PREP version 4 Documentation

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Z-DOS v4 PREP

PREP Version 4 is a DOS hard drive preparation utility that initializes a Z-217 MFM hard drive. It is the first piece of software that must be run on an MFM hard drive in order to make it usable by other software.

PREP's functions include:

- Determining type of hard drive installed
- Testing the data retention capabilities of the hard disk media
- Isolating questionable disk sectors. If the /I or /Q switch is specified, a fresh Bad Sector Table is begun.
- Performing low-level format on the drive
- Writing out the default tables and the Software Boot Code (SBC)
- Dividing the hard drive's disk into partitions (maximum size allowed by DOS)

Note: PREP v4 requires Z-DOS v4.6 and MTR-ROM v4.3 or later.

The PREP utility prepares the magnetic surface of many different sizes of MFM encoded hard drives for use as mass storage devices in a Z-100 environment. The PREP utility is seldom needed, except:

* If a hard drive is newly installed. A drive used previously in an IBM-PC environment will require PREPping before use.

* If the disk begins to consistently have an unreasonable number of disk access errors that the use of the VERIFY utility cannot correct.

Although the hard drive will be prepared using the Z-DOS version 4 utilities, you can boot up any properly installed operating system from it, just as you would with any other bootable disk.

CAUTION: The use of PREP has the potential of destroying all software and/or data stored on your hard drive. Please read the following procedures very carefully and DO NOT USE PREP until you have transferred or backed up any critical disk files to floppy disks.
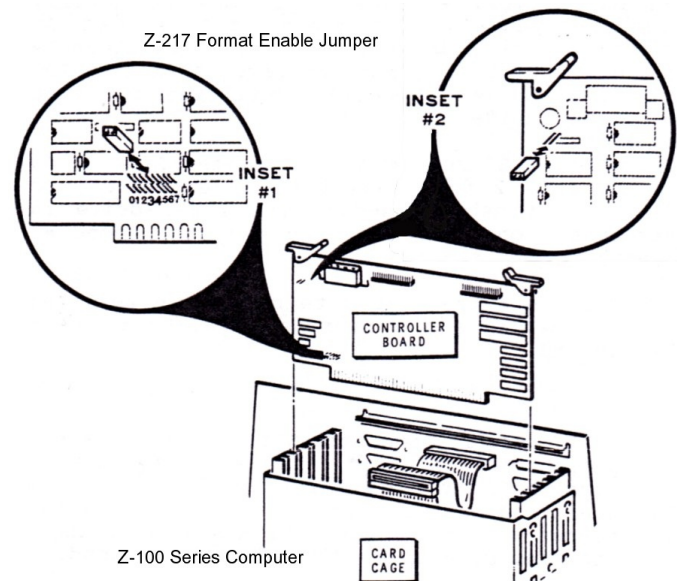

Figure 1.
Z-217 Format Enable Plug

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Note: Before you use the PREP utility, a hardware "jumper" must be installed at the "FORMAT ENABLE" location in the upper left corner, just under the power cable connection, on the Z-217 Winchester Disk Controller Board. This jumper is stored, when not in use, between pins 3 and 4 in the top row of a double row of pins at the bottom left of the board.

WARNING: Unplug your computer from its power source before touching any hardware component within the computer's cabinet.

Recent Changes to PREP

One of the biggest changes to this version of PREP is the attempt to make previously unusable drives usable. With earlier versions of PREP, any bad sector below the first user partition caused the drive to be considered "unusable". I'm sure all of us are probably familiar with the "Track 0 contains bad sectors" message turning many a hard drive into boat anchors.

 + The Software Boot Code (SBC) is now loaded into the first three consecutive sectors found without errors. During a boot operation, the new MTR-ROM v4.3 searches the entire first two tracks of the hard drive for the SBC.

While PREP must find three consecutive sectors on the first two tracks for the disk to be bootable, if PREP cannot locate three sectors without errors, all is not lost. The first sector of the SBC is the most critical because it provides the pointers to the partition tables and the bad sector tables. Therefore, we make as many copies of this first sector of the SBC as we can below the first user partition.

As long as one of the copies of this first sector of the SBC can be read by ASGNPART version 4, the disk will still be accessible for use. This should keep a drive usable, even if the original location for the SBC becomes corrupted or unreadable.

There are still two copies of the partition and bad sector tables pointed to by the SBC. They will normally be located one on each of the first two tracks of the drive. The first user partition will start at the first good sector following the 2nd BST.

 + The user data and partitions are not destroyed with the /P switch, which updates, non-destructively, old drives with new "PC" style Software Boot Code. All previous data is retained unchanged.

 + Every attempt is made to fit the Software Boot Code, Partition Tables and Bad Sector Tables below the first user partition. A minimum of two good sectors are required, one for the Software Boot Code and one for the Partition Table. Although the drive would not be bootable in this configuration, it would be usable without doing a full PREP.

 + PREP now has a new Volume Label function to assign a 31 byte label to each hard drive. Presently used and displayed by ASGNPART, PART, and ZIMAGE utilities, a label, such as "10mb Miniscribe sn12345", would help you store each drive's critical data from ZIMAGE.

A future utility is planned that may potentially help repair a bad hard drive by restoring the critical software boot code, partition table and bad sector table information saved by ZIMAGE.

 + When a full PREP is done, the user can request the number of "passes" or tests for bad sector detection.

   * If 0 tests are requested, no testing is done on the media.

   * If 1-7 tests are requested, there will also be a final check for the 0E5h bit pattern generated from the Format Drive command, except when a 317 SCSI controller is detected. Additionally, all sectors below the first user partition are tested even with the /P switch. If bad sectors are located, they are added to the bad sector table, and not used for storing the Software Boot Code, Partition Tables, and the Bad Sector Tables.

During PREP, if the bad sector table fills up, you will receive an error that states the bad sector count has been exceeded. While older versions of PREP would stop on this error, this version of PREP will continue. Additional bad sectors are just not recorded. To identify and lock out ALL the bad sectors, run FORMAT with the /V switch.

If an error occurs during the Format Drive command, PREP tries to finish formatting the drive "track by track" with the Format Track command, again hopefully making a previously unusable drive usable.

 + With PREP v4 the physical size of the hard drive is no longer limited to 32Mb (or 64Mb with the /K switch). For example, an 80Mb drive would be automatically divided into two 32Mb partitions and a 16Mb partition. Also, under Z-DOS v4 only, partition sizes are no longer limited to 32Mb or 64Mb. With the /O switch, an 80Mb drive could have an 80Mb partition. However, that partition could NOT be used with other operating systems.

 + It is no longer necessary to reboot after using the PREP v4 utility. However, at the earliest normal shutdown opportunity, protect the hard drive from accidental erasure by returning the "FORMAT ENABLE" jumper to its storage location.

MFM Hard Drive Features

Hard drives, often called "Winchester Disks", come in a variety of configurations and sizes. The central feature of a hard drive is a rigid platter, consisting of a non-magnetic metal (generally aluminum) disk, coated with a thin plating of ferric oxide or cobalt. This differs from the floppy disk, which has a plastic (usually mylar) core with a thin coating of a similar magnetic substrate.

Hard drive platters are generally sealed to prevent particulate matter (such as dust, smoke, dirt, or hair) from contaminating a platter's surface or interfering with the read/write head (a head crash).

Hard disks can be either "fixed" or "removable".

The read/write heads are electromagnets that slide back and forth a fraction of an inch above the surface of hard drive disk platters. The movement of a hard drive's read/ write heads between the hub of the platters and the edge of the platters is called "stepping". Thus, this movement is measured by an amount known as the "step rate".

Heath/Zenith hard drives can be divided into as many as 16 logical subunits called "partitions". This makes large quantities of storage locations easier to deal with and speeds the storage and retrieval of data.

A "sector" is the basic unit of data organization for disk drive devices. Like floppy disks, hard drive disks are divided into sectors. The hard disk sectors are normally 512 bytes long on smaller drives, such as 10 or 20Mb drives, and 1024 on larger drives, 32Mb and above.

Each recording surface of a hard drive's disk platter is also divided into concentric rings called "tracks", which are similar to the tracks of a floppy disk. The hard disks initialized by PREP are formatted with 18 sectors per track.

A further division of a hard disk's storage area is the cylinder. A "cylinder" is a collection of all tracks that are located the same distance from the outer edge of each recording surface. The hard drive's read/write heads can access all of the data stored on a particular cylinder without any stepping movement.

For example, if a hard drive has four read/write heads, the drive can access a cylinder of 72 sectors (4 tracks times 18 sectors) without stepping (moving the heads). This amounts to a total of 36,864 bytes (36 kilobytes) being read or written.

Finally, hard drives are available in numerous encoding formats determined by the drive's hardware - MFM, RLL, SCSI, IDE, and more. The Z-100's Z-217 Winchester Disk Controller Board only uses MFM encoded hard drives.

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*The **PREP** utility helps you to:*

   * *initialize surface of Winchester drive*
   * *test data retention capabilities of Winchester drive media*
   * *isolate questionable drive sectors*
   * *divide the Winchester drive into partitions (maximum size allowed by DOS)*

PREP may prompt you to specify six Winchester drive characteristics
in order to identify the type of Winchester drive you have installed.
                Usage: [d:\][pathname\]PREP [?][/x]
Where:
   d:\   - Is the optional drive with transient command file.
   pathname\   - Is the optional path to transient command file.
   ?   - Prints this message.
   /x   - Is any combination of the following switches:
       /Ca   - Specifies Z217 controller card "A" or "B".
       /I   - INIT the Bad Sector Table to Zero.
       /K   - Forces 1024 byte sector size instead of 512.
       /L   - Force Winchester Volume Label Prompt.
       /O   - Force ONE large partition instead of multiple smaller ones.
       /P   - Updates old drives with new "PC" style Software Boot Code.
       /Q   - Forces the prompt for 6 physical drive characteristics.
       /Tn   - Specifies number of bad sector tests to perform (0-7).
       /Un   - Specifies UNIT number of the drive (0-3).

Figure 2
PREP HELP SCREEN

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PREP Version 4 Operation

1 Invoking PREP Help

PREP v4, as with most Z-DOS v4 utilities, has a help screen that can be invoked by typing either of the following commands:

>   **PREP ?**
>   **PREP /?**

This displays the help screen of Figure 2.

Note: As you may recall, earlier versions of PREP only had the /K and /Q switches.

Let's look closer at each of the switches:

/Ca   Controller Card - specifies Z-217 controller card "A" or "B". Unlike the Z-207 Floppy Disk Controller Card which has jumpers that can change the card's address, the Z-217 Winchester Controller Card's address can only be changed by the firmware in a PROM on the card. Nevertheless, PREP has the capability to recognize a second card if someone ever goes through the trouble to program one.

/I   Init BST - allows initializing the Bad Sector Table to Zero, without using the /Q switch and responding to all those questions.

/K   Kilobyte - causes PREP to format the hard disk with 1024-byte sectors rather than 512-byte sectors. This permits using 64Mb partitions instead of 32Mb. Also, Z-DOS v4 no longer has a 32 or 64Mb limit.

CAUTION: Do not specify the /K (Kilobyte) switch if you intend to are still using the Z-DOS v1 operating system, which only supported the 512-byte sector, or if you intend to install another operating system, such as CP/M.

There are some restrictions on using the /K switch with the Gemini PC-emulator card. If the hard drive is PREPed WITHOUT the /K switch, ASGNPART now supports accessing the GEMINI Boot partition from the Z-100 side in Z-100 native mode or ZPC PC mode.

/L   Label - forces Winchester Volume Label Prompt. As PREP will not request a label if one already exists, you must use this switch to change an existing label.

This function was added to be able to provide a 31 byte volume label to each hard drive. Presently used and displayed by ASGNPART, PART, and ZIMAGE utilities, a label, such as "10mb Miniscribe SN12345", would help you store each drive's data from ZIMAGE. A future utility is planned that may potentially help repair a bad hard drive by restoring the drive information saved by ZIMAGE.

/O   One Partition - forces ONE large partition instead of defaulting to 32Mb or 64Mb partition sizes. On drives smaller than 32Mb, PREP only creates one partition labeled "PART1".

Z-DOS v4 has eliminated the DOS partition size limit. Using the /O switch, you could have a single 80Mb partition on an 80Mb drive. However, it would not be usable with older operating systems.

/P   PC Boot Code - non-destructively updates old drives with new "PC" style Software Boot Code. All previous data is retained unchanged. The full PREP recommended by earlier DOS v4 software is NO longer necessary.

Note: While the user data and partitions are not destroyed with the /P switch, every attempt is made to fit the Software Boot Code, Partition Tables and Bad Sector Tables below the first user partition. A minimum of two good sectors are required, one for the Software Boot Code and one for the partition table. Although the drive would not be bootable in this configuration, it would be accessible by ASGNPART and usable without doing a full PREP.

Note: Since PREP /P will relocate the Software Boot Code, Partition Tables, and Bad Sector Tables to "usable" sectors, this switch may also be used to correct a suspected defect in the Software Boot Code and/or tables.

/Q   Query - caused PREP to prompt for disk parameters regardless of whether they have been previously specified. (Normally, PREP prompts for the hard drive's parameters only if PREP has never been used on the drive before or if an error is found in the reserved area of a previously PREPped disk.) Also, this switch initializes the Bad Sector Table.

If you specify the /Q switch, PREP will prompt you to specify the following six hard drive characteristics in order to identify the type of hard drive you have installed:

  - Number of Read/Write Heads
  - Number of Cylinders
  - Reduced Write Current Cylinder
  - Pre-compensation Cylinder
  - Step Rate
  - Parking Cylinder Number

/Tn   Tests - specifies number (0-7) of different bad sector test sequences to perform:

  * If 0 tests are requested, no testing is done on the media.
  * If 1-7 tests are requested, there will also be a final check for the 0E5h bit pattern generated from the Format Drive command, except when a 317 SCSI controller is detected. Additionally, all sectors below the first user partition are tested even with the /P switch. If bad sectors are located, they are added to the bad sector table, and not used for storing the Software Boot Code, Partition Tables, and the Bad Sector Tables.

/Un   Unit - specifies the UNIT number (0-3) of the drive. If not used, the program will question the operator for the device unit number.

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2 Invoking PREP

Invoke PREP by entering the following command at the Z-DOS system prompt:

PREP [/x] {RETURN}

Where /x is one of the optional switches discussed earlier.

When you invoke PREP, the following display appears:

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            PREP version 4.06
Copyright(C) 1984, Zenith Data Systems Corporation

     Type "PREP ?" for switch definitions.

CAUTION: Using PREP will destroy all files on your
Winchester drive. Do not use PREP until you have
transferred your files to floppy disks.

Do you wish to proceed with PREP (Y/N)? _

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Pressing an {N} at this prompt ends the PREP utility and returns you to the system prompt.

Pressing a {Y} causes PREP to display the following prompt:

Input Winchester Volume Label > _

The Volume Label is optional but is requested whenever PREP finds that the drive does not have an existing label. Pressing {RETURN} displays the following prompt:

Last Chance to ABORT. Type "P" to proceed.. _

Pressing any response other than {P} ends the PREP utility and returns you to the system prompt.

Note: If PREP is invoked with the /P switch, which is non-destructive, the display above is not used. Instead, PREP will display the following sequence of statements:

Winchester drive unit number (0-3): _
Input Winchester Volume Label > _
Update successful. You need to run ASGNPART
* to gain access to the drive.*

3 Responding to Disk Characteristic Prompts

If you had used the /Q switch, the Disk Characteristic prompts are requested before asking if you wish to proceed. If you had not used the /Q switch or /Un switch, pressing {P} at the "Please type P to proceed" prompt causes PREP to query:

Winchester drive unit number (0-3): _

Responding with a number from 0-3, with 0 representing the first drive, causes PREP to begin its operation.

If the disk has been previously prepared by PREP and no errors are found in the first sector of the boot code (see "5 The Reserved Winchester Area"), PREP skips these disk characteristic prompts, assumes the disk surface has been previously initialized, and proceeds immediately to disk initialization (see "4.1 Initializing the Disk").

If the disk has not been prepared with PREP, if there is an error found in the first sector of the boot code, or if you had invoked PREP with the /Q switch, then the following six disk characteristic prompts will appear in sequence:

Enter number of heads in hex:
Enter number of cylinders in hex:
Enter reduced write cylinder in hex:
Enter pre-comp cylinder in hex:
Enter step rate code in hex:
Enter parking cylinder number in hex:

Note that the numbers needed to respond to these questions are in hexadecimal. In other PREP-like programs, they may need to be given in decimal.

The significance of each of these disk characteristic prompts is:

Enter number of heads in hex:

Type the number of read/write heads contained in the drive you are preparing and press {RETURN}.

Enter number of cylinders in hex:

Type the hexadecimal value of the number of cylinders contained in the device you are preparing and press {RETURN}.

For disks with floating read/write heads, this number would be equal to the total number of tracks divided by the total number of read/write heads. For disks with fixed read/write heads, this number would be equal to the total number of tracks divided by the total number of usable platter surfaces.

Enter reduced write current cylinder in hex:

Type the hexadecimal value for the location of the first cylinder at which read/write head current must be reduced and press {RETURN}.

Toward the hub of the platters, where the circumference of each cylinder is smaller, data storage sectors are recorded closer together than the sectors on cylinders near the edge of the platters. Therefore, some hard drives reduce the electrical current sent to the read/write heads when they write data on cylinders that are close to the hub of the disk platters.

This reduction of current reduces the probability of magnetic interference between the data sectors that are recorded extremely close together.

Enter pre-comp cylinder in hex:

Enter the hexadecimal value for the number of the first cylinder at which pre-compensation must take place and press {RETURN}.

On the cylinders located close to the hub of a hard disk, where data is recorded at extremely high density, bit shift can occur. "Bit shift" is a phenomenon where the data bits written at a particular location spread apart slightly on the media after they have been written. Bit shift is most likely to occur when similar bits are written close together.

The "pre-comp" (write pre-compensation) characteristic compensates for bit shift by writing some bits earlier or later than the normal rate of data writing. Pre-compensation for hard disks causes a slight deviation (about 12 nanoseconds for every 100 nanoseconds) from the normal rate of data writing during the writing of bits that are apt to shift.

> *Enter step rate code in hex:*

Enter the hexadecimal value code that indicates the rate at which the read/write heads step between tracks and press {RETURN}.

> *Enter parking cylinder number in hex:*

Enter the hexadecimal value code that indicates the cylinder at which you want the read/write heads parked when the SHIP utility is run. If the manufacturer of your hard drive does not specify a parking cylinder, enter the maximum allowable cylinder number for your unit at this prompt.

After pressing {RETURN} to the "parking cylinder number" prompt, PREP will automatically begin to perform its three operations (see "4 PREP Operations") in sequence.

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Table 4. Common Hard Drives and Parameters

The PREP utility is capable of preparing a wide variety of hard drives for data storage.

Table 4 (provided at the end of this article) lists several different hard drives and indicates the hexadecimal values you should enter, in sequence, to prepare each disk when prompted by PREP for a specific disk characteristic.

The labels for the columns of numbers in Table 4 correspond to the PREP character- istic prompts. If the model number of your hard drive is listed in the left-hand column of the table, then enter the numbers listed in the right-hand columns in sequence as the characteristic prompts are displayed.

The first row for each hard drive lists the values in Hex. The second row provides the corresponding Decimal amount, if needed for other purposes.

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4 PREP Operations

PREP begins to prepare the surface of your hard drive disk either after displaying the initial screen messages or after you respond to the six disk characteristic prompts. PREP prepares the disk by performing three operations in sequence:

  * Initializing the Disk (low-level format)
  * Testing the Disk Media
  * Initializing the Reserved Winchester
    Area

4.1 Initializing the Disk

After you have responded to the disk character- istic prompts, PREP initializes the surface of the disk for the test that will follow. While this occurs, you will see the message:

> *Formatting DRIVE...*

This initialization is similar to FORMAT in that it magnetically records a map of all sectors on the disk surface. PREP normally formats the hard drive disk with 512-byte sectors. This format is compatible with all operating systems supported by Zenith Data Systems.

Note that the size of the hard drive is no longer limited to 32Mb. PREP will automatically divide a larger drive into 32Mb partitions.

If the /K switch was specified when PREP was invoked, PREP will format the disk with 1024-byte sectors. This allows you to divide a hard drive into 64Mb partitions. Note, however, that the larger sector format is NOT supported by Z-DOS v1 and other early operating systems.

Note: If an error occurs during the Format operation, PREP tries to finish formatting the drive "track by track" with the Format Track command. This was another attempt to make a previously unusable drive usable.

When the surface has been initialized, the message shows:

> *Formatting DRIVE...completed*

and then PREP begins testing the disk media.

Note: If your hard drive hardware has not been properly adjusted, the following message will be displayed instead of the "Formatting DRIVE..." message:

> *Error during formatting of the drive.*
> *Check format enable jumper.*

The error message will be followed by the system prompt. If this message appears, you must now perform a hardware adjustment as explained in the text entitled "6 PREP Hardware Adjustments".

4.2 Testing the Disk Media

When PREP is run, two kinds of error checks are made:

- **Hardware**: The Z-217 controller board checks the CRC of each sector on the hard drive during each read operation. When errors are caught by hardware, the bad sector number is displayed in regular video.

- **Software**: PREP performs up to seven test passes to check the integrity of the disk's storage capacity. The tests are made on a sector-by-sector basis. During each test pass, PREP writes a predetermined code to each sector (the drive light will flicker) and then reads back that code to verify that it remained correct (the drive light will appear constantly on). If the error is discovered because the predetermined code will not verify, then the bad sector number is displayed in reverse video.

PREP keeps you informed of its progress by displaying the message:

Media test in progress, pass n Writing CYLINDER xxx(xxxh)

Where n is the number (in the range 1-7) of the pass that it is currently conducting and the xxx represents the decimal(hexadecimal) value of the cylinder being tested.

During the reading of data, the message becomes:

Media test in progress, pass n Writing CYLINDER Reading CYLINDER xxx(xxxh)

PREP uses a different code on each pass it makes through the test. If PREP finds sectors containing unusable media, it stores the address of these sectors, and later places these sector addresses into a Bad Sector Table.

Be patient. At 5 MHz, this PREP operation will take about 15 minutes per 10Mb of disk capacity for EACH pass performed.

4.3 Initializing the Reseved Winchester Area

After completing the media tests, PREP records and verifies the Reserved Winchester Area (RWA) (see "5 The Reserved Winchester Area") on the first several sectors of the hard disk found to be error free. During this operation, PREP displays the following message:

Formatting DRIVE...

When PREP adds the word completed to the end of this display, it begins a recheck of the final format, with the display:

Formatting DRIVE...completed
Re-checking final format. Reading CYLINDER xxx(xxxh)

When PREP displays the system prompt, then all PREP operations are complete.

While earlier versions of PREP required rebooting the Z-100 at this point, PREP v4 permits proceeding directly with the PART utility, if desired.

Note: At the earliest convenience, perform a normal shutdown and remove the hardware jumper from the "FORMAT ENABLE" location on the Z-217 Winchester Drive Controller Board (See Figure 1). Store the jumper on pins 3 and 4 of the upper row (there are two rows) of pins at the bottom left of the board. This procedure will help to protect the data on the hard drive from being destroyed accidentally.

PREP creates one partition on a hard drive smaller than 32Mb. If you were to enter the command ASGNPART 0: {RETURN} at this point, it would show the following partition information:

Partition Name: PART1
Operating System Name: MS-DOS
Pecentage: 100.00%
Kilobytes: xxxxx (size of drive)

On drives greater than 32Mb, or 64Mb if the /K switch is used, additional partitions are created in 32Mb or 64Mb chunks. For example, an 80Mb drive would have PART1 of 32Mb, PART2 of 32Mb, and PART3 of 16Mb.

If PREP is invoked with the /O switch, one partition of 80Mb would be created on this 80Mb drive. **Note:** This partition could only be used under Z-DOS v4 and later.

5 The Reserved Winchester Area

Note: Information concerning the Reserved Winchester Area (RWA) is not essential for use of the PREP utility or the hard drive. This information is provided for users who wish to obtain a deeper understanding of the operations that PREP performs in order to prepare a hard drive disk.

When the PREP utility is run, it locates the first three consecutive error-free sectors and records the Software Boot Code (SBC). If other error-free sectors are located, it also records the partition table, and bad sector table on the first track of the drive. A second copy of the partition table and bad sector table are recorded on the second track.

The Reserved Winchester Area consists of three important elements:

- The **Software Boot Code (SBC),** which takes 2 or 3 sectors depending on the /K switch.
- The **Partition Table (OSI),** which takes 1 sector each regardless of the sector size. There is one copy on track 0 and one copy on track 1, if able.
- The **Bad Sector Table (BST),** which takes 1 sector each regardless of the sector size. There is one copy on track 0 and one copy on track 1, if able.

They are recorded on the hard drive's disk during PREP's reserved area initialization operation (see "4.3 Initializing the Reserved Winchester Area").

Note: Even if the /K switch is used, the maximum number of bad sectors allowed in the BST is 170, and the maximum number of user partitions allowed in the partition table is 16. This is how Zenith designed the drives. It would be easy to double the limits for 1024 byte sector sizes, but other operating systems (CP/M) and programs have to access these tables and would be unaware of the increased entry limits.

If no error-free sectors are found on the first track (such as when a head has failed), PREP will continue to look at the next track and record the software boot code, partition table, and bad sector table, then, if space permits, the second copies of the partition table and bad sector table.

If no usable sectors can be located in the first two tracks, PREP gives the error,

Cannot Read/Write drive.

If PREP cannot locate enough good sectors, it displays,

WRITE ERRORS on SBC, OSI, and/or BST.

Copies of the first, and most critical, sector of the SBC is then copied to the remaining free sectors of the first track.

The Reserved Winchester Area is also vital during hard drive bootup because it provides access to a particular partition after the hard disk itself is accessed. Users of CP/M-85 and MS-DOS with the hard drive also use these data structures to make unusable media (bad sectors) inaccessible before FORMAT is run.

The new MTR-ROM v4.3 now searches for the SBC, which can be located anywhere on the first two tracks. The first user partition will start at the first good sector following the second bad sector table.

5.1 The Software Boot Code (SBC)

The "Software Boot Code" (SBC) helps locate the partition to be booted after entry of a hard drive bootup command. The SBC also helps the system avoid bad sectors during disk access by referring to the bad sector table.

PREP v4 records the SBC on the first 3 "usable" sectors (2 sectors if 1024-bytes) of the hard disk during initialization of the Reserved Winchester Area (see "4.3 Initializing the Reserved Winchester Area").

Additional copies of the first sector of the SBC are placed in the Reserved Winchester Area as will fit. This should keep a drive usable, even if the original location for the SBC becomes corrupted or unreadable.

5.1.1 Role of SBC During Bootup

When you enter a hard disk bootup command, the MTR-100 monitor ROM reads the SBC into the computer's Random Access Memory (RAM). Once within RAM, the SBC plays a crucial part in the successful access of a partition for the purpose of loading the operating system into memory. The partition that is accessed is determined either by a bootstring or a default boot partition. A bootstring can be specified by the user during bootup. A default boot partition is stored in a fixed location within the SBC (see "5.1.2 SBC Entries").

In order to access a partition for bootup, the SBC must match the specified bootstring or the default boot partition with a partition that exists in the partition table.

When the SBC finds a partition that matches the specified bootstring or default boot partition, the SBC loads the first 32 sectors of that partition into RAM. If the accessed partition contains CP/M-85 or MS-DOS, then the boot loader program begins to execute the remainder of the bootup operation.

5.1.2 SBC Entries

The entries included in the first 128 bytes of the SBC are described in Table 1.

Table 1.   Software Boot Code Entries
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BYTES:	SBC ENTRIES:
3	System bytes
1	PART/SBC version number (To synchronize different releases of software)
1	PART/SBC revision number (To synchronize different releases of software)
27	Default bootstring, includes: 16 bytes for partition name 1 byte for the semicolon 10 bytes define OS name
3	Begin sector address of bad sector table A
3	Begin sector address of bad sector table B
3	Begin sector address of superblock A
3	Begin sector address of superblock B
2	Sector size (512 bytes/sector)
2	Sectors per track (18)
2	Tracks per cylinder
2	Cylinders per volume
2	Sectors per cylinder
3	Number of sectors on entire disk
1	Number of Regions -1
2	Checksum for superblock A
2	Checksum for superblock B
2	Checksum for bad sector table A
2	Checksum for bad sector table B
12	Set drive for Z-217 controller
3	Address of first user sector (1st sector beyond Reserved Win Area)

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   6      Date partitioned, or default date,
          when PART is run (When PREP is run,
          the value 00 is used for each byte)
   2      Checksum of SBC (initial value=0)
   2      Parking cylinder number
   2      Boot Port
  32      31 byte HDrive Volume Label + 00h
   3      Reserved for future expansion
 -----
  128     First Quarter-sector of SBC
```

The format for each three-byte sector number is
low, middle, high byte.

Note: This table describes one quarter-sector of
the 3-sector SBC. The rest of the SBC consists
of the assembly instructions that lead to the
actual access of the specified partition. This
includes the new code for a PC compliant method
of storing partitions beginning at 1BEh and two
bytes for the PC Boot Loader at 510h.

~~~~~~

A "PC" style Master Boot Signature (0AA55h) and
Table (up to the first 4 partitions) has been
added to the SBC's first 512 bytes. This allows
low level disk access by programs like Norton's
Diskedit full editing and access via ZPC's low
level interrupt 13h processor.

5.1.3 SBC Verification

A check code called a "Checksum" is calculated
by PREP for the SBC before PREP records the SBC
on the disk. The results of these checksums are
recorded in entries within the SBC.

During bootup, verification checksums are per-
formed to verify that the SBC has not changed
since the original checksums were performed.
If the SBC has changed, or if it cannot be read,
then an error message will be displayed.

The SBC also contains the checksums used to
verify the partition table and bad sector
tables).

5.2 The Superblock

The "Superblock" or partition table contains
information about each partition on the disk.
A maximum of 16 partitions can be defined for
a given disk. The superblock reserves space for
the following types of information for each
partition:

  - partition name
  - operating system name
  - flag byte (to show whether PREP or
    PART has been run on the disk since
    the last time the partition was
    formatted)
  - address of the starting sector

5.2.1 Superblock Entries

These items, recorded for one partition, con-
stitute one superblock entry. Each superblock
entry occupies 30 bytes of disk space. The 17
superblock entries (for up to 16 user-definable
partitions) are structured as shown in Table 3.
PART is the utility used to create or change the
various hard disk partitions and to define the
attributes (name, size, etc.) of any given
partition.

Table 2.   Superblock Entries
```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  BYTES:   SUPERBLOCK ENTRY:
   30      Entry for 1st partition,
           which includes for each:
           16-byte partition name
           10-byte system name
            1-byte flag
            3-byte starting sector
   30      Entry for 2nd partition
   30      Entry for 3rd partition
    "           "
    "           "
    "           "
   30      Entry for 16th partition
   30      Entry for 17th partition
    2      Reserved for future expansion
  -----
  512     Total for Each Superblock

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

5.2.2 Superblock Verification

During initialization of the Reserved Winchester
Area, PREP records superblock entries twice on
the hard disk. The primary copy of the super-
block, called Superblock A, is used unless some
of its contents have been damaged since it was
recorded. The backup copy of the superblock,
called Superblock B, is used if Superblock A is
damaged. Each copy is recorded on separate
tracks, if possible, to decrease the chance that
both could be damaged simultaneously.

A check code called a "checksum" is calculated
by PREP for each superblock copy before PREP
records these superblock copies on the hard
disk. The results of these checksums are
recorded in the software boot code.

Then, when execution of either PART or PREP is
repeated, verification checksums are performed
to verify that the superblocks have not changed
since the original checksums were performed.
A similar sequence is used during normal disk
access operations. In either case, if Superblock
A cannot be read, or if the results of the
second checksum of Superblock A differ from the
results of the original checksum, then an
attempt is made to read Superblock B. If Super-
block B cannot be read, or if the results of the
second checksum of Superblock B differ from the
results of the original checksum, then all
partitions will be inaccessible.

5.3 The Bad Sector Table

The "Bad Sector Table" is an ordered list of the addresses of each sector on the disk that contains unusable media. The information in the bad sector table enables the disk operating system to avoid bad sectors (unusable media) when it accesses a partition during your everyday activities.

The bad sector table can include the addresses of up to 170 bad sectors. Each bad sector address is recorded in a three-byte entry. Space for the maximum number of entries (sector addresses) is reserved when the table is created; entries that do not contain a sector address are filled with three zeros.

5.3.1 Bad Sector Table Entries

The structure of the bad sector table is explained in Table 3.

During media testing (see "4.2 Testing the Disk Media"), PREP maintains a record of the location of all the bad sectors (sectors containing unusable media) that it finds on the disk. Then, during initialization of the reserved Winchester area (see "4.3 Initializing the Reserved Winchester Area"), PREP creates a table of all bad sectors and records two copies of this table on separate tracks, if possible, on the disk.

The primary copy of the table, Bad Sector Table A, is normally used during disk access operations unless some of its contents have been damaged. The second copy of the table, Bad Sector Table B, provides a backup copy of the table.

If Bad Sector Table A cannot be used due to media or data damage, Bad Sector Table B is used.

Table 3. Bad Sector Table Entries
~~~~~~

BYTES:	BAD SECTOR TABLE ENTRY:
3	Address of 1st bad sector found by PREP
3	Address of 2nd bad sector
3	Address of 3rd bad sector
"	"
"	"
"	"
3	Address of 168th bad sector
3	Address of 169th bad sector
3	Last entry in table (always contains 000)
2	Reserved for future expansion

512	Total for each Bad Sector Table

~~~~~~

5.3.2 Bad Sector Table Verification

A check code, called a "checksum", is calculated by PREP for each of the copies of the bad sector table before PREP records these bad sector table copies on the hard disk. The results of these checksums are recorded in the software boot code.

Then, when execution of PREP or PART is repeated on the same hard disk, verification checksums are performed to verify that the bad sector tables have not changed since the original checksums were performed.

If Bad Sector Table A cannot be read, or if the results of the second checksum of Bad Sector Table A differ from the results of the original checksum, then Bad Sector Table B is read.

If Bad Sector Table B cannot be read, or if the results of the second checksum of Bad Sector Table B differ from the results of the original checksum, then no bad sector table information will be available in the reserved Winchester area.

If the FORMAT utility is then used on a partition of this disk, it will assume that the disk has no bad sectors and format without avoiding any bad sectors. **Only using FORMAT /V will mark bad sectors unusable.**

If the DETECT utility is used on this disk, it will find no bad sector table to which it can append new bad sectors. **DETECT can ONLY add entries to an existing bad sector table.**

6 PREP Hardware Adjustments

Before you can use the PREP utility, a "jumper" must be placed on the **"FORMAT ENABLE"** pins on the Z-217 Winchester Disk Controller Board, as mentioned earlier (See Figure 1).

This jumper is a small conductive metal clip covered with a box-like plastic case. This kind of jumper is known as a Berg jumper.

6.1 Jumper Movement Procedure

WARNING: The internal components of your Z-120 "All-in-one" computer can cause severe electric shock if touched while the computer is running. Therefore, you should turn off your computer and unplug it from its power source before touching any hardware component within the computer's cabinet.

   1. Remove any disk that may be in the floppy disk drive.

   2. Turn off your computer's power and unplug it from the power source.

3. Remove the cabinet top from your computer. (Refer to Appendix I of the Z-100 Series User's Manual for detailed information on removal.)

4. Locate the Z-217 Winchester Disk Controller Board in the "Card Cage".

Note: Your computer also contains a Z-207 Floppy Disk Controller Board. The Z-217 Winchester Disk Controller Board is the board that is connected to the hard drive (rather than the floppy disk drive) by a flat, ribbon-like cable. It also has a power cable attached routed directly from the power supply.

5. Using the two levers attached to the top edge of the board to pry the board upward, gently slide the board upward until the two horizontal rows of pins are visible on the lower left corner. You do not need to remove the Z-217 board completely from the card cage. As you slide the board upward, be certain that some of the board is still anchored between the card cage's vertical tracks.

Note: In order to slide the Z-217 controller board upward, you might first have to temporarily unplug Z-217 cables or a cable that lies above the Z-217 board. Carefully note the positions of the cables, where they are routed, and, on the flat cables, the marked edge.

6. Two horizontal rows of pins are located at the bottom left corner of the Z-217 controller board. Locate the jumper covering pins 3 & 4 of the top horizontal row of pins. Remove it by carefully sliding it away from the board. Be careful not to bend the pins.

7. Locate the two pins just below the power connector and labeled **"FORMAT ENABLE"**. Carefully slide the jumper over these pins, being careful not to bend the pins. When connected by the jumper, the pins allow the hard disk to be initialized by PREP.

8. Gently slide the Z-217 board downward until the bottom edge of the board is securely engaged to the horizontal connector at the bottom of the card cage.

Note: Be careful that the Z-217 board remains between the same pair of vertical card cage tracks as you slide it downward.

9. If you unplugged any internal cables, plug them back into the appropriate sockets on the controller boards. Make sure that all cables are firmly connected, cover all their respective pins (not offset to one side), and have the marked edge in the proper direction.

10. Replace the top cover of your computer and make sure that it is completely latched in place.

11. Plug the computer back into the power source and turn it on.

12. Boot up the Winchester Utilities Working Disk and proceed to use the PREP utility as explained in the text entitled "2 Invoking PREP".

WHEN YOU HAVE FINISHED USING PREP, perform the above steps in reverse order to relocate the jumper to the storage position.

CAUTION: You should remove the jumper from the **"FORMAT ENABLE"** pins before performing any other activity. If this jumper remains on the **"FORMAT ENABLE"** pins, irregularities in the power supply can cause the hard disk to be automatically initialized during normal use of the disk. This initialization will destroy any data recorded on the disk.

7 PREP Error Messages

In addition to the usual errors, such as "Drive Not Ready", others need additional explanation:

> *ABORTING, You must run ASGNPART to regain access to drive.*
> *ABORTING, You must run PREP to regain access to drive.*
> *ABORTING, cannot use /P switch, bad CRC detected.*

Cause: When running PREP or PREP /P, you aborted PREP for some reason. These errors are informatory, giving you some idea as to how to proceed as a next step.

Cure: Perform the next command, as directed, or in the case of the failed /P operation, backup any necessary files, and run a full PREP as outlined above.

> *Bad sector count exceeded for this drive. Must format with "/V".*

Cause: The upper bound limit (170 bad sectors) for bad sectors has been exceeded. Besides showing an excess of bad sectors, if they are all being listed in a row, or only on a certain head, this could also indicate a hardware malfunction.

Cure: While earlier versions of PREP would stop at this point, making the disk unusable, PREP v4 continues, but can no longer add bad sectors to the full bad sector table. Run PREP again.

If this error message reappears after the second attempt, the drive, data separator, or controller board may be faulty. Also, check the cables again. Try running FORMAT /V on the drive to lock out all the bad sectors. If successful, the drive can still be used.

> *Cannot read old information, continue without "/P"?*

Cause: You attempted to run PREP with the /P switch, but the old information cannot be read.

Cure: If the drive is still readable, save all critical files and run a full PREP.

> *Cannot Read/Write drive.*

Cause: PREP cannot find any good sectors on tracks 0 or 1 to write the software boot code, partition tables, and bad sector tables.

Cure: Run PREP again. If this error message reappears after repeated use of PREP, the drive, data separator, or controller board may be faulty. Check the cables again.

> *Continue by Zeroing the Bad Sector Table(Y/N)?*

Cause: If you did not choose to Initialize the bad sector table with the /I switch, PREP is reporting that the old bad sector table cannot be read.

Cure: Choose Yes to zero the bad sector table. This version of PREP uses extensive testing of the media to locate all unreliable sectors.

> *CRC failure on Partition Tables, continue anyway?*
> *CRC failure on Bad Sector Tables. (A)bort, (Z)ero, or (U)se?*

Cause: A bad sector error has occurred in the reserved area of the hard disk. This could indicate a read/write malfunction that occurred later in the process.

Cure: PREP will automatically use the backup copy of whichever table had the problem and resume the operation it was conducting when the error message was displayed. However, this message indicates that only one usable copy of that table remains on the disk.

Although you could use the disk in this condition, all hard disk data may become inaccessible if the partition table is ever damaged. Therefore, it is recommended that you back up critical files when the current operation is complete and run PREP /P to recreate two valid copies of the tables.

> *DOS/BIOS version ERROR.*
> *You must use BIOS version 4.06, and DOS version 4.00.*
> *The versions are displayed at boot time and with the VER command.*

Cause: You attempted to run PREP with an older version of DOS.

Cure: Make a new Z-DOS v4.06 Hard Drive Utilities floppy disk. Ensure all previous superceded software is removed from this working floppy disk.

> *Drive has too many bad sectors in track 0 rerun without /P.*
> *Too many Track 0 bad sectors for /P, drive will NOT be bootable.*

Cause: Too many bad sector errors have occurred in the reserved area of the hard disk while updating the hard drive to "PC Boot Code".

Cure: You will need to do the entire PREP procedure outlined above. This PREP will isolate the bad area, if possible. While under earlier versions of PREP, bad sectors in track 0 would render the hard drive unusable, PREP v4 permits us to continue PREP, making the disk usable as a data disk... perhaps to store back-up files.

Error during formatting of the drive.
Check format enable jumper.

Cause: This message indicates that an error occurred during PREP's initialization of all usable disk surfaces. There are three possible causes for this type of error:

* incorrect responses to PREP's six drive parameter prompts
* improper positioning of the **"FORMAT ENABLE"** jumper on the Z-217 controller
* a hardware malfunction

Cure: Refer to the text entitled "6 PREP Hardware Adjustment". If you have not already done so, move the jumper to the **"FORMAT ENABLE"** position on the Z-217 controller board. Then invoke PREP again, and double check your responses to the six drive characteristic prompts, if they appear. After using PREP, remove the jumper from the **"FORMAT ENABLE"** position.

Invalid HEX value, try again:

Cause: The value entered at a drive parameter prompt was not a valid hexadecimal number, or the value was outside of the possible range.

Cure: Double check the appropriate hexadecimal value against the disk manufacturer's documentation or Table 2 at the end of this article. Then attempt to enter the correct value at the prompt again.

Sector Size change requested. Previous
Bad Sector Table will not be useable.

Cause: When changing the sector size from whatever the drive previously used, such as invoking PREP with the /K switch, the sector size change will render any previous bad sector table unusable. This message is for information only.

Too many Track 0 bad sectors for /P, drive
will NOT be bootable.

Cause: See the related error "Drive has too many bad sectors in track 0".

Unable to communicate with the Z-217
controller

Cause: PREP cannot locate the Z-217 Winchester Disk Controller Board. There is a hardware malfunction.

Cure: Ensure the Z-217 is firmly plugged into the S-100 bus and the drive cable connectors are correctly and securely fastened. Run PREP again.

Update successful. You need to run
ASGNPART to gain access to the drive.

Cause: This is a normal message, indicating that your PREP /P operation to update your "PC Boot Code" was successful.

Cure: Run ASGNPART and proceed normally.

WRITE ERRORS on SBC, OSI, and/or BST.

Cause: An error was encountered as PREP attempted to write to the reserved Winchester area of the disk. PREP cannot find enough good sectors to write the software boot code, partition tables, and bad sector tables. If no good sectors are found in tracks 0 or 1, PREP will display the message **"*Cannot Read/ Write drive.*"**

Cure: Run PREP again. If this error message reappears after repeated use of PREP, the drive, data separator, or controller board may be faulty. Check the cables again.

Z-217 controller error on Set Drive
Parameters command

Cause: One or more responses to the six drive characteristic prompts were not valid for the particular drive connected. A hardware malfunction of the Z-217 controller is possible.

Cure: Recheck the drive characteristics and run PREP again. If this error occurs after repeated attempts to run PREP, the drive, data separator, or controller board may be faulty. Check the cables again.

If you have any questions or comments regarding the use of PREP version 4, please email me at:

z100lifeline@swvagts.com

Cheers,

Steven W. Vagts

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      Table 4:  COMMON HARD DRIVES & PARAMETERS FOR THE Z-100
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              Cap:           Total    Reduced   PreComp  Step  Park
Drive:       (Megs) Heads:   Cyl:     WC Cyl:   Cyl:     Rate: Cyl:   Pwr:  Notes:
============================================================================

Computer Memories, Inc:
CMI 5412       11      4    132hex    133h       80h      1    135h   25w    3
                           306dec     307d      128d           309d
CMI 5619       16      6    132hex    133h       80h      1    135h
                           306dec     307d      128d           309d


IMI:
5006H           5      2    132h      133h       D6h      1    148h
                           306d       307d      214d           328d
5012H          11      4    132h      133h       D6h      1    148h
                           306d       307d      214d           328d
5018H          16      6    132h      133h       D6h      1    148h
                           306d       307d      214d           328d


Miniscribe:
Mod II, 2012   11      4    132h      133h       80h      1    14Fh
                           306d       307d      128d           335d
Mod III, 3012  11      2    264h      265h       80h      1    28Dh
                           612d       613d      128d           653d
3425           20      4    264h      265h       12Ch     1    267h
                           612d       613d      300d           615d
3438           20      4    264h      265h       12Ch     1    267h
                           612d       613d      300d           615d
3650           40      6    329h      32Ah       80h      5
                           809d       810d      128d
Mod IV, 4020   16      4    1E0h      200h       80h      1    209h
                           480d       512d      128d           521d
5619           16      6    132h      133h       80h      1    135h
                           306d       307d      128d           309d
6085           72      8    400h      401h       200h     1    406h   25w    5
                           1024d      1025d     512d           1030d


Mitsubishi:
MR535-u00      42      5    3D1h      12Ch       12Ch     5     0             6
                           977d       300d      300d


NEC:
D5126          20      4    264h      265h       265h     5     0
                           612d       613d      613d


Rodime:
R0202E         22      4    280h      281h       12Ch     1    283h
                           640d       641d      300d           650d
R0203E         33      6    280h      281h       80h      1    283h   30w    3
                           640d       641d      128d           650d
R0204E         44      8    280h      281h       80h      1    283h
                           640d       641d      128d           650d
R0252          11      4    132h      133h       80h      1    135h
                           306d       307d      128d           309d


Tandon:
TM 262         21      4    267h      268h       268h     1    26Ch   12w    4
                           615d       616d      616d           620d
TM 502         11      4    132h      133h       80h      1    135h
                           306d       307d      128d           309d
TM 602S         5      4    99h       80h        40h      96   9Ah
                           153d       128d      64d            154d
TM 603S        11      6    99h       80h        40h      96   9Ah
                           153d       128d      64d            154d
```

Table 4 (Cont): COMMON HARD DRIVES & PARAMETERS FOR THE Z-100

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Drive:	Cap: (Megs)	Heads:	Total Cyl:	Reduced WC Cyl:	PreComp Cyl:	Step Rate:	Park Cyl:	Pwr:	Notes:
Seagate:									
ST-125	21	4	267h	268h	268h	1	26Ch	10w	4,5
			615d	616d	616d		620d		
ST-138	32	6	267h	268h	268h	1	0	10w	4,5,6
			615d	616d	616d				
ST-212	11	4	132h	133h	80h	1	135h		
			306d	307d	128d		309d		
ST-312	10	2	267h	268h	12Ch	1	267h		
			615d	616d	300d		615d		
ST-225	20	4	267h	268h	12Ch	1	267h	15w	1
			615d	616d	300d		615d		
ST-238	20	4	264h	265h	12Ch	1	267h		
			612d	613d	300d		615d		
ST-251	42	6	334h	335h	335h	1	38Eh	11w	1,5,6
			820d	821d	821d		910d		
ST-251-1	42	6	334h	335h	335h	1	38Eh	12w	1,5
			820d	821d	821d		910d		
ST-406	5	2	132h	200h	80h	1	131h		
			306d	512d	128d		305d		
ST-412	11	4	132h	200h	80h	1	131h		
			306d	512d	128d		305d		
ST-419	16	6	132h	200h	80h	1	131h		
			306d	512d	128d		305d		
ST-506	5	4	99h	80h	40h	96	9Ah		
			153d	128d	64d		154d		
ST-706	5	2	132h	200h	80h	1	131h		
			306d	512d	128d		305d		
ST-4026	21	4	267h	268h	268h	1	0	25w	2
			615d	616d	616d				
ST-4038	32	5	2DDh	2DFh	2DFh	1	0	25w	2
			733d	735d	735d				
ST-4051	42	5	3D1h	3D2h	3D2h	1	0	25w	2,6
			977d	978d	978d				
ST-4096	80	9	400h	401h	401h	1	0	25w	5,6
			1024d	1025d	1025d				
SyQuest:									
SQ 312RD	12	2	267h	268h	268h	1	26Ch		
			615d	616d	616d				

NOTES:
1. Half height drive.
2. Voice coil full sized drive - park automatic on power down.
3. Full sized stepper drive. Mount in any position.
4. 3.5" low power drive in 5" half height frame.
5. Autopark drive on power off.
6. For Z-100 use on the UCI EASYWIN setup, 810 cylinders must be specified;
   when using with Zenith's controller card set, specify 255h for this value,
   which will give 32.9 megs - or use the PREP/k switch for 1024 byte
   sectors; 64 meg max.
7. The newer half-height drives generally require about 1 amp at 5 volts and
   1 amp steady state at 12 volts. Starting current on 12 volts for the first
   10 seconds is about 4 amps. Full height and older drives slightly more on
   5 and 12 volts, with considerably more power consumption.

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