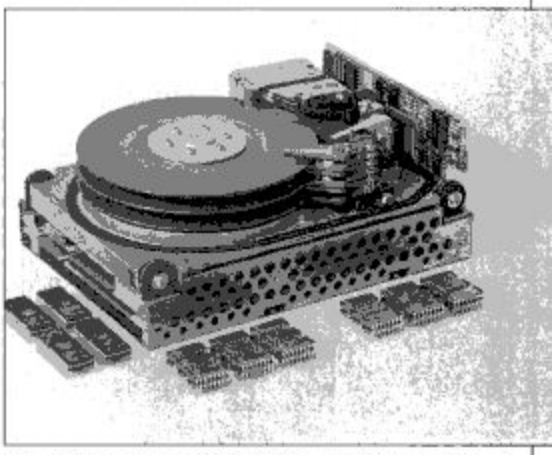
Because all three drives were developed with PC-DOS and the AT in mind, and because the AT was designed to accept a variety of hard disk drives, there are none of the compatibility problems that plague hard disk drives for the Macintosh. There were no problems using PC-DOS 3.0 or any of the software we ran with any of the three units. Although we did not test exact power consumption, the AT's power supply was not overtaxed by any of the drives. All of the disks are fairly quiet in normal operation; unfortunately, not all of them stayed that way.

There is one more thing these products have in common: Phone calls to a number of dealers and distributors indicate that all can be had at substantial discounts, so shop around (being mindful, of course, of the service issues we mentioned earlier).

So much for the similarities among these disk drives. The differences — in technology, speed, and, most strikingly, in reliability — are more important. Our conclusion is that two of the units we tested are solid products; one, the CMI unit, shouldn't be on the market in its present state.

Because speed is an important consideration for AT users, we did a number of tests to determine how fast the disks operate in actual use. To a large extent, the speed of a drive is dependent on the type of tests used to judge it, but we ran enough tests to be able to conclude that both of the newer drives are faster than the CMI.

Speed is not the only important characteristic of a drive, though. Reliability is at least of equal importance, and a factor often not tested. However, as the problems with the CMI drive illustrate, even the fastest drive in the world won't do you much good if it eats up data and has frequent breakdowns. Hard disks are especially vulnerable because their read/write heads (usually four of them on 20-megabyte drives) fly a few millionths of an inch above the disk platter, which is spinning at 3,600 revolutions per minute. This is comparable to a Boeing 747 flying across the country just six feet off the ground: Get just a little closer, and disaster will strike. In the case of the hard disk drive, if the heads touch a portion of the spinning drive, they will destroy the data on that particular sector. Worse yet, you will experience a so-called head crash, which destroys everything on the disk and perhaps even the disk and heads themselves. Even when the disk is not in motion, a touch of the heads can mean lost data.



Drive laid bare: Core's IBM PC AT-compatible hard disk unit uses three platters to store 21 megabytes of information.

Because the chances of the heads touching the platters are especially great when the computer is turned off and on and when the computer is jostled, we used several tests to determine how rugged these products are. One operation that poses the most potential problem for the heads contacting the surface at the wrong time is turning the disk drive on or off. We devised a gadget that turned each drive on and off every few minutes, for a total of 3,500 stops and starts per drive. All three disks survived this test equally well with no bad bytes created and no data lost. We did not jar the drives during this operation, so this is strictly a test of the units' head control mechanisms.

The jostling of computers is very common, however. Someone need only bump into a desk, drop a book onto a desk, or hit the table when sitting down or getting up to jostle the computer enough to disturb a hard disk drive. There are also, of course, harder jolts, such as when a computer is lifted off the table and then dropped, perhaps after searching for a pencil that rolled under it, or when the whole table is moved.

We subjected each disk to five levels of bumps while it was running a seek test: 1) bumping the table it was on; 2) dropping one side of the table from a height of six inches; 3) dropping the entire table from a height of one foot; 4) bumping the table after stopping the drive in the middle of a seek test (to determine whether parking the drive heads made any difference); and 5) dropping a heavy book directly onto the drive. Each test was repeated several times. ***We caution you not to attempt these tests on your own equipment.*** These trials were done to test the limits of these disks and could cause damage to your units.

The CMI drive is sold mainly to original equipment manufacturers and others who buy in large quantities. However, we found some dealers willing to sell the disk drive alone for installation into an unenhanced AT.

CMI's heads are controlled by a stepper motor, the technology that has been employed in almost all hard disk drives for microcomputers until very recently. Like most of the drives using stepper motors, the CMI drive does not automatically park and lock the heads when the system is shut off or loses power. You must use an operating system utility to perform this necessary task, and a power loss could result in trouble, with heads contacting the platter surface.

The CMI manual warns that the warranty may be voided if you do not park the heads just before you turn off the disk drive. Interestingly, the IBM PC AT manual does not mention this, saying only that the heads should be parked before you move the computer.

The CMI drive is no slowpoke compared to the drive on the IBM XT, but it was consistently the slowest of the three drives tested. This is due in large part to the use of the highly mechanical stepper motor technology; the other two drives use voice-coil technology, an electronic method of moving heads that is more efficient. Clearly, CMI is pushing stepper technology to its limit. Whether or not the speed differences between the CMI drive and the other two drives is significant is something only you

can determine. However, as the speed table illustrates, there is a world of difference between any of the AT drives and those of the XT: The AT drives are almost three times faster.

Reliability, however, is a huge problem with the CMI drive. It was the only unit that failed every bump test, destroying data and developing bad bytes with even the gentlest of the tests. Because the jostling of test 1 is fairly common in offices, the chances of your losing data with the CMI drive are good with only normal, regular use, precisely the problem reported by many AT users.

During test 2, the CMI disk came close to self-destruction. It developed more than a million bad bytes, rendering more than 5 percent of the disk unusable. All information on the disk was lost because one of the damaged sectors contained the map the disk keeps of the location of data, meaning we could not use it to locate files. After several hours of careful reformatting, we established a new map and were able to use the rest of the disk as if it were blank; the old information was lost. This drive, as quiet as the others to begin with, became noisier as a result of our tests.

The CMI drive lost data and developed bad bytes consistently when we bumped it after shutting off the computer (test 4). Because the other two drives survived this test unscathed, we attribute some of the CMI's troubles to the fact that its heads were not parked and locked. If you do use this drive, diligence in parking and locking will probably help avoid some troubles.

Test 5 was the death knell for the CMI drive. Dropping an IBM manual directly on the drive resulted in an irreparable head crash. Although it is true that most drives are not subjected to such abuse, it is significant that the other two units were not affected at all by the same procedure. And, in the event you install the CMI yourself, you could conceivably drop it to the floor during the procedure, yielding the same result as dropping a book on it.

We judge the CMI to be an unreliable product because it failed every bump test. We were also greatly disappointed with CMI's customer response. We twice called the company to ask questions and had the technicians helping us call as dealers instead of users. Although we were told in each case that our calls would be returned, we are still waiting. The combination of these two factors prevents us from recommending the CMI hard disk at all.

There is much better news to report with regard to the other two disk drives. The Core and the Miniscribe drives both boast two features not found on the CMI product: voice-coil technology and automatic head parking and locking (meaning that there is no need to run a park utility when

you turn off or move the computer).

The Core disk is preformatted, so partitioning the disk for use took little time. All told, the disk drive was installed and ready to go in less than 50 minutes, significantly faster than the other disks. There were also no bad bytes or sectors on our test disk when we started it up for the first time, a highly unusual condition for any hard disk drive.

In speed tests, the Core unit was slightly slower than the Miniscribe but faster than the CMI. The speed of the Core and Miniscribe disks is quite impressive. Disk-intensive operations that used to make users sit back and fume are now finished before the fuming begins.

Core's product has to be considered the Sherman tank of hard disk drives. It comes with a heavy metal plate on the bottom, something you don't normally find on hard disk drives. And whether it is because of the metal plate or something else, this disk drive seems virtually indestructible. It survived all of our bump tests but one completely intact. The drive did lock up after considerable punishment — the third running of test 3 — far more punishment than would be expected in a typical environment. But the damage was only temporary. A few pulls and pushes on the park-lock mechanism, followed by reformatting, restored the drive to working order. We did lose all the information on the drive when it failed test 3, but after reformatting there wasn't a bad byte on the disk.

We called Core's technical support several times and our questions were answered quickly and accurately. The calls were not toll free. (None of the three manufacturers offers a toll-free hot line.)

Miniscribe sells mainly to original equipment manufacturers, but individual drives can be bought from a number of dealers, a list of which can be had with a phone call to Miniscribe. Although Miniscribe's manual claims the disk has 26 megabytes after formatting, this is a misleading figure as far as the AT goes. The disk is set up in such a way that the AT's controller card can use only about 82 percent of it, about 21 megabytes. (For all practical purposes, this is equivalent to the actual storage capacities of the other two disk drives we tested.)

The Miniscribe drive does not install as easily as the Core unit. The manual, although very technical, lacks the practical information you need. Even our technicians couldn't install it without calling the manufacturer. Our calls were greeted with prompt, accurate advice, however, enabling us to continue. To save you a phone call to Miniscribe, we will tell you that you need to answer "10" when the diagnostic disk setup option asks for drive type.

Miniscribe's specifications claim a much faster access speed than Core's and CMI's, and in actual use it was faster than the Core. Ironically, the Miniscribe performed best, clearly outdistancing the Core on the speed tests that come with a disk in the Core kit.

The Miniscribe did much better than CMI on the jostling tests, but not quite as well as the Sherman tank Core. It started shrieking during the more punishing of the tests and both locked up and lost data earlier than the Core (during the second try at test 3). We were able to unlock it and reformat it and found that no permanent bad bytes had been created in the process. The drive was as good as new after reformatting, except that it operated a little more noisily.

The CMI is very fast for a drive that uses stepper motor technology, but our tests confirm that there is something seriously amiss with it. IBM and CMI can say what they will, but it is clear this product cannot operate properly in an ordinary office environment.

By contrast, both the Core and Miniscribe drives are very quick and very dependable. Because the Miniscribe costs several hundred dollars less than the Core, we recommend it over the Core for most consumers. But we think you can't go wrong with either of these drives. □