ALIENWARE X51 PERFORMANCE AND GAMING COMPARISON: SAMSUNG SSD VS. TRADITIONAL HARD DRIVE
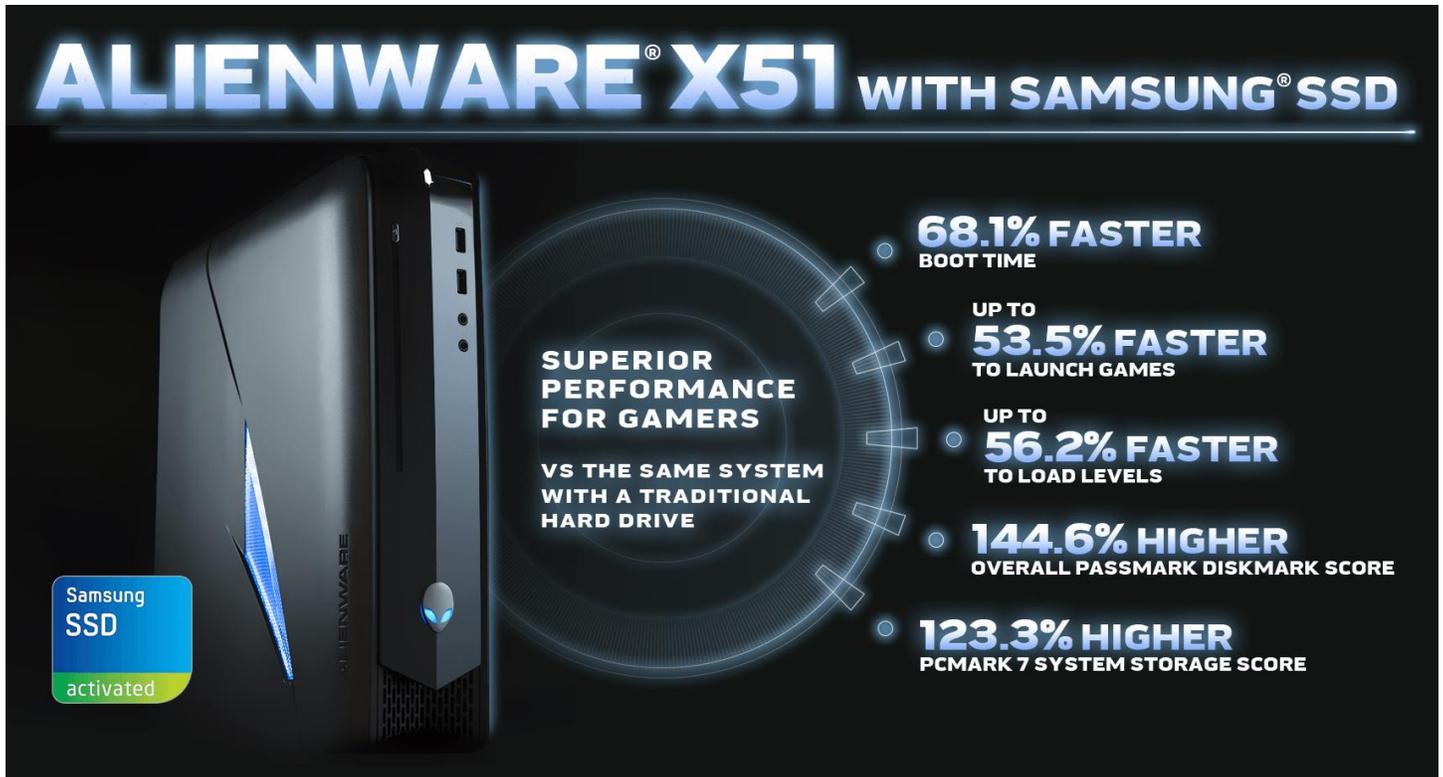
Gamers, who demand high levels of performance from their computers, reap enormous benefits from the increased speed that solid-state drives (SSDs) can deliver. In the Principled Technologies (PT) labs, we conducted a series of tests on the Alienware X51 desktop, which Dell calls "a one-stop gaming and entertainment system." We tested two configurations that were identical except for the storage—one system had a traditional spindle hard drive and the other had a Samsung SSD. Our findings? The Samsung SSD-based Alienware X51 achieved superior performance across the board and operated at a lower temperature.

This means that for an additional investment of only $250, users could enjoy this increased performance, faster boot, shutdown, game launch, and level load times, and a dramatically improved gaming experience with the Samsung SSD.

HIGH PERFORMANCE + SPEEDY LAUNCH AND LOAD TIMES = SUPERIOR GAMING EXPERIENCE

Because extremely strong performance and speedy game launching and loading are essential to those who use their computers to play video games, we tested two configurations of the new Alienware X51, a system designed for gaming. One was equipped with a Samsung solid-state drive and the other with a traditional hard drive. We conducted each test three times and report the median score. For detailed system configuration information, see Appendix A. For details on how we conducted the tests, see Appendix B.

WHAT WE FOUND

Booting and shutting down

We timed how long the two systems took to boot and shut down. As Figure 1 shows, the Alienware X51 with SSD booted 68.1 percent faster and shut down 46.3 percent faster than the HDD-based system.

Figure 1: Boot and shutdown times for the two systems we tested. Lower numbers are better.
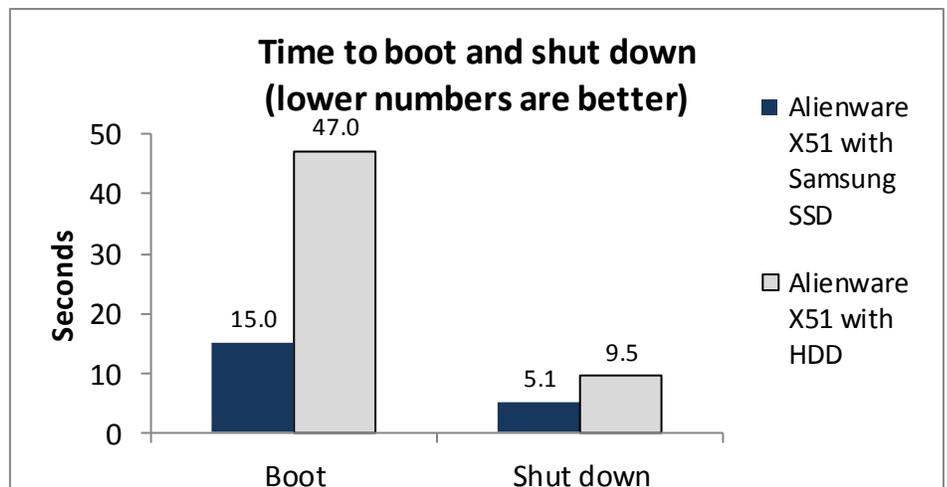
Copying a large file

To see how the two systems handled copying large files, we copied a 3.98GB video file from one location on the storage device to another location on the storage device. As Figure 2 shows, this process was 41.6 percent faster on the SSD-based Alienware X51 than on the HDD-based system.

Time to copy a large file (lower numbers are better)

Figure 2: File copy times for the two systems we tested. Lower numbers are better.

Seconds

60
50 — 52.4
40
30 — 30.6
20
10
0

- Alienware X51 with Samsung SSD
- Alienware X51 with HDD
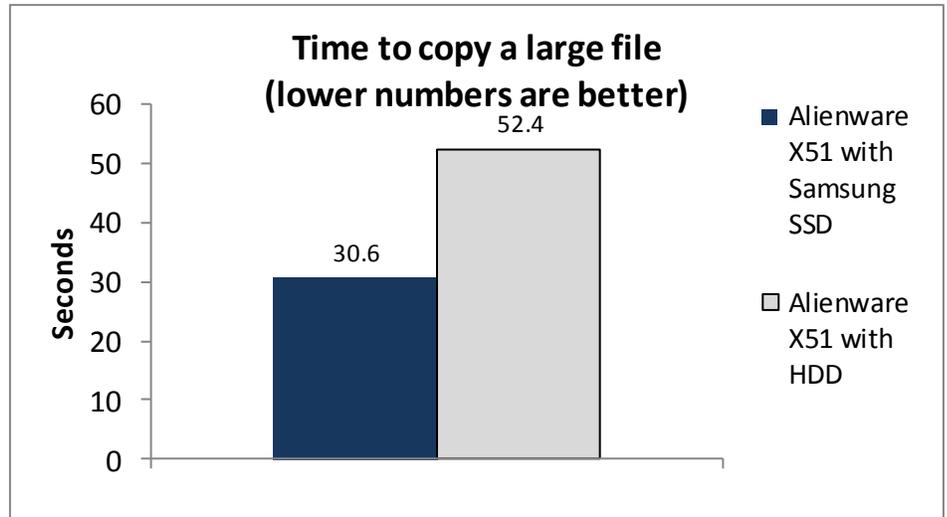
Launching and loading games

Using the two configurations of the Alienware X51, we measured the time it took to load levels and launch three video games. We tested each game two ways, with low-quality graphics and with high-quality graphics. With both types of graphics, the Samsung SSD-based system was considerably faster.

Battlefield 3

Battlefield 3 is a first-person shooter game developed by EA Digital Illusions CE and published by Electronic Arts. As Figure 3 shows, with both low- and high-quality graphics, the Alienware X51 with SSD launched the game and loaded a level in less than half the time as the HDD-based system. Launching the game with the faster SSD-based system saves you more than 30 seconds, allowing you to surprise the enemy.

Figure 3: Time to launch and load levels with Battlefield 3 for the two systems we tested. Lower numbers are better.

Time to launch and load Battlefield 3 (lower is better)

Minutes:seconds

	Low-quality graphics		High-quality graphics	
	Launch	Load level	Launch	Load level
Alienware X51 with SSD	31.5	13.6	31.2	13.3
Alienware X51 with HDD	1:07.8	0:30.7	1:05.9	0:30.2
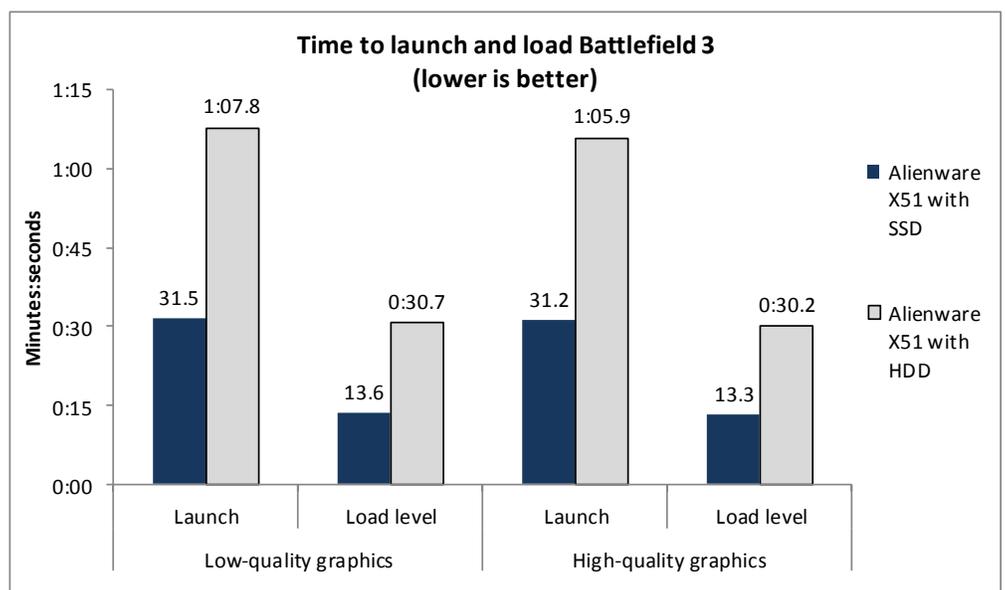
Star Wars: The Old Republic

Star Wars: The Old Republic is a massively multiplayer online role-playing game (MMORPG) based in the Star Wars universe, developed by BioWare Austin and a supplemental team at BioWare Edmonton. We timed how long the two systems took to launch The Old Republic and load a level. As Figure 4 shows, with low-quality graphics, the Alienware X51 with SSD launched the game 18.4 percent faster and loaded a level 36.3 percent faster than the HDD-based system. With high-quality graphics, the SSD allowed the system to launch 19.2 percent faster and load a level 23.2 percent faster. Players on the Samsung SSD system will wield the Force faster than their friends who use the same system with a traditional hard drive.
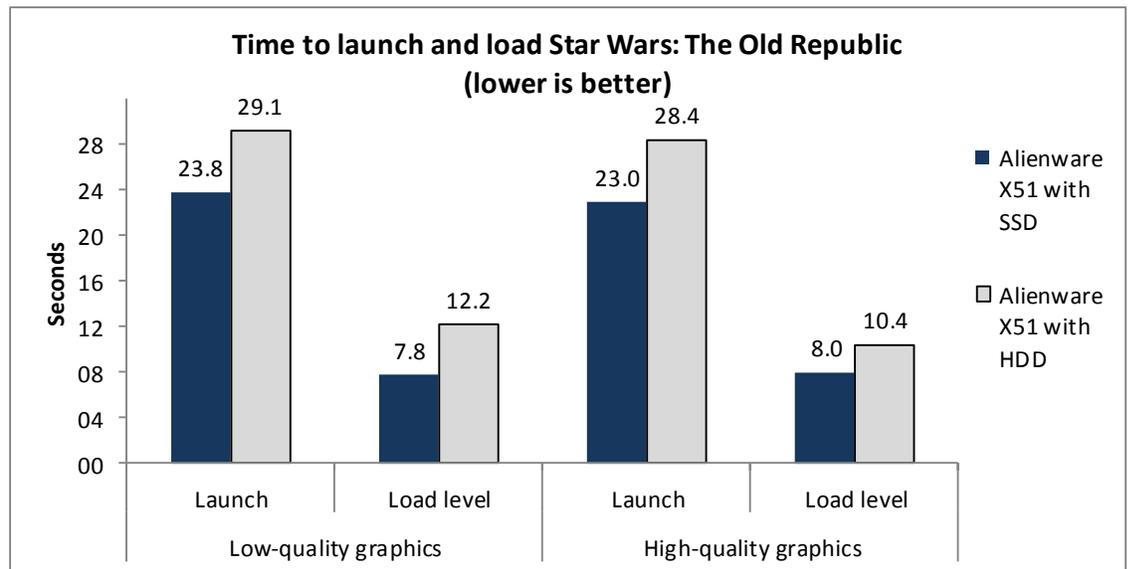
Figure 4: Time to launch and load levels with Star Wars: The Old Republic for the two systems we tested. Lower numbers are better.

The Elder Scrolls V: Skyrim

The Elder Scrolls V: Skyrim is an action role-playing open world video game developed by Bethesda Game Studios and published by Bethesda Softworks. We found that players could see the dragons of Skyrim faster with a solid-state drive. As Figure 5 shows, with low-quality graphics the Alienware X51 with SSD launched the game 8.2 percent faster and loaded a level 26.6 percent faster than the HDD-based system. With high-quality graphics, the SSD allowed the system to load a level 24.4 percent faster.

Figure 5: Time to launch and load levels with The Elder Scrolls V: Skyrim 3 for the two systems we tested. Lower numbers are better.
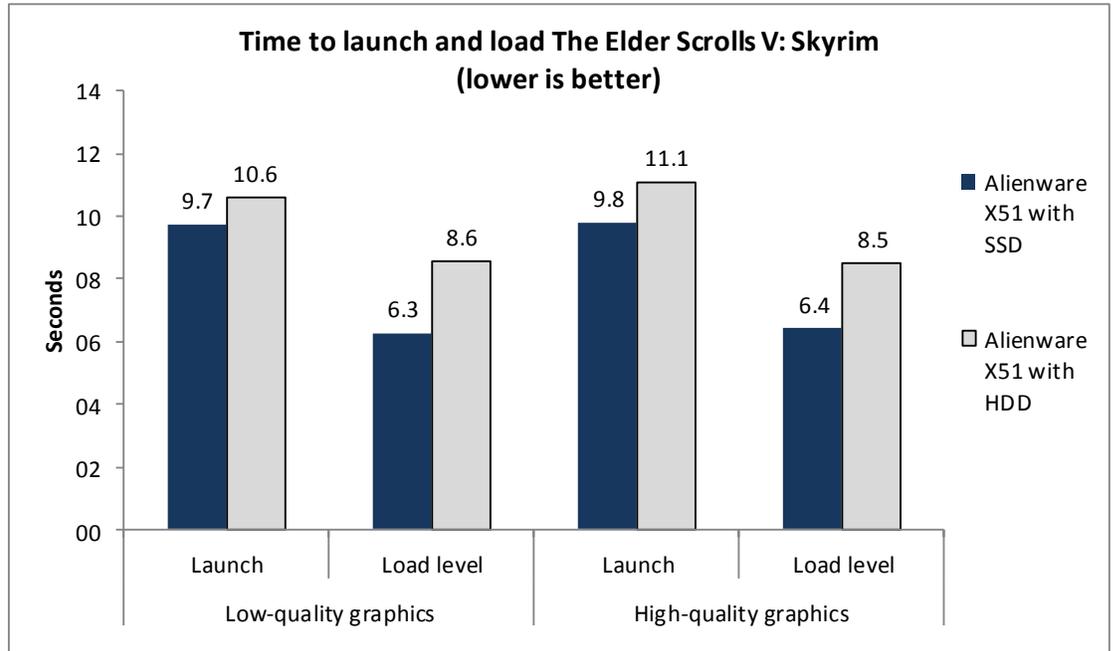
Figure 6 summarizes our game launch and load time test results.

	Alienware X51 with Samsung SSD	Alienware X51 with HDD	Percentage win with Samsung SSD
Battlefield 3			
Low-quality graphics			
Launch	31.5	67.8	53.5% faster
Load level	13.6	30.7	55.8% faster
High-quality graphics			
Launch	31.2	65.9	52.7% faster
Load level	13.3	30.2	56.2% faster
Star Wars: The Old Republic			
Low-quality graphics			
Launch	23.8	29.1	18.4% faster
Load level	7.8	12.2	36.3% faster
High-quality graphics			
Launch	23.0	28.4	19.2% faster
Load level	8.0	10.4	23.2% faster
The Elder Scrolls V: Skyrim			
Low-quality graphics			
Launch	9.7	10.6	8.2% faster
Load level	6.3	8.6	26.6% faster
High-quality graphics			
Launch	9.8	11.1	11.6% faster
Load level	6.4	8.5	24.4% faster

Figure 6: Median scores for the Futuremark PCMark 7 benchmark. Higher numbers are better.

Futuremark PCMark 7 storage performance

Futuremark® PCMark® 7 includes workloads covering storage, computation, image and video manipulation, Web browsing, and gaming. Figures 7 and 8 show the median results of our PCMark tests. The SSD-based Alienware X51 achieved a 123.3 percent higher PCMark 7 System Storage score than the HDD-based system did. It also achieved a higher overall PCMark 7 score and higher scores on all of the PCMark 7 subtests.

Figure 7: The PCMark System Storage scores for the two systems we tested. Higher numbers are better.

PCMark 7 System Storage score (higher numbers are better)
- Alienware X51 with Samsung SSD: 4,972
- Alienware X51 with HDD: 2,227
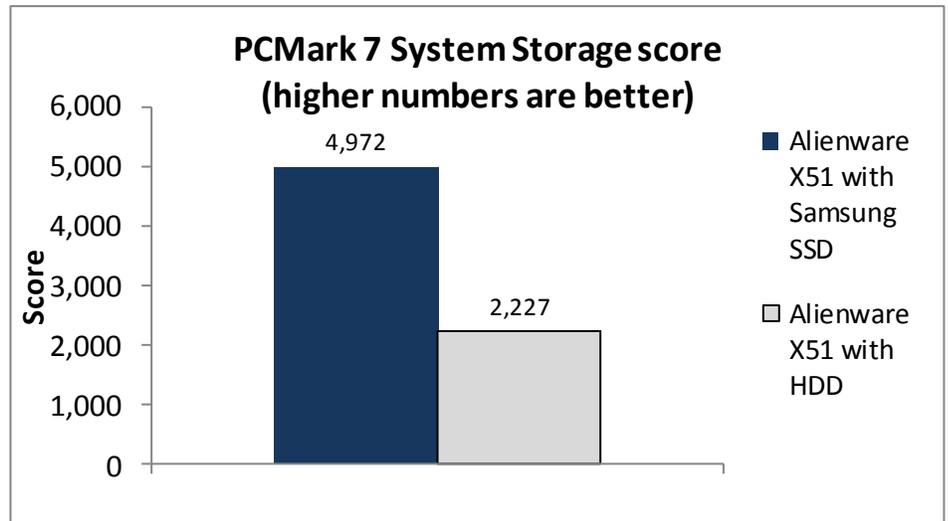
Futuremark PCMark 7 v1.0.4	Alienware X51 with Samsung SSD	Alienware X51 with HDD	Percentage win with Samsung SSD
PCMark Score - Median	5,492	3,985	37.8%
Lightweight Score	5,074	2,781	82.5%
Productivity Score	5,209	2,688	93.8%
Creativity Score	5,409	4,033	34.1%
Entertainment Score	5,249	4,583	14.5%
Computation Score	5,508	5,438	1.3%
System Storage Score	4,972	2,227	123.3%

Figure 8: Median scores for the Futuremark PCMark 7 benchmark. Higher numbers are better.

PassMark Disk Mark storage performance

The Disk Mark component of the PassMark® PerformanceTest™ measures data transfer speed to one or more disks. As Figures 9 and 10 show, the Samsung SSD-based Alienware X51 scored 144.6 percent higher overall on PassMark DiskMark test than the HDD-based system. It also scored 71.2 percent higher on the PassMark Sequential Read test, 66.4 percent higher on the PassMark Sequential Write test, and 2,363.6 percent higher on PassMark Random Seek score.

Figure 9: The PassMark DiskMark overall scores for the two systems we tested. Higher numbers are better.

PassMark DiskMark overall score (higher numbers are better)

- Alienware X51 with Samsung SSD: 2,649
- Alienware X51 with HDD: 1,083
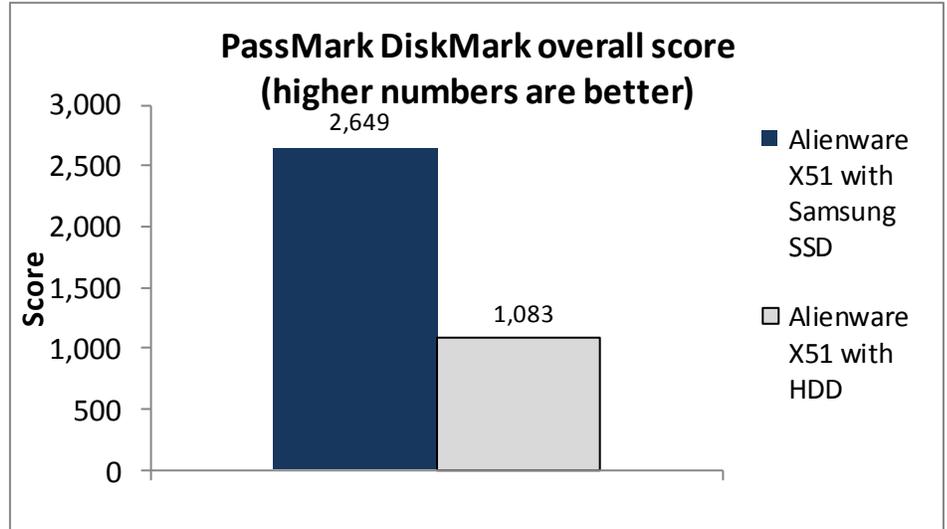
Figure 10: The PassMark DiskMark subscores for the two systems we tested. Higher numbers are better.

PassMark DiskMark subscores (higher numbers are better)

	Alienware X51 with Samsung SSD	Alienware X51 with HDD
Sequential Read	248.8	145.3
Sequential Write	239.8	144.1
Random Seek + RW	243.9	9.9
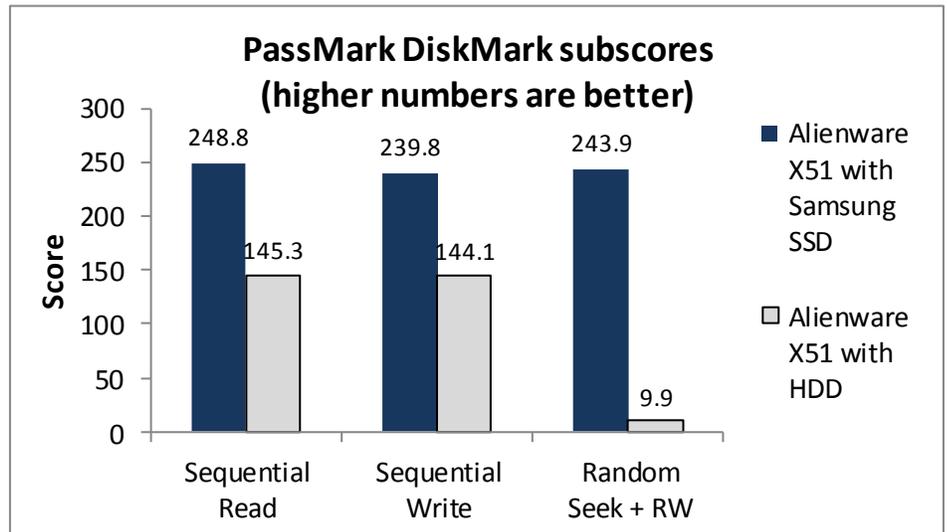
Measuring surface temperature

The surface temperature of a system not only affects the comfort of the user but can also be factor in a system's durability, as components tend to last longer at a cooler temperature. Figure 11 presents the temperature at two locations on the two system configurations we tested. Both when the systems were idle and when they were under load, the Alienware X51 with Samsung SSD was cooler in these locations that the same system with an HDD.

Figure 11: Surface temperature of the two systems we tested when idle and when under load. Lower numbers are better.
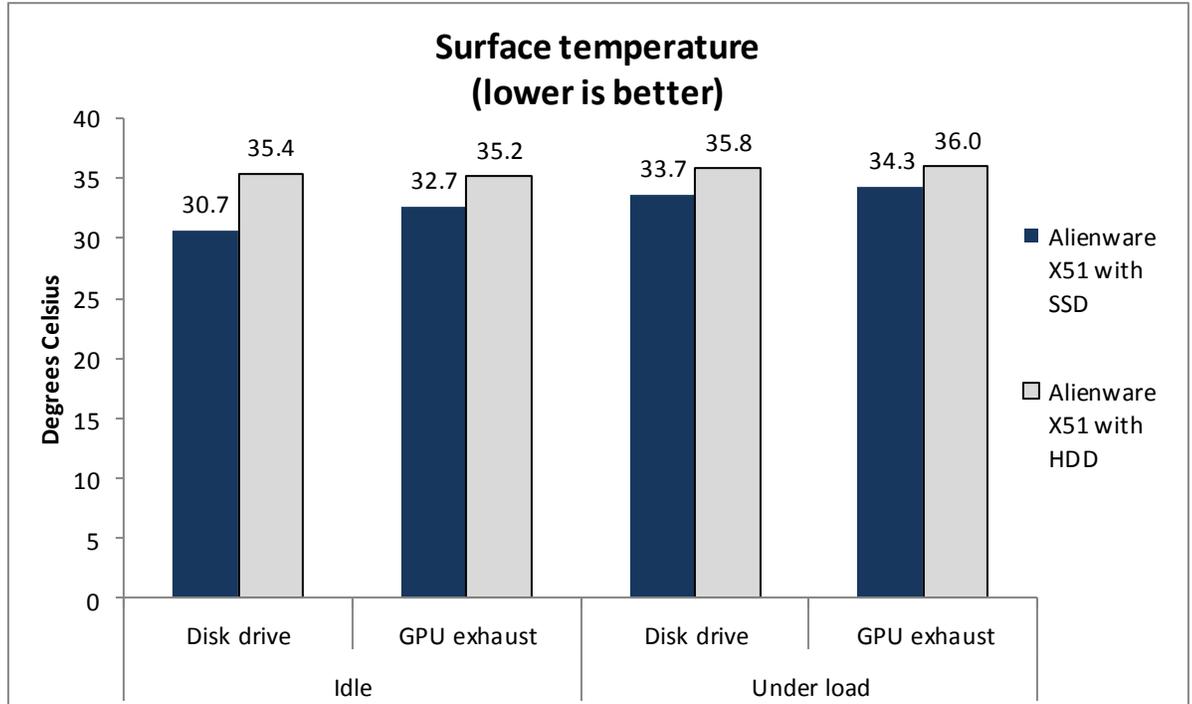
THE BENCHMARK TESTS WE USED

Futuremark PCMark 7 1.0.4

Futuremark's PCMark 7 includes seven PC tests for Windows 7, combining more than 25 individual workloads covering storage, computation, image and video manipulation, Web browsing, and gaming. Specifically designed to cover the full range of PC hardware from netbooks and tablets to notebooks and desktops, PCMark 7 offers complete PC performance testing for Windows 7 for home and business use. For more information on this benchmark, see http://www.pcmark.com/benchmarks/pcmark7/

PassMark DiskMark

The DiskMark component of PassMark's Performance Test measures data transfer speed when reading or writing data both sequentially and randomly to one or more disks. Many factors affect this speed, and the Advanced Disk Drive Test allows the user to vary most of these factors and compare the results. For more information on this benchmark, see http://www.passmark.com/products/pt.htm.

IN CONCLUSION

The Alienware X51 with Samsung SSD delivers greater speed and performance than the same machine with HDD storage, which for gamers means better gaming experiences. For a modest additional investment, users could avoid frustrating lag times when booting and shutting down their systems and when starting up games and loading new levels. They can also enjoy a cooler system, which could be important to the life of the machine. Users should appreciate the noticeable improvements that a solid-state drive brings.

APPENDIX A – DETAILED SYSTEM CONFIGURATION INFORMATION

Figure 12 presents detailed configuration information for the systems we tested.

System	Alienware X51 with HDD	Alienware X51 with Samsung SSD
General		
Number of processor packages	1	1
Number of cores per processor	4	4
Number of hardware threads per core	2	2
Total number of processor threads in system	8	8
System power management policy	High Performance	High Performance
Processor power-saving option	EIST	EIST
Retail price, excluding tax, shipping, and discounts, as of April 4, 2013	$1,199	$1,449
CPU		
Vendor	Intel®	Intel
Name	Core® i7	Core i7
Model number	3770	3770
Stepping	E1	E1
Socket type	Socket 1155LGA	Socket 1155LGA
Core frequency (GHz)	3.4 (3.9 Turbo)	3.4 (3.9 Turbo)
Bus frequency	DMI 5 GT/s	DMI 5 GT/s
L1 cache	4 x 32 KB + 4 x 32 KB	4 x 32 KB + 4 x 32 KB
L2 cache	4 x 256 KB	4 x 256 KB
L3 cache	8 MB	8 MB
Platform		
Vendor	Alienware	Alienware
Motherboard model number	06G6JW	06G6JW
Motherboard chipset	Intel H61	Intel H61
BIOS name and version	Alienware A12 (01/18/2013)	Alienware A12 (01/18/2013)
Memory module(s)		
Vendor and model number	Hyundai Electronics HMT351U6CFR8C-PB	Hyundai Electronics HMT351U6CFR8C-PB
Type	PC3-12800	PC3-12800
Speed (MHz)	1,600	1,600
Speed running in the system (MHz)	1,600	1,600
Timing/Latency (tCL-tRCD-tRP-tRASmin)	11-11-11-28	11-11-11-28
Size (MB)	4096	4096
Number of memory module(s)	2	2
Total amount of system RAM (GB)	8	8
Chip organization (single-sided/double-sided)	Double-sided	Double-sided

System	Alienware X51 with HDD	Alienware X51 with Samsung SSD
Channel (single/dual)	Dual	Dual
Storage		
Vendor and model number	Western Digital® WD10EZEX-7	Samsung PM830
Number of disks in system	1	1
Size	1 TB	256 GB
Buffer size (MB)	64	N/A
RPM	7,200	N/A
Type	SATA 6 Gb/s	SSD
Controller	Intel 6 series/C200 Chipset AHCI Controller	Intel 6 series/C200 Chipset AHCI Controller
Driver	Intel 9.2.0.1011 (09/10/2010)	Intel 9.2.0.1011 (09/10/2010)
Operating system		
Name	Windows® 7 Home Premium x64	Windows 7 Home Premium x64
Build number	7601	7601
Service Pack	1	1
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
Microsoft DirectX version	11	11
Graphics		
Vendor and model number	NVIDIA® GeForce™ GTX 660	NVIDIA GeForce GTX 660
Type	Discrete	Discrete
Chipset	GeForce GTX 660	GeForce GTX 660
BIOS version	80.4.48.0.2	80.4.48.0.2
Total available graphics memory (MB)	4,095	4,095
Dedicated video memory (MB)	1,536	1,536
System video memory (MB)	0	0
Shared system memory (MB)	2,559	2,559
Resolution	1,920 x 1,080	1,920 x 1,080
Driver	NVIDIA 8.17.13.142 (05/15/2012)	NVIDIA 8.17.13.142 (05/15/2012)
Sound card/subsystem		
Vendor and model number	Realtek™ High Definition Audio	Realtek High Definition Audio
Driver	Realtek 6.0.1.6494 (11/02/2011)	Realtek 6.0.1.6494 (11/02/2011)
Ethernet		
Vendor and model number	Realtek PCIe GBE Family Controller	Realtek PCIe GBE Family Controller
Driver	Realtek 7.46.610.2011 (06/10/2011)	Realtek 7.46.610.2011 (06/10/2011)
Wireless		
Vendor and model number	Dell Wireless 1506 802.11b/g/n	Dell Wireless 1506 802.11b/g/n
Driver	Atheros 9.2.0.469 (11/22/2011)	Atheros 9.2.0.469 (11/22/2011)
Optical drive(s)		
Vendor and model number	PLDS DL-8A4SH	PLDS DL-8A4SH
Type	DVD-RW	DVD-RW

System	Alienware X51 with HDD	Alienware X51 with Samsung SSD
USB ports		
Number	8	8
Type	6 x USB 2.0, 2 x USB 3.0	6 x USB 2.0, 2 x USB 3.0
Other	eSATA, Display Port	eSATA, Display Port
IEEE 1394 ports		
Number	0	0
Monitor		
Type	Dell U2212HM	Dell U2212HM
Screen size	21.5"	21.5"
Refresh rate (Hz)	60	60

Figure 12: Detailed configuration information for the two systems we tested.

APPENDIX B – TEST METHODOLOGY

Measuring time to boot and shut down

Setting up the test

Download and install the Windows Assessment and Deployment Kit (ADK) for Windows® 8 with default options from http://www.microsoft.com/en-us/download/details.aspx?id=30652.

Windows ADK Boot Performance Assessment (Full Boot) test

1. Boot the system and bring up an administrative command prompt:
    a. Type `cmd`
    b. Right-click the Command Prompt app to open App options.
    c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
3. Do not interact with the system until the command exits.
4. After the command exits, wait 5 minutes before running the test.
5. To launch the Windows Assessment Console, click Windows Start orb→All Programs→Windows Kits→Windows ADK→Windows Assessment Console.
6. Select Run Individual Assessments, and click Boot Performance Assessment (Full Boot).
7. Click Run.
8. Record the results.
9. Shut down the computer.
10. Repeat steps 1 through 9 twice.

Measuring time to copy large files

Setting up the test

1. We used a 3.98 GB .MOV file for this test.
2. Copy the .MOV file to the Videos directory.

Running the test

1. Boot the test system.
2. Bring up an elevated command prompt:
    a. Select Windows Start orb.
    b. Type `cmd` and press Control-Shift-Enter.
3. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
4. Do not interact with the system until the command completes.
5. After the command completes, wait 5 minutes before running the test.
6. Browse to the Videos directory and right-click→copy the .MOV file.
7. Browse to the C: root directory.
8. Simultaneously right-click→paste the .MOV file into the C: root directory and start the stopwatch.
9. Stop the stopwatch when the file has finished copying.
10. Delete the file from the C: root directory and shutdown the system.
11. Repeat steps 1 and 10 two more times.

Measuring game load times

Measuring Battlefield 3 load times

Setting up the test

1. Install the Origin client:
    a. Download the Origin client from http://www.origin.com/download.
    b. Double-click the OriginThinSetup.exe file.
    c. Click Run.
    d. Click Install.
    e. Accept the license agreement, and click OK.
    f. Enter login information, and click Log In.
2. Install Battlefield 3:
    a. Click My Games.
    b. Right-click Battlefield 3, and select Download.
    c. When the game installation is complete, double-click the desktop icon.
    d. Click Play Campaign.
    e. In the Joining server pop-up, click Open Game Manager.
    f. In the Browser plugin update available window, click Download.
    g. Click Save File.
    h. Double-click the battlelog-web-plugins_2.1.3_108.exe file.
    i. Click Run.
    j. Click Continue.
    k. Click Campaign.
    l. Click Easy.
    m. Play until you reach the Uprising mission.
    n. Exit the mission.
3. Click Options.
    a. Depending on the test scenario you are running, select either Low or Ultra from the Overall Quality drop-down menu. Ensure the following settings are selected:
        *   Full screen
        *   1920 x 1080
4. Click Back.
5. Exit the game.

Running the test (Scenarios 1 and 2)

1. Boot the system and open an administrative command prompt:
    a. Type `CMD`
    b. Right-click the Command Prompt app to open App options.
    c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
    Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Double-click the Battlefield 3 desktop icon.

5. Prepare the stopwatch.
6. Simultaneously click Play Campaign and start the stopwatch.
7. Stop the stopwatch when the game loads, and record this time as Game Launch time.
8. Prepare the stopwatch.
9. Simultaneously click Resume Campaign and start the stopwatch.
10. Stop the stopwatch when the game loads and record this time as Load Level time.
11. Exit the game.
12. Shut down the system.
13. Repeat steps 1 through 11 two more times.
14. Change the Graphics Quality for the second scenario and repeat steps 1 through 11 three times.

Running the test (Scenario 3 Downloading Large File with Ultra Quality Graphics)
1. Boot the system and open an administrative command prompt:
    a. Type `CMD`
    b. Right-click the Command Prompt app to open App options.
    c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Open Internet Explorer, and navigate to http://msdn.microsoft.com/subscriptions/default.aspx.
5. Sign in.
6. Click the Download Software link.
7. Click the Download button for Windows 8 (multiple editions) (x64) - DVD (English).
8. Click OK.
9. Double-click the Battlefield 3 desktop icon.
10. Prepare the stopwatch.
11. Simultaneously click Play Campaign and start the stopwatch.
12. Stop the stopwatch when the game loads, and record this time as Game Launch time.
13. Prepare the stopwatch.
14. Simultaneously click Resume Campaign and start the stopwatch.
15. Stop the stopwatch when the game loads and record this time as Load Level time.
16. Exit the game.
17. Cancel the MSDN download.
18. Shut down the system.
19. Repeat steps 1 through 17 two more times.

Measuring Star Wars the Old Republic load times
Setting up the test
1. Download the SWTOR_setup.exe game from https://account.swtor.com/play-free?intcmp=sor_bwa-mkt-t-us-a-002.
2. Double-click the SWTOR_setup.exe file.
3. Click Install.
4. Enter account name and password, and press Enter.
5. After the game installs, click Play.

6. Click the Preferences button.
   a. Depending on the test scenario you are running, select either Very Low or Very High from the Graphics Quality Preset drop-down menu. Ensure the following settings are selected:
      - Full screen
      - 1980 x 1080
   b. Click OK.
7. Select character, and click Play.
8. Play the enough of the game to acquire a space ship and travel to Hutta.
9. Exit the game.

Running the test (Scenarios 1 and 2)
1. Boot the system and open an administrative command prompt:
   a. Type `CMD`
   b. Right-click the Command Prompt app to open App options.
   c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Double-click the Star Wars: The Old Republic desktop icon.
5. Enter the username and password.
6. Prepare the stopwatch.
7. Simultaneously click Play and start the stopwatch.
8. Stop the stopwatch when the Character Selection screen appears. Record this number as the Game Launch time.
9. Prepare the stopwatch.
10. Simultaneously select the game character and click Play, and start the stopwatch.
11. Stop the stopwatch when the game level is loaded, and record this time as the Initial Load Level time.
12. Prepare the stopwatch.
13. Simultaneously click on the door of the spaceship to Hutta, and start the stopwatch.
14. Stop the stopwatch when the hangar is loaded, and record this time as Load Level time.
15. Return to the ship and quit the game.
16. Shut down the system.
17. Repeat steps 1 through 13 two more times.
18. Change the Graphics Quality for the second scenario and repeat steps 1 through 13 three times.

Running the test (Scenario 3 Downloading Large File with Very High Quality Graphics)
1. Boot the system and open an administrative command prompt:
   a. Type `CMD`
   b. Right-click the Command Prompt app to open App options.
   c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Open Internet Explorer, and navigate to http://msdn.microsoft.com/subscriptions/default.aspx.

5. Sign in.
6. Click the Download Software link.
7. Click the Download button for Windows 8 (multiple editions) (x64) - DVD (English).
8. Click OK.
9. Double-click the Star Wars: The Old Republic desktop icon.
10. Enter the username and password.
11. Prepare the stopwatch.
12. Simultaneously click Play and start the stopwatch.
13. Stop the stopwatch when the Character Selection screen appears. Record this number as the Game Launch time.
14. Prepare the stopwatch.
15. Simultaneously select the game character and click Play, and start the stopwatch.
16. Stop the stopwatch when the game level is loaded, and record this time as the Initial Load Level time.
17. Prepare the stopwatch.
18. Simultaneously click on the door of the spaceship to Hutta, and start the stopwatch.
19. Stop the stopwatch when the hangar is loaded, and record this time as Load Level time.
20. Return to the ship and quit the game.
21. Cancel the MSDN download.
22. Shut down the system.
23. Repeat steps 1 through 19 two more times.

Measuring Elder Scrolls V: Skyrim load times

Setting up the test

1. Install Elder Scrolls V: Skyrim:
    a. Insert the installation DVD.
    b. Click Install The Elder Scrolls V: Skyrim.
    c. Accept the Skyrim license agreement and click Install.
    d. Accept the Steam license agreement and click Next.
    e. Click Install.
    f. Log in to the Steam account.
    g. Click Next to install the game.
    h. Click Finish.
2. Right-click the Elder Scrolls V: Skyrim in Steam, and select Create Desktop Shortcut from the drop-down menu.
3. Double-click the Elder Scrolls V: Skyrim desktop icon.
4. Click Options.
    a. Depending on the test scenario you are running, select either Low or Ultra from the Detail Options pane. Ensure the following settings are selected:
        - Full screen
        - 1920 x 1080
5. Click OK.
6. Click Play.
7. Play enough of the game to arrive at Helgen Keep.
8. Exit the game.

Running the test (Scenario 1 and 2)

1. Boot the system and open an administrative command prompt:
    a. Type `CMD`
    b. Right-click the Command Prompt app to open App options.
    c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Double-click the Elder Scrolls V: Skyrim desktop Icon.
5. Prepare the stopwatch.
6. Simultaneously click Play and start the stopwatch.
7. Stop the stopwatch when the game menu appears, and record this time as the Game Launch Time.
8. Click Load.
9. Select Auto Helgen Keep.
10. Prepare the stopwatch.
11. Simultaneously press Enter and start the stopwatch.
12. Stop the stopwatch when the game loads and record this time as the Load Level time.
13. Exit the Game.
14. Shut down the system.
15. Repeat steps 1 through 19 two more times.
16. Change the Graphics Quality for the second scenario and repeat steps 1 through 14 three times.

Running the test (Scenario 3 Downloading Large File with Ultra Quality Graphics)

1. Boot the system and open an administrative command prompt:
    a. Type `CMD`
    b. Right-click the Command Prompt app to open App options.
    c. Click Run as administrator.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Open Internet Explorer, and navigate to http://msdn.microsoft.com/subscriptions/default.aspx.
5. Sign in.
6. Click the Download Software link.
7. Click the Download button for Windows 8 (multiple editions) (x64) - DVD (English).
8. Click OK.
9. Double-click the Elder Scrolls V: Skyrim desktop Icon.
10. Prepare the stopwatch.
11. Simultaneously click Play and start the stopwatch.
12. Stop the stopwatch when the Bethesda Game Studios symbol appears, and record this time as the Game Launch Time.
13. Click Load.
14. Select Auto Helgen Keep.

15. Prepare the stopwatch.
16. Simultaneously press Enter and start the stopwatch.
17. Stop the stopwatch when the game loads, and record this time as the Load Level time.
18. Press Escape.
19. Click Save Game.
20. Prepare the stopwatch.
21. Simultaneously click New Save and start the stopwatch.
22. Stop the stopwatch when the word Saving disappears, and record this time as Save Game time.
23. Exit the Game.
24. Cancel the MSDN download.
25. Shut down the system.
26. Repeat steps 1 through 25 two more times.

Measuring system performance with Futuremark PCMark 7

Setting up the test
1. Reset the system with the appropriate test image.
2. Download the PCMark_7_v104_installer.exe Windows package from www.futuremark.com/benchmarks/pcmarkvantage/download/.
3. Install PCMark 7 1.0.4 with the default options by double-clicking the PCMark_7_v104_installer.exe file.
4. Launch PCMark 7 1.0.4 by clicking on the PCMark 7 desktop icon. Enter the registration code, click Register, and click OK.
5. Exit PCMark 7 1.0.4.

Running the test
1. Reboot the system.
2. Double-click the PCMark 7 desktop icon to launch the benchmark.
3. Select all test suites.
4. Click Run Benchmark.
5. When the benchmark run completes take a screenshot of the results, and record them as follows:
   - PCMark Score
   - Lightweight Score
   - Creativity Score
   - Entertainment Score
   - Computation Score
   - System Storage Score
6. Repeat steps 1 through 5 two more times, and report the median of the three runs.

Measuring hard disk performance with PassMark PerformanceTest 8

Setting up the test
1. Download PassMark PerformanceTest Professional 8.0 from http://www.passmark.com/products/pt.htm.
2. Double-click petst.exe to run setup.
3. At the Welcome screen, click Next.
4. Accept the license agreement, and click Next.
5. At the Choose Install Location screen, accept the default location of C:\Program Files\PerformanceTest, and click Next.

6. At the Select Start Menu Folder screen, click Next.
7. At the Ready to Install screen, click Install.
8. At the Completing the PerformanceTest Setup Wizard screen, deselect View Readme.txt, and click Finish to launch PerformanceTest.
9. At the Purchasing information screen, copy and paste the Username and key, and click Continue.
10. At the Key accepted screen, click OK.

Running the test
1. Boot the system and double-click the desktop icon to launch PassMark PerformanceTest.
2. Bring up an elevated command prompt:
    a. Select Windows Start orb.
    b. Type `cmd` and press Control-Shift-Enter.
3. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`

4. Do not interact with the system until the command completes.
5. After the command completes, wait 5 minutes before running the test.
6. From the top menu, click Tests→Disk→All.
7. After the run has finished, record the PassMark Disk Mark results containing Sequential Read, Sequential Write, and Random Seek results.
8. Power the system off.
9. Repeat the steps 1 through 7 two more times.

Measuring surface temperature

Test requirements
- Fluke® 2680A Data Acquisition System
- PassMark BurnInTest Professional

Measuring system temperature while idle
Setting up the test
6. Set the power plan to the manufacturer's default setting. Set the display brightness to 100 percent:
    a. Click Start.
    b. In the Start menu's quick search field, type `Power Options`
    c. Move the Screen brightness slider all the way to the right.
7. Set the remaining power plan settings as follows:
    - Dim the display: Never
    - Turn off the display: Never
    - Put the computer to sleep: Never
8. Disable the screen saver.
9. Place the system under test, mouse, keyboard, and display in a windowless, climate-controlled room.
10. Attach a Type T thermocouple to the exterior of the system under test at the following locations:
    - Center front exhaust fan

- Center top exhaust vent
- Center of disk drive
- Center rear CPU exhaust vent
- Center graphics card exhaust vent

11. Configure the Fluke 2680A Data Acquisition System to take measurements from the temperature probes and one ambient temperature probe using the Fluke DAQ software.
    a. Connect the Type T thermocouples to channels in the Fluke Fast Analog Input module (FAI).
    b. In the Fluke DAQ software, click each surface temperature channel, select Thermocouple from the list of Functions, and choose T from the list of ranges.
    c. Label each channel with the location associated with each thermocouple.
    d. In the Fluke DAQ software, click the ambient temperature channel, select Thermocouple from the list of Functions, and choose T from the list of ranges.
    e. Label this channel Ambient.
12. While running each test, use a Fluke 2680A Data Acquisition System to monitor ambient and temperature at each exterior point.

Running the test
1. Boot the system and bring up an elevated command prompt:
    - Select Windows Start orb.
    - Type `cmd` and press Control-Shift-Enter.
2. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
3. After the command completes, wait 5 minutes before running the test.
4. Start the Fluke 2680A data logger using the Fluke DAQ software.
5. Allow the system under test to sit idle for 1 hour.
6. After 1 hour, stop the Fluke 2680A data logger using the Fluke DAQ software.
7. Export the thermal measurements to a CSV file.
8. Use the thermal measurement CSV file to find and report the highest temperature measured at each location during the test.
9. Power the system under test off for 1 hour, and allow it to return to room temperature.
10. Repeat steps 1 through 9 two more times.

Measuring system temperature while under load

Setting up the test
1. Download PassMark BurnInTest Professional 7.0 from http://www.passmark.com/products/bit.htm.
2. Double-click bitpro_x64.exe to run setup.
3. At the Welcome screen, click Next.
4. Accept the license agreement, and click Next.
5. At the Choose Install Location screen, accept the default location of C:\Program Files\BurnInTest, and click Next.
6. At the Select Start Menu Folder screen, click Next.
7. At the Ready to Install screen, click Install.

8. At the Completing the BurnInTest Setup Wizard screen, deselect View Readme.txt, and click Finish to launch BurnInTest.
9. At the Purchasing information screen, copy and paste the Username and key, and click Continue.
10. At the Key accepted screen, click OK.
11. Select Test selection and duty cycles from the Configuration menu item.
12. Change the Auto Stop After field to 180.
13. Select CPU, 2D Graphics, 3D Graphics, RAM, and Disk(s), and deselect all other subsystems.
14. Set load to 100, and click OK.
15. Select Test Preferences from the Configuration menu item and set or verify the following by clicking on each tab:
    - Disk: select C: drive
    - Logging: select Turn automatic logging on
    - 2D Graphics: select All available Video Memory
    - 3D Graphics: defaults
    - RAM: select Multi-Process Torture Test

Running the test
1. Boot the system double-click the desktop icon to launch PassMark BurnInTest.
2. Bring up an elevated command prompt:
    c. Select Windows Start orb.
    d. Type `cmd` and press Control-Shift-Enter.
3. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`
   Do not interact with the system until the command completes.
4. After the command completes, wait 5 minutes before running the test.
5. Click Start Selected Tests in the BurnInTest V7.0 Pro screen.
6. Start the Fluke 2680A data logger using the Fluke DAQ software.
7. After 1 hour, stop the Fluke 2680A data logger using the Fluke DAQ software.
8. Export the thermal measurements to a CSV file.
9. Use the thermal measurement CSV file to find and report the highest temperature measured at each location during the test.
10. Power the system under test off for 1 hour, and allow it to return to room temperature.
11. Repeat the steps 1 through 10 two more times.

ABOUT PRINCIPLED TECHNOLOGIES

![Principled Technologies logo]

Principled Technologies, Inc.
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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.