



# **IBM Magstar 3590**

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**White Paper**

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## About this Study

This study, intended for technical reviewers, presents Progressive Strategies' technical assessment of the methodology IBM used in validating claims for two tape backup systems: the IBM Magstar 3590 Tape Subsystem and the StorageTek 9840 Tape Drive. It summarizes each product's performance and capacity claims, discusses the testing approaches, explains the test results, and evaluates the tests' applicability to real-world conditions.

The performance information contained in this paper was obtained in a controlled environment based on the use of specific data. The performance results obtained in other operating environments may vary significantly. Users of this information should verify the performance of their applicable data in their specific environment.

The performance information contained in this paper is believed to be accurate as of the date of the initial publication of this paper in August, 1999. All information is provided on an "AS IS" basis without any representations or warranties, express or implied. No responsibility or obligation is undertaken by anyone to update any information that appears in this paper. A user of information in this paper should check with the applicable vendor to obtain more recent performance information.

# Introduction

Tools and simulated conditions used to gauge a product’s performance and capacity (in order to publish the results in marketing materials) may not always represent real-world conditions. In the large-capacity tape subsystem market, we examine IBM’s testing methodology in order to validate the advertised performance and capacity of the two IBM Magstar 3590 models, as compared to those of a product from StorageTek: the STK 9840. We will review each test, explain the results, and discuss how well it simulates real-world conditions.

Side-by-side presentation of each vendor’s product specifications and claims follow:

	IBM 3590B	IBM 3590E	STK 9840
Capacity (per cartridge)			
Native Uncompressed	10 GB	20 GB	20 GB
Compressed Average	30 GB*	60 GB*	80 GB*
Compression	LZ-1, 3:1*	LZ-1, 3:1*	LZ-1, 4:1*
Data Buffer Size	16 MB	16 MB	8 MB
Data Transfer Rate (Head to Tape)	9 MB/sec	14 MB/sec	10 MB/sec*
Interface (Burst Rate)	40 MB/sec Ultra-SCSI*	40 MB/sec Ultra-SCSI*	40 MB/sec Ultra-SCSI*
Maximum Block Size	256 Kb	256 Kb	256 Kb
Tape Speed			
Read/Write	2 m/sec	3.14 m/sec	2 m/sec
Search/Rewind	5 m/sec	5 m/sec	8 m/sec

*\*Individual results may vary depending on the data characteristics and other variables.*

## Test Environment

Each drive was hosted on an RS/6000 H50 computer with one (1) gigabyte (GB) physical memory. Both drives were connected to their host computers via a 40 MB/sec Ultra-SCSI controller. Tape cartridges used include the High Performance Tape Cartridge (for IBM drives) and the 9840 Cartridge (for the STK).

Testing was performed using a variety of shell scripts and C programs that simulate tape writing. We found that this approach minimizes the number of variables that can affect performance measurements, and ensures that each test produced real product capabilities. The following data types were used to simulate real-world conditions:

Data Type Number	Data Types
1	Data from earth resource satellite observations
2	Raw data from a nuclear reactor
3	Telephone call logs from a telephone company
4	Telephone billing data
5	Database dump from a telephone company
6	Data from atmospheric research organization
7	Super computing data from a national lab
8	Passenger transaction data from an airline
9	Master file data from a telecommunications company
10	Wind tunnel test data from an aeronautic and space research organization

# Capacity Tests

In this test, the objective was to determine the amount of data each product can store in native uncompressed and compressed modes.

## ***Compressed and Uncompressed Capacity by Data Type Using Largest Block Size***

This test aimed at determining how each drive fared in compressed and uncompressed capacity when backing up real-world data. The scripts and C programs that were used produced data patterns representing a 256-KB data block from each of the data types (above). The driver script then executed these data creation scripts/programs, wrote the resulting data pattern to tape, repeated the process until the tape was full, and produced a report showing the total number of data blocks written to tape. Actual capacity is determined by multiplying the total number of blocks written by the block size (256 KB, or 262,144). This test was repeated for each data type with compression turned on, and again with compression turned off.

In this test phase, both of the IBM 3590 drives were tested. The StorageTek, on the other hand, was tested only in compressed mode since it ships with compression turned on by default and requires additional drivers (not readily available in the product packaging) to turn off compression.

Data Type Number	Com-pression	IBM 3590B			IBM3590E			STK 9840		
		Total Blocks	Total Capacity*	Com-pression Ratio	Total Blocks	Total Capacity*	Com-pression Ratio	Total Blocks	Total Capacity*	Com-pression Ratio
1	ON	65,921	17.3	1.7	127,449	33.4	1.7	128,913	33.8	1.7
1	OFF	39,330	10.3	1.0	75,981	19.9	1.0	**	**	**
2	ON	38,199	10.0	1.0	73,579	19.3	1.0	77,147	20.2	1.0
2	OFF	39,447	10.3	1.0	75,966	19.9	1.0	**	**	**
3	ON	138,052	36.2	3.6	266,300	69.8	3.5	248,652	65.2	3.3
3	OFF	39,429	10.3	1.0	75,983	19.9	1.0	**	**	**
4	ON	328,136	86.0	8.6	633,402	166.0	8.3	591,142	155.0	7.7
4	OFF	39,420	10.3	1.0	75,929	19.9	1.0	**	**	**
5	ON	111,575	29.2	2.9	215,086	56.4	2.8	183,293	48.0	2.4
5	OFF	39,423	10.3	1.0	75,941	19.9	1.0	**	**	**
6	ON	71,341	18.7	1.9	137,678	36.1	1.8	128,928	33.8	1.7
6	OFF	39,440	10.3	1.0	75,974	19.9	1.0	**	**	**
7	ON	222,462	58.3	5.8	428,878	112.2	5.6	443,294	116.2	5.8
7	OFF	39,428	10.3	1.0	75,975	19.9	1.0	**	**	**
8	ON	107,370	28.1	2.8	206,856	54.2	2.7	193,355	50.7	2.5
8	OFF	39,425	10.3	1.0	75,951	19.9	1.0	**	**	**
9	ON	42,109	11.0	1.1	81,176	21.3	1.1	83,264	21.8	1.1
9	OFF	39,417	10.3	1.0	75,965	19.9	1.0	**	**	**
10	ON	70,428	18.5	1.8	135,878	35.6	1.8	141,856	37.2	1.9
10	OFF	39,423	10.3	1.0	75,930	19.9	1.0	**	**	**

\*Total capacity is in gigabytes (GB)

\*\* Not tested

In native uncompressed mode, both IBM 3590 drives performed as advertised, yielding an average of 10 GB (IBM 3590B) and 20 GB (IBM 3590E) in all the data pattern tests. (The STK could not be tested in uncompressed mode, for the reasons mentioned above.)

In compressed mode, both IBM 3590 drives produced varying compression ratios for each of the data types. On average, they produced a 3:1 ratio as advertised. The STK also produced varying ratios for each data type. It did not average 4:1 as advertised. Rather, it yielded an average of 2.9:1.

Tape Drive	Average Compressed Capacity	Average Compression Achieved
IBM 3590B	31.4 GB	3.0:1
IBM 3590E	60.5 GB	3.0:1
STK 9840	58.2 GB	2.9:1

# Performance Tests

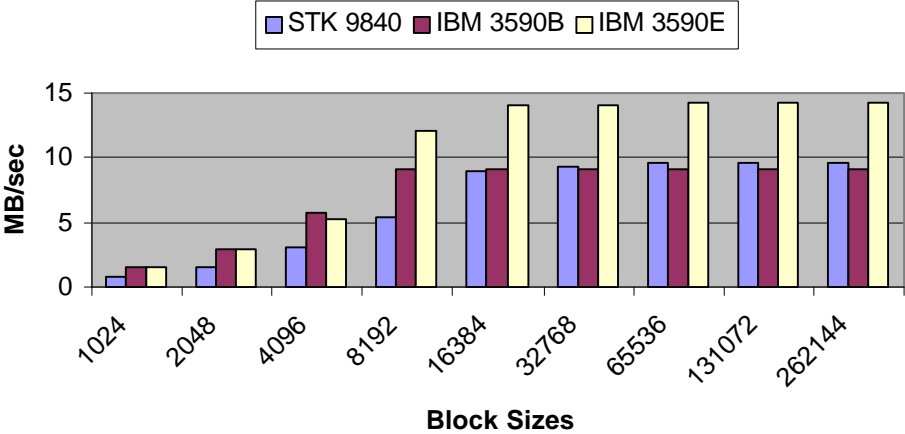
Each product advertises competitive data transfer rates. To validate these claims and understand what conditions (real world or otherwise) must exist to achieve performance results as advertised, several performance tests were conducted. The focus of the performance tests were on the tape backup drive activity that matters most to typical administrators — how fast it can actually back up data.

To achieve unobstructed results, the environment was configured with the fastest available and supported host-to-drive interface; both products were tested using a 40 MB/sec Ultra-SCSI drive-to-host interface. This minimized the possibility that the test components might have affected each product’s ability to prove its claim. As with the capacity testing, data pattern-writing shell scripts and C programs were used to simulate tape backup activities. A looping driver script then executed these scripts/programs, wrote the resulting data patterns to tape, timed each tape writing activity, and reported the results. These reports displayed high, low, and average speed for each data block size pattern. Figures below are those marked as high in the test results.

In every tape writing process, tape drives conduct additional activities that add to the tape writing time. Typically, these activities occur before and/or after each data block written to tape. Considering this, drives are expected to perform much more slowly than advertised when backing up multiple smaller blocks of data. In this phase, each drive was tested using 9 fixed block size patterns, with compression turned on and then again with compression turned off.

## ***Uncompressed Tape Writing Speed per Data Block Size (in MB per sec)***

Drive	Block Size								
	1024	2048	4096	8192	16384	32768	65536	131072	262144
STK 9840	0.8	1.6	3.1	5.5	8.9	9.3	9.5	9.7	9.7
IBM 3590B	1.50	2.9	5.7	9.1	9.1	9.1	9.2	9.2	9.2
IBM 3590E	1.57	3.0	5.3	12.1	14.0	14.1	14.2	14.2	14.2



In uncompressed mode, the IBM 3590B confirmed its 9 MB/sec claim when writing block sizes of 8,192 bytes and above. The IBM 3590E did equally well, performing at speeds of 14 MB/sec for data blocks sized at 16,384 bytes and above. To determine how well STK did in this mode, it was configured with a

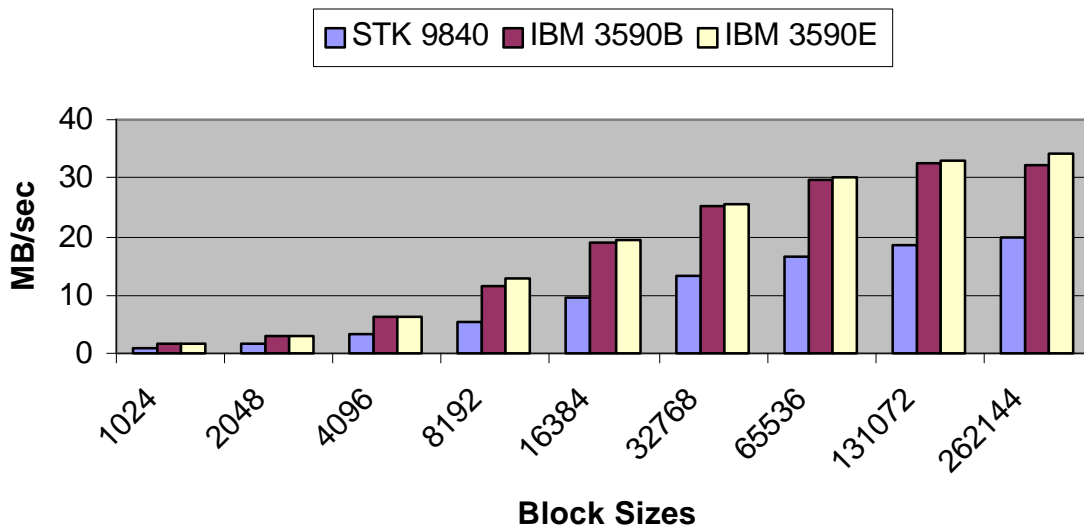
1:1 compression ratio. When tested, the STK 9840 came very close to its advertised 10 MB/sec data transfer rate. With large data blocks (where drives are expected to perform best), its fastest rate was 9.7 MB/sec.

### **Compressed Tape Writing Speed per Data Block Size (in MB per sec)**

For compressed pattern testing, each drive was tested with various preset compression ratios. However, only results from a 4:1 ratio test are scrutinized, since this best represents each product's advertised capability.

#### **4:1 Compression (Tape Writing Speeds in MB per sec)**

Drive	Block Size								
	1024	2048	4096	8192	16384	32768	65536	131072	262144
STK 9840	0.8	1.6	3.1	5.6	9.3	13.0	16.3	18.5	19.8
IBM 3590B	1.5	2.9	6.0	11.7	19.0	25.0	29.6	32.7	32.2
IBM 3590E	1.5	2.9	6.3	12.9	19.5	25.5	30.1	33.0	34.3



Configured to compress at a 4:1 ratio, the IBM 3590 drives performed as advertised. The IBM 3590 B reached 32 MB/sec, greater than its advertised compressed rate of 27 MB per second. The IBM 3590 E performed as advertised at 34MB/sec. The STK 9840 performed at a maximum compressed data rate of 19.8 MB/sec, almost achieving its 20 MB/sec advertised rate. (with 2:1 compression ratio)

# Conclusion

Based on marketing literatures (from the web site of each company/products), materials (e.g., tools used and test results) provided by IBM labs testing personnel, an inspection of the lab facilities, and interviewing IBM lab personnel, Progressive Strategies has determined that IBM employs methods that allow accurate and unbiased capacity and performance measurements of its tape drives and those of its competitors.

# NOTES

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