What is 3DMark?

3DMark is a benchmark designed to measure the performance of computer hardware. This version includes three different tests, each designed for a specific type of hardware ranging from smartphones to high-performance gaming PCs. More tests will be added over time.

3DMark works by running intensive graphical and computational tests on your hardware. The more powerful your hardware, the smoother the tests will run. Don't be surprised if your frame rates are low as 3DMark tests are very demanding.

Each test gives a score, which you can use to compare similar devices and systems. Unlike previous versions, there is no overall 3DMark score, only individual test scores. When testing devices or components, be sure to use the most appropriate test for the hardware's capabilities and report your results using the full name of the test, for example:

**CORRECT**  "Video card scores 5,800 in 3DMark Cloud Gate benchmark."
**WRONG**   "Video card scores 5,800 in 3DMark benchmark."

3DMark is used by millions of gamers, hundreds of hardware review sites and many of the world's leading manufacturers. We are proud to say that 3DMark is the world's most popular and widely used benchmark.

What's new in this version?

Cross-platform benchmarking

With the new 3DMark, for the first time, you can measure the performance of Windows, Windows RT, Android and iOS devices and directly compare scores across all four platforms.

Check the Futuremark website for the latest information on cross-platform availability. Please note that the more demanding tests requiring more advanced hardware will only be available in the Windows versions of 3DMark initially.

Complete Windows benchmarking toolkit

On Windows, this version of 3DMark is the first to include tests for DirectX 11, DirectX 10, and DirectX 9 level hardware within one application. All three tests, even those targeting DirectX 9 and DirectX 10 compatible hardware are powered by modern DirectX 11 engines using Direct3D feature levels. The new 3DMark is best and most versatile benchmark we have ever created.
3DMark lingo

This version is simply called **3DMark** to reflect its all-round versatility. Not only is this 3DMark the first in the series to offer cross-platform comparisons, it is also the first to test different Direct3D feature levels within one application.

Please avoid referring to this new version by any other name.

**CORRECT**  
3DMark

**WRONG**  
3DMark 12, 3DMark 2013, 3DMark Next, 3DMark for Windows

3DMark includes **Benchmark Tests** for measuring the performance of hardware and devices. Please do not abbreviate or use symbols for individual tests.

**CORRECT**  
"My phone can hardly run the Ice Storm test."

**WRONG**  
"My phone can hardly run the IS test."

Tests may also have a number of **Presets**, predefined settings that scale the workloads to match a specific range of hardware capabilities. Please do not abbreviate individual presets.

**CORRECT**  
"My PC struggles to run the Fire Strike Extreme preset."

**WRONG**  
"My new PC struggles to run the Fire Strike E preset."

Each Test may generate one or more **component scores** such as a Physics score, Graphics score or Combined score.

"My 3DMark Cloud Gate Physics score is lower than expected."

Component scores are generated from one or more **parts**, individual workloads designed to focus on a specific combination of effect and techniques.

**In summary**

<table>
<thead>
<tr>
<th>3DMark</th>
<th>The name of the application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Strike</td>
<td>Benchmark Test</td>
</tr>
<tr>
<td>Extreme</td>
<td>Preset</td>
</tr>
<tr>
<td>Graphics test</td>
<td>Component score</td>
</tr>
<tr>
<td>Part 2</td>
<td>Component test part</td>
</tr>
</tbody>
</table>

"What is your 3DMark Fire Strike Extreme Graphics test part 2 score?"
About this guide

Last updated: September 9, 2013

Latest version numbers

<table>
<thead>
<tr>
<th>3DMark GUI</th>
<th>Windows</th>
<th>Windows RT</th>
<th>Android</th>
<th>iOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3DMark GUI</td>
<td>1.1.0</td>
<td>Not yet released</td>
<td>1.1.0.1179</td>
<td>1.1.0</td>
</tr>
<tr>
<td>Ice Storm</td>
<td>1.1</td>
<td>n/a</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Cloud Gate</td>
<td>1.1</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Fire Strike</td>
<td>1.1</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Test compatibility

<table>
<thead>
<tr>
<th></th>
<th>Ice Storm</th>
<th>Cloud Gate</th>
<th>Fire Strike</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Windows RT</td>
<td>●</td>
<td>X¹</td>
<td>X¹</td>
</tr>
<tr>
<td>Android</td>
<td>●</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Apple iOS</td>
<td>●</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

¹ These tests will be added to 3DMark Windows RT Edition when there are publicly available Windows RT devices that support DirectX feature level 10 and feature level 11.
## System requirements

### Windows

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>Windows Vista(^2)</td>
<td>Windows 7 or Windows 8</td>
</tr>
<tr>
<td>Processor</td>
<td>1.8 GHz dual-core Intel or AMD CPU</td>
<td>1.8 GHz dual-core Intel or AMD CPU</td>
</tr>
<tr>
<td>Memory</td>
<td>2 GB</td>
<td>4GB</td>
</tr>
<tr>
<td>Graphics(^3)</td>
<td>DirectX 9(^4)</td>
<td>DirectX 11 with 1 GB graphics memory(^5)</td>
</tr>
<tr>
<td>Storage</td>
<td>3 GB free disk space</td>
<td>3 GB free disk space</td>
</tr>
</tbody>
</table>

### Windows RT

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>Windows RT</td>
</tr>
<tr>
<td>Memory</td>
<td>1 GB</td>
</tr>
<tr>
<td>Device</td>
<td>All Windows RT devices</td>
</tr>
<tr>
<td>Storage</td>
<td>164 MB</td>
</tr>
</tbody>
</table>

---

\(^2\) Windows Vista users must install the DirectX 11 platform update from Microsoft.

\(^3\) 3DMark Ice Storm requires 128 MB video card memory, Cloud Gate requires 256 MB video card memory, Fire Strike requires 1 GB video card memory, and Fire Strike Extreme requires 1.5 GB video card memory and 4 GB system memory. Video cards with less memory than specified can usually run the test but at the expense of a considerable performance penalty.

\(^4\) DirectX 9 hardware needs Shader Model 3.0 support, 128 MB and WDDM 1.1 drivers. Note that ATI Radeon X1x00 series cards do not have WDDM 1.1 drivers available and cannot run 3DMark. The oldest cards confirmed to work with 3DMark are Radeon HD 2x00 series (Ice Storm, Cloud Gate), NVIDIA GeForce 7x00 series (Ice Storm) and Intel GMA X4500 (Ice Storm).

\(^5\) Graphics hardware that supports all DirectX 11 features is required to run all tests in 3DMark.
### Android

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>Android 3.1</td>
</tr>
<tr>
<td>Memory</td>
<td>1 GB</td>
</tr>
<tr>
<td>Graphics</td>
<td>OpenGL ES 2.0 compatible</td>
</tr>
<tr>
<td>Storage</td>
<td>155 MB</td>
</tr>
</tbody>
</table>

### Apple iOS

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>iOS 6.0</td>
</tr>
<tr>
<td>Memory</td>
<td>512 MB</td>
</tr>
<tr>
<td>Device</td>
<td>iPhone 4, iPad 2, iPod touch (5th Gen)</td>
</tr>
<tr>
<td>Storage</td>
<td>174 MB</td>
</tr>
</tbody>
</table>
Does 3DMark use DirectX 11.1?

Yes, but only in a minor way and with a fallback for DirectX 11 to ensure compatibility with the widest range of hardware and to ensure that all tests work with Windows Vista and Windows 7 as well as Windows 8.

DirectX 11.1 API features were evaluated and those that could be utilized to accelerate the rendering techniques in the tests designed to run on DirectX 11.0 were used.

Discard resources and resource views

In cases where subsequent Direct3D draw calls will overwrite the entire resource or resource view and the application knows this, but it is not possible for the display driver to deduce it, a discard call is made to help the driver in optimizing resource usage. If DirectX 11.1 is not supported, a clear call or no call at all is made instead, depending on the exact situation. This DX11.1 optimization may have a performance effect with multi-GPU setups or with hardware featuring tile based rendering, which is found in some tablets and entry-level notebooks.

16 bpp texture formats

The 16 bpp texture formats supported by DirectX 11.1 are used on Ice Storm game tests to store intermediate rendering results during post processing steps. If support for those formats is not found, 32 bpp formats are used instead. This optimization gives a noticeable performance effect on hardware such as tablets, entry-level notebooks for which the Ice Storm tests provide a suitable benchmark.

There are no visual differences between the tests when using DX11 or DX11.1 in 3DMark and the practical performance difference from these optimizations is limited to Ice Storm on very low-end Windows hardware, and on Windows RT.
Good testing guide

To get accurate and consistent benchmark results you should test clean systems without third party software installed. If this is not possible, you should close as many background tasks as possible, especially automatic updates or tasks that feature pop-up alerts such as email and messaging programs.

If you are testing a mobile device, it is a good idea to close apps that may be running in the background, and disable notifications before running the benchmark. Some high-powered mobile devices use thermal throttling to avoid overheating the CPU, which can lead to lower scores on successive runs. To reduce this effect, we recommended waiting 15 minutes before and after 3DMark runs to allow the device to cool down.

- Running other programs and tasks during the benchmark can affect the results.
- Avoid touching the mouse, keyboard or touchscreen while the tests are running.
- Do not change the window focus while the benchmark is running.
- Press the ESC key (PC) or Back Button (Android) if you want to stop the test.

How to set up your hardware or device

1. Install all system updates to ensure your operating system is up to date.

2. Install the latest approved drivers for your hardware.

3. Restart the computer or device.

4. Wait 2 minutes for startup to complete.

5. Close all other programs, especially those that run in the background or task bar.

6. Wait for 15 minutes.

7. Run the benchmark test.

8. Repeat from step 3 at least three times to verify that the results are consistent.
3DMark settings

The settings found on the Help tab (Windows) and Settings screen (Windows RT, Android and iOS) apply to all 3DMark benchmark tests available in that version.

Run demo

Uncheck this box if you wish to skip the demo. This option is selected by default.

Register / Unregister

If you have a 3DMark Advanced or Professional Edition upgrade key, copy it into the box and press the Register button. If you wish to unregister your key, so you can move your license to a different machine for example, press the Unregister button.

Automatically view results online

When this box is checked 3DMark will automatically open a browser window allowing you to view your results on the Futuremark website after you complete a benchmark run. This option is selected by default and cannot be disabled in 3DMark Basic Edition.

Automatically hide results online

Check this box if you wish to keep your 3DMark test scores private. Hidden results are not visible to other users and do not appear in search results. Hidden results are not eligible for competitions or the Futuremark Overclocking Hall of Fame. This option is disabled by default and cannot be selected in 3DMark Basic Edition.

Scan SystemInfo

SystemInfo is a component used by Futuremark benchmarks to identify the hardware in your system or device. It does not collect any personally identifiable information. This option is selected by default and is required in order to get a valid benchmark test score.

SystemInfo hardware monitoring

This option controls whether SystemInfo monitors your CPU temperature, clock speed, power, and other hardware information during the benchmark run. This option is selected by default.

Demo audio

Uncheck this box if you wish to turn off the soundtrack while a demo is running. This option is selected by default.

GPU count

You can use this drop down to tell 3DMark how many GPUs are present in the system you are testing. The default choice, automatic, is fine in most cases and should only be changed in the rare instances when SystemInfo is unable to correctly identify the system's hardware.
Scaling mode

This option controls how the rendered output of each test, which is at a fixed resolution regardless of hardware, is scaled to fit the native resolution of the system's display or screen. The default option is Letterbox, which maintains the aspect ratio of the rendered output and adds bars to the top and bottom of the image to fill the remainder of the screen. Selecting Stretched will stretch the rendered output to fill the screen without preserving the original aspect ratio. This option does not affect the test score.

Language

Use this drop down to change the display language. The choices are English, German, Traditional Chinese and Simplified Chinese.

Custom settings

Each test has its own settings, found on the Custom tab (Windows) or Settings screen (Windows RT, Android and iOS), which you can adjust to explore the limits of your hardware's performance.

On Windows platforms, these custom settings are only available in 3DMark Advanced and Professional Editions.

You will only get an official 3DMark test score when you run a test with the default settings or one of the predefined Presets. When using custom settings you will still get the results from individual sub-tests as well as hardware performance monitoring information.
Ice Storm

Ice Storm is a cross-platform benchmark for mobile devices. Use it to test the performance of your smartphone, tablet, ultra-portable notebook or entry-level PC. Ice Storm includes two Graphics tests focusing on GPU performance and a Physics test targeting CPU performance.

On Windows and Windows RT, Ice Storm uses a DirectX 11 engine limited to Direct3D feature level 9, making it the ideal benchmark for portable devices supporting that feature level.

On Android and iOS, Ice Storm uses OpenGL ES 2.0.

Ice Storm's test content, settings and rendering resolution are the same on all platforms and scores can be compared across Windows, Windows RT, Android and iOS.

- Cross-platform benchmark for mobile devices.
- Includes two Graphics tests and a Physics test.
- Compare scores across Windows, Windows RT, Android and iOS.

How is 3DMark Ice Storm different from 3DMark06?

3DMark Ice Storm and 3DMark06 can both benchmark DirectX 9 compatible hardware, however, they use different engines and target different types of hardware. Scores from 3DMark06 and 3DMark Ice Storm cannot be directly compared.

<table>
<thead>
<tr>
<th></th>
<th>3DMark Ice Storm</th>
<th>3DMark06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>DirectX 11 targeting Direct3D feature level 9</td>
<td>DirectX 9</td>
</tr>
<tr>
<td>Target hardware</td>
<td>Powerful mobile devices (in 2013)</td>
<td>Powerful gaming PCs (in 2006)</td>
</tr>
</tbody>
</table>

3DMark Ice Storm is the ideal benchmark for modern mobile devices such as tablets, netbooks, ultra-portable notebooks and entry-level PCs that support Direct3D feature level 9.

For testing modern gaming PCs we recommend 3DMark Cloud Gate or 3DMark Fire Strike, since such systems will almost certainly support DirectX 10 or DirectX 11.
Ice Storm

<table>
<thead>
<tr>
<th>Rendering resolution</th>
<th>1280x720 (720p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPU memory budget</td>
<td>128 MB</td>
</tr>
<tr>
<td>Texture quality</td>
<td>Low</td>
</tr>
<tr>
<td>Bloom resolution</td>
<td>1/8</td>
</tr>
</tbody>
</table>

Use Ice Storm for device-to-device comparisons of mainstream mobile devices. Ice Storm is rendered at a fixed 720p resolution ("off-screen rendering") and then scaled to the native resolution of the display. This is the best approach for ensuring that devices can be compared fairly.

Many mobile devices lock their display refresh rate to 60Hz and force the use of vertical sync. If your device is able to run this test at more than 60 frames per second you will be prompted to run Ice Storm Extreme instead.

Ice Storm Extreme

<table>
<thead>
<tr>
<th>Graphics tests rendering resolution</th>
<th>1920x1080 (1080p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics test rendering resolution</td>
<td>1280x720 (720p)</td>
</tr>
<tr>
<td>GPU memory budget</td>
<td>256 MB</td>
</tr>
<tr>
<td>Texture Quality</td>
<td>High</td>
</tr>
<tr>
<td>Bloom resolution</td>
<td>1/4</td>
</tr>
</tbody>
</table>

Use Ice Storm Extreme for device-to-device comparisons of high performance mobile devices. Ice Storm Extreme raises the rendering resolution from 720p to 1080p and uses higher quality textures and post-processing effects in the Graphics tests to create a more demanding load for the latest smartphones and tablets. The Physics test runs at 720p to ensure the result is not influenced by the GPU.

Many mobile devices lock or limit their display refresh rate to 60Hz and force the use of vertical sync. If your device is able to run this test at more than 60 frames per second you will be prompted to run Ice Storm Unlimited instead.
Ice Storm Unlimited

<table>
<thead>
<tr>
<th>Graphics tests rendering resolution</th>
<th>1280x720 (720p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics test rendering resolution</td>
<td>1280x720 (720p)</td>
</tr>
<tr>
<td>GPU memory budget</td>
<td>128 MB</td>
</tr>
<tr>
<td>Texture Quality</td>
<td>Low</td>
</tr>
<tr>
<td>Bloom resolution</td>
<td>1/8</td>
</tr>
</tbody>
</table>

How does Unlimited differ from the other tests?

Ice Storm and Ice Storm Extreme measure the performance of the complete device. The nature of the test content and the methods used to render it to the screen are the same as typically used in the latest graphically demanding games. These two benchmark tests are the best choice when you want to measure the real-world performance of a device and make device-to-device comparisons.

Ice Storm Unlimited is a different type of benchmark test designed for making chip-to-chip comparisons of the hardware inside a device. The test provides an accurate and consistent way to measure the potential performance capability of chipsets, CPUs, GPUs and APUs without vertical sync, display resolution scaling and other operating system factors affecting the result.

In Unlimited mode the rendering engine uses a fixed time step between frames and renders exactly the same frames in every run on every device. The frames are rendered in 720p resolution "offscreen" while the display is updated with frame thumbnails every 100 frames to show progress.

Comparing scores

Scores from 3DMark Ice Storm, Ice Storm Extreme and Ice Storm Unlimited should not be compared to each other - they are separate tests with their own scores, even though they share the same content.

Scores from individual tests can be compared across platforms. Ice Storm Unlimited will be added to 3DMark Windows Edition soon.
Graphics test 1

Ice Storm Graphics test 1 stresses the hardware’s ability to process lots of vertices while keeping the pixel load relatively light. Hardware on this level may have dedicated capacity for separate vertex and pixel processing. Stressing both capacities individually reveals the hardware’s limitations in both aspects. Pixel load is kept low by excluding expensive post processing steps, and by not rendering particle effects.

Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Triangles</th>
<th>Pixels(^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Storm</td>
<td>530,000</td>
<td>180,000</td>
<td>1.9 million</td>
</tr>
<tr>
<td>Ice Storm Extreme</td>
<td>580,000</td>
<td>190,000</td>
<td>4.4 million</td>
</tr>
</tbody>
</table>

Graphics test 2

Graphics test 2 stresses the hardware’s ability to process lots of pixels. It tests the ability to read textures, do per pixel computations and write to render targets. The additional pixel processing compared to Graphics test 1 comes from including particles and post processing effects such as bloom, streaks and motion blur. The numbers of vertices and triangles are considerably lower than in Graphics test 1 because shadows are not drawn and the processed geometry has a lower number of polygons.

Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Triangles</th>
<th>Pixels(^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Storm</td>
<td>79,000</td>
<td>26,000</td>
<td>7.8 million</td>
</tr>
<tr>
<td>Ice Storm Extreme</td>
<td>89,000</td>
<td>28,000</td>
<td>18.6 million</td>
</tr>
</tbody>
</table>

\(^6\) This figure is the average number of pixels processed per frame before the image is scaled to fit the native resolution of the device being tested. If the device’s display resolution is greater than the test’s rendering resolution, the actual number of pixels processed per frame will be even greater.
Physics test

The purpose of the Physics test is to benchmark the hardware's ability to do gameplay physics simulations on CPU. The GPU load is kept as low as possible to ensure that only the CPU's capabilities are stressed.

The test has four simulated worlds. Each world has two soft bodies and two rigid bodies colliding with each other. One thread per available CPU core is used to run simulations. All physics are computed on the CPU with soft body vertex data updated to the GPU each frame. The background is drawn as a static image for the least possible GPU load.

The Physics test uses the Bullet Open Source Physics Library.

Ice Storm engine

Ice Storm uses the same engine on all platforms. The engine supports the following features.

- Traditional forward rendering using one pass per light.
- Scene updating and visibility computations are multithreaded.
- Draw calls are issued from a single thread.
- Support for skinned and static geometries.
- Surface lighting model is basic Blinn Phong.
- Supported light types include unshadowed point light and optionally shadow mapped directional light as well as pre-computed environmental cube.
- Support for transparent geometries and particle effects.
- 16-bit color formats are used in illumination buffers if supported by the hardware.

Windows

On Windows and Windows RT, Ice Storm requires support for Direct3D feature level 9_3 or 9_1 with the optional shadow filtering support.

Android

Ice Storm does not use any vendor specific OpenGL ES 2.0 extensions. Textures are compressed using ETC. Textures that require an alpha channel are loaded uncompressed.

iOS

Textures, including those with an alpha channel, are compressed using PVRTC.
Windows edition change log

3DMark Windows Edition v1.1.0 – May 6, 2013

New

- Added Ice Storm Extreme preset to 3DMark Advanced and Professional Editions.

3DMark Windows Editions v1.0.0 – February 4, 2013

- Launch version.

Android edition change log


New

- New Ice Storm Unlimited test, see main app description for details.
- Compare 3DMark scores with Apple iOS devices in the Device Channel.

Improved

- Forced vertical sync on Android devices limits apps to displaying a maximum of 60 frames per second. Your score will be shown as "Maxed out" if your device hits the vertical sync limit during a test.
- 3DMark will recommend the best test for your device to avoid vertical sync limits.

Compatibility

- Nexus 7 (2013) is correctly identified.

3DMark Android Edition v1.0.3-1138 - August 20, 2013

Compatibility

- Added a workaround for a driver bug on Nexus 7 devices running Android 4.3.
3DMark Android Edition v1.0.2-1109 - May 2, 2013

New

- Added chipset model to device detail pages.

Improved

- Ice Storm Extreme Physics test for measuring CPU performance now runs at 720p to ensure the result is not influenced by the GPU. Ice Storm Extreme scores may improve slightly on devices with low-end GPUs.

Optimized

- Faster image loading in the Device Channel.
- Better score bar scaling in search result lists.
- Reduced app size to 149 MB.

Compatibility

- Automatically skip demo on devices with TI OMAP 44xx chipset to avoid a memory-related crash. There will be some visual corruption during the Physics test however this does not affect the score and you will now be able to complete all the tests on these devices.
- Automatically skip demo if the device runs out of memory during the demo, typically on devices with 512 MB of memory. The recommended minimum device memory for 3DMark is 1 GB (1024 MB).

Fixed

- Fixed a bug that prevented your best score being shown as your Highest Score.
- My Device now shows the Android OS version installed on the current device. Device Channel detail pages show the Android OS version shipped with the model.


New

- You can now search the Device Channel.
- You can now report unknown and incorrectly identified devices.

Fixed

- Fixed a bug that caused crashes for some users.
- Fixed the "no score" bug that could cause the test to exit after the demo.
The Device Channel list loads faster and uses less memory.

3DMark Android Edition v1.0.0 – April 2, 2013

- Launch version.
- Added Ice Storm Extreme test for the latest smartphones and tablets.

iOS edition change log

3DMark iOS Edition v1.1.0 – September 9, 2013

- Launch version.
Cloud Gate

Cloud Gate is a new test designed for Windows notebooks and typical home PCs. It is a particularly good benchmark for systems with integrated graphics. Cloud Gate includes two graphics tests and a physics test. The benchmark uses a DirectX 11 engine limited to Direct3D feature level 10 making it suitable for testing DirectX 10 compatible hardware. Cloud Gate is only available in the Windows edition of 3DMark.

- Designed for typical home PCs and notebooks.
- DirectX 11 engine supporting DirectX 10 hardware.
- Includes two graphics tests and a physics test.

3DMark Cloud Gate and 3DMark Vantage compared

3DMark Vantage and 3DMark Cloud Gate are both benchmarks for DirectX 10 compatible hardware. The difference is in the engine powering each benchmark.

3DMark Vantage, released in April 2008, uses a DirectX 10 engine. 3DMark Cloud Gate uses a DirectX 11 engine limited to Direct3D feature level 10. Using Direct3D feature levels is the modern approach to game engine design as it allows developers to use a DirectX 11 engine and still support older generation hardware all the way down to DirectX 9 level models.

We recommend using 3DMark Cloud Gate for testing DirectX 10 based systems. Scores from 3DMark Vantage and 3DMark Cloud Gate cannot be directly compared.

Cloud Gate default settings

<table>
<thead>
<tr>
<th>Rendering Resolution</th>
<th>1280x720</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPU memory Budget</td>
<td>256 MB</td>
</tr>
<tr>
<td>Shadow Sample Count</td>
<td>4</td>
</tr>
<tr>
<td>Shadow Map Resolution</td>
<td>1024</td>
</tr>
<tr>
<td>Depth of Field Quality</td>
<td>Low</td>
</tr>
<tr>
<td>Bloom Resolution</td>
<td>1/8</td>
</tr>
</tbody>
</table>
Graphics test 1

Cloud Gate Graphics test 1 has an emphasis on geometry processing while having simple shaders. Volumetric illumination is disabled, but the scene contains particle effects. FFT based bloom effects and a depth of field effect are added as post processing steps.

Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Triangles</th>
<th>Pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Gate</td>
<td>3.0 million</td>
<td>1.1 million</td>
<td>15.6 million</td>
</tr>
</tbody>
</table>

Graphics test 2

Cloud Gate Graphics test 2 has shaders that are more mathematically complex than Graphics test 1, but has less geometry to process. Simple volumetric illumination is used, but the scene has no particle effects. Post processing steps are similar to Graphics test 1.

Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Triangles</th>
<th>Pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Gate</td>
<td>1.8 million</td>
<td>690,000</td>
<td>16.3 million</td>
</tr>
</tbody>
</table>

Physics test

The Cloud Gate Physics test benchmarks the hardware's ability to run gameplay physics simulations on CPU. The GPU load is kept as low to ensure that only the CPU is stressed.

The test has 32 simulated worlds. Each world has 4 soft bodies, 4 joints and 20 rigid bodies colliding with each other. The rigid bodies are invisible and are there to cause the blast effect on the soft bodies.

The simulations run on one thread per available CPU core. All physics are computed on the CPU with soft body vertex data updated to the GPU each frame. Each world also has one CPU simulated particle system. The Physics test uses a forward renderer for minimum GPU load.

\[7\] This figure is the average number of pixels processed per frame before the image is scaled to fit the native resolution of the device being tested. If the device's display resolution is greater than the test's rendering resolution, the actual number of pixels processed per frame will be even greater.
The test duration is 20 seconds but the score calculation begins after 8 seconds. The first 8 seconds skipped to allow all simulated objects to actively participate in simulation.

The Cloud Gate Physics test uses the Bullet Open Source Physics Library.

**Cloud Gate engine**

Cloud Gate tests use same engine as Fire Strike, but with a reduced set of features including a simplified lighting model and some fallbacks implemented for Direct3D feature level 10.

On Windows and Windows RT, Cloud Gate requires graphics hardware with support for Direct3D feature level 10 or greater.

**Change log**

3DMark Windows Edition v1.1.0 – May 6, 2013

- No changes to Cloud Gate in this update.

3DMark Windows Editions v1.0.0 – February 4, 2013

- Launch version
Fire Strike

Fire Strike is the new showcase DirectX 11 benchmark for high-performance gaming PCs. Using a multi-threaded DirectX 11 engine, Fire Strike includes two graphics tests, a physics test and a combined test designed to stress the CPU and GPU at the same time.

3DMark Advanced and Professional Editions include an additional Extreme preset for high-end systems with multiple GPUs. Fire Strike is only available in the Windows editions of 3DMark initially.

- Designed for high-performance gaming PCs.
- Extreme preset for multi-GPU systems.
- Stunning DirectX 11 showcase graphics.

How is 3DMark Fire Strike different from 3DMark 11?

3DMark 11 is a DirectX 11 benchmark that was released in December 2010. 3DMark Fire Strike is a second generation DirectX 11 benchmark and is the more modern and demanding of the two. Scores from 3DMark 11 and 3DMark Fire Strike cannot be directly compared.

<table>
<thead>
<tr>
<th></th>
<th>3DMark Fire Strike</th>
<th>3DMark 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>DirectX 11</td>
<td>DirectX 11</td>
</tr>
<tr>
<td>Default setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rendering resolution</td>
<td>1920x1080 (1080p)</td>
<td>1280x720 (720p)</td>
</tr>
<tr>
<td>Extreme preset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rendering resolution</td>
<td>2560x1440 (1440p)</td>
<td>1920x1080 (1080p)</td>
</tr>
</tbody>
</table>

While 3DMark 11's Entry preset can prove useful for testing entry-level hardware, in most cases we recommend using 3DMark Fire Strike for testing DirectX 11 based systems.
### Fire Strike default settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>1920x1080</td>
</tr>
<tr>
<td>GPU Memory Budget</td>
<td>1 GB</td>
</tr>
<tr>
<td>Tessellation Detail</td>
<td>Medium</td>
</tr>
<tr>
<td>Surface Shadow Sample Count</td>
<td>8</td>
</tr>
<tr>
<td>Shadow Map Resolution</td>
<td>1024</td>
</tr>
<tr>
<td>Volume Illumination Quality</td>
<td>Medium</td>
</tr>
<tr>
<td>Particle Illumination Quality</td>
<td>Medium</td>
</tr>
<tr>
<td>Ambient Occlusion Quality</td>
<td>Medium</td>
</tr>
<tr>
<td>Depth of Field Quality</td>
<td>Medium</td>
</tr>
<tr>
<td>Bloom Resolution</td>
<td>1/4</td>
</tr>
</tbody>
</table>

### Fire Strike Extreme settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>2560x1440</td>
</tr>
<tr>
<td>GPU Memory Budget</td>
<td>1.5 GB</td>
</tr>
<tr>
<td>Tessellation Detail</td>
<td>High</td>
</tr>
<tr>
<td>Surface Shadow Sample Count</td>
<td>16</td>
</tr>
<tr>
<td>Shadow Map Resolution</td>
<td>2048</td>
</tr>
<tr>
<td>Volume Illumination Quality</td>
<td>High</td>
</tr>
<tr>
<td>Particle Illumination Quality</td>
<td>High</td>
</tr>
<tr>
<td>Ambient Occlusion Quality</td>
<td>High</td>
</tr>
<tr>
<td>Depth of Field Quality</td>
<td>High</td>
</tr>
<tr>
<td>Bloom Resolution</td>
<td>1/4</td>
</tr>
</tbody>
</table>
How is the Extreme preset different from default settings?

3DMark Fire Strike Extreme is a modified version of 3DMark Fire Strike designed for high-end multi-GPU (SLI/Crossfire) systems and future hardware generations. In addition to the higher rendering resolution, additional visual quality improvements increase the rendering load to ensure accurate performance measurements for truly extreme hardware setups.

Scores from 3DMark Fire Strike and Fire Strike Extreme should not be compared to each other - they are separate tests with their own scores, even if they share the same benchmark content. The Extreme preset is the highest workload 3DMark can currently offer.

Graphics test 1

3DMark Fire Strike Graphics test 1 focuses on geometry and illumination. Particles are drawn at half resolution and dynamic particle illumination is disabled.

There are 100 shadow casting spot lights and 140 non-shadow casting point lights in the scene. Compute shaders are used for particle simulations and post processing. Pixel processing is lower than in Graphics test 2 as there is no depth of field effect.

Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Tessellation patches</th>
<th>Triangles</th>
<th>Pixels(^8)</th>
<th>Compute shader invocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Strike</td>
<td>3.9 million</td>
<td>500,000</td>
<td>5.1 million</td>
<td>80 million</td>
<td>1.5 million</td>
</tr>
<tr>
<td>Fire Strike Extreme</td>
<td>3.9 million</td>
<td>560,000</td>
<td>9.9 million</td>
<td>150 million</td>
<td>3.5 million</td>
</tr>
</tbody>
</table>

Graphics test 2

3DMark Fire Strike Graphics test 2 focuses on particles and GPU simulations. Particles are drawn at full resolution and dynamic particle illumination is enabled.

There are two smoke fields simulated on GPU. Six shadow casting spot lights and 65 non-shadow casting point lights are present. Compute shaders are used for particle and fluid simulations and for post processing steps. Post processing includes a depth of field effect.

---

\(^8\) This figure is the average number of pixels processed per frame before the image is scaled to fit the native resolution of the device being tested. If the device’s display resolution is greater than the test’s rendering resolution, the actual number of pixels processed per frame will be even greater.
### Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Tessellation patches</th>
<th>Triangles</th>
<th>Pixels</th>
<th>Compute shader invocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Strike</td>
<td>2.6 million</td>
<td>240,000</td>
<td>5.8 million</td>
<td>170 million</td>
<td>8.1 million</td>
</tr>
<tr>
<td>Fire Strike Extreme</td>
<td>3.9 million</td>
<td>260,000</td>
<td>12.9 million</td>
<td>400 million</td>
<td>10.4 million</td>
</tr>
</tbody>
</table>

### Physics test

3DMark Fire Strike Physics test benchmarks the hardware's ability to run gameplay physics simulations on the CPU. The GPU load is kept as low as possible to ensure that only the CPU is stressed. The Bullet Open Source Physics Library is used as the physics library for the test.

The test has 32 simulated worlds. One thread per available CPU core is used to run simulations. All physics are computed on CPU with soft body vertex data updated to GPU each frame.

### Combined test

3DMark Fire Strike Combined test stresses both the GPU and CPU simultaneously. The GPU load combines elements from Graphics test 1 and 2 using tessellation, volumetric illumination, fluid simulation, particle simulation, FFT based bloom and depth of field.

The CPU load comes from the rigid body physics of the breaking statues in the background. There are 32 simulation worlds running in separate threads each containing one statue decomposing into 113 parts. Additionally there are 16 invisible rigid bodies in each world except the one closest to camera to push the decomposed elements apart. The simulations run on one thread per available CPU core.

The 3DMark Fire Strike Combined test uses the Bullet Open Source Physics Library.

### Processing performed in an average frame

<table>
<thead>
<tr>
<th></th>
<th>Vertices</th>
<th>Tessellation patches</th>
<th>Triangles</th>
<th>Pixels</th>
<th>Compute shader invocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Strike</td>
<td>7.5 million</td>
<td>530,000</td>
<td>7.9 million</td>
<td>150 million</td>
<td>110 million</td>
</tr>
<tr>
<td>Fire Strike Extreme</td>
<td>9.2 million</td>
<td>540,000</td>
<td>14.8 million</td>
<td>390 million</td>
<td>110 million</td>
</tr>
</tbody>
</table>
Fire Strike engine

Multithreading

The multithreading model is based on DX11 deferred device contexts and command lists. The engine utilizes one thread per available CPU core. One of the threads is considered as the main thread, which uses both immediate device context and deferred device context. The other threads are worker threads, which use only deferred device contexts.

Rendering workload is distributed between the threads by distributing items (e.g. geometries and lights) in the rendered scene to the threads. Each thread is assigned roughly equal amount of scene items.

When rendering a frame, each thread does the work associated to items assigned to the thread. That includes, for example, computation of transformation matrix hierarchies, computation of shader parameters (constants buffer contents and dynamic vertex data) and recording of DX API calls to a command list. When the main thread is finished with the tasks associated to its own items, it executes the command lists recorded by worker threads.

Tessellation

The engine supports rendering with and without tessellation. The supported tessellation techniques are PN Triangles, Phong, and displacement map based detail tessellation. Both triangle and quad based tessellation is supported.

Tessellation factors are adjusted to achieve desired edge length for output geometry on the render target. Additionally, patches that are back facing and patches that are outside of the view frustum are culled by setting the tessellation factor to zero.

Tessellation is turned entirely off by disabling hull and domain shaders when size of object's bounding box on render target drops below a given threshold. This applies both to g-buffer and shadow map drawing.

Lighting

Lighting is done in deferred style. Geometry attributes are first rendered to a set of render targets. Ambient occlusion is then computed from depth and normal data. Finally illumination is rendered based on those attributes.
Surface illumination

Two different surface shading models and g-buffer compositions are supported. The more complex model uses four textures and depth texture as the g-buffer. The simpler model uses two textures and depth texture.

Surface illumination model is either combination of Oren-Nayar diffuse reflectance and Cook-Torrance specular reflectance or basic Blinn Phong reflectance model. Simple surface shading model is used on Feature Level 10 demo and tests while the complex model is used on Feature Level 11 demo and tests. Optionally atmospheric attenuation is also computed.

Horizon based screen space ambient occlusion can be applied to the surface illumination.

Point, spot and directional lights are supported. Spot and directional lights can be shadowed. For spot lights, shadow texture size is selected based on size of the light volume in screen space. Shadow maps are sampled using best candidate sample distribution. Sample pattern is dithered with 4x4 pixel pattern.

Volumetric illumination

The renderer supports volume illumination. It is computed by approximating the light scattered towards the viewer by the medium between eye and the visible surface on each lit pixel. The approximation is based on volume ray casting and the Rayleigh-Mie scattering and attenuation model.

One ray is cast on each lit pixel for each light. The cast ray is sampled at several depth levels. Sampling quality is improved by dithering sampling depths with a 4x4 pixel pattern. The achieved result is blurred to combine the different sampling depths on neighboring pixels before combining the volume illumination with the surface illumination.

When rendering illumination, there are two high dynamic range render targets. One is for surface illumination and the other for volume illumination.

Particle illumination

Particle effects are rendered on top of opaque surface illumination with additive or alpha blending. Particles are simulated on the GPU. Particles can be either simply self-illuminated or receive illumination from scene lights.

Lights that participate in particle illumination can be individually selected. To illuminate particles, the selected lights are rendered to three volume textures that are fitted into view frustum. The textures contain incident radiance in each texel stored as spherical harmonics. Each of the three textures holds data for one color channel storing four coefficients. Incident radiance from each light is rendered to these volume textures as part of light rendering.
When rendering illuminated particles, hull and domain shaders are enabled. Incident radiance volume texture sampling is done in the domain shader. Tessellation factors are set to produce fixed size triangles in screen pixels. Tessellation is used to avoid sampling incident radiance textures in the pixel shader.

Particles can cast shadows on opaque surface and on other particles. For generating particle shadows, particle transmittance is first rendered to a 3D texture. The transmittance texture is rendered from the shadow casting light like a shadow map. After particles have been rendered to the texture, an accumulated transmittance 3D texture is generated by accumulating values of each depth slice in the transmittance texture. The accumulated transmittance texture can then be sampled when rendering illumination or incident radiance that is used to illuminate particles.

**Post-processing**

**Particle based distortion**

Particles can be used to generate a distortion effect. For particles that generate the effect, a distortion field is rendered to a texture using a 3D noise texture as input. This field is then used to distort the input image in post processing phase.

**Depth of field**

The effect is computed using the following procedure:

1. Circle of confusion radius is computed for all screen pixels and stored in a full resolution texture.
2. Half and quarter resolution versions are made from the radius texture and the original illumination texture.
3. Positions of out-of-focus pixels whose circle of confusion radius exceeds a predefined threshold are appended to a buffer.
4. The position buffer is used as point primitive vertex data and, using Geometry Shaders, the image of a hexagon-shaped bokeh is splatted to the positions of these vertices. Splatting is done to a texture that is divided into regions with different resolutions using multiple viewports. First region is screen resolution and the rest are a series of halved regions down to 1x1 texel resolution. The screen space radius of the splatted bokeh determines the used resolution. The larger the radius the smaller the used splatting resolution.
5. Steps 3 and 4 are performed separately for half and quarter resolution image data with different radius thresholds. Larger bokehs are generated from lower resolution image data.
6. The different regions of the splatting texture are combined by up-scaling the data in the smaller resolution regions step by step to the screen resolution region.
7. Finally, the out-of-focus illumination is combined with the original illumination.

Lens reflections

The effect is computed by first applying a filter to the computed illumination in frequency domain like in the bloom effect. The filtered result is then splatted in several scales and intensities on top of the input image using additive blending. The effect is computed in the same resolution as the bloom effect and therefore the forward FFT needs to be performed only once for both effects. As in the bloom effect, the forward and inverse FFTs are performed using the CS and 32bit floating point textures.

Bloom

The effect is computed by transforming the computed illumination to frequency domain using Fast Fourier Transform (FFT) and applying bloom filter to the input in that domain. An inverse FFT is then applied to the filtered image. The forward FFT, applying the bloom filter and inverse FFT are done with the CS. The effect is computed in reduced resolution. The input image resolution is halved two or three times depending on settings and then rounded up to nearest power of two. The FFTs are computed using 32bit floating point textures. A procedurally pre-computed texture is used as the bloom filter. The filter combines blur, streak, lenticular halo and anamorphic flare effects.

Anti-aliasing

MSAA and FXAA anti-aliasing methods are supported.

In MSAA method G-buffer textures are multisampled with the chosen sample count. Edge mask is generated based on differences in G-buffer sample values. The mask is used in illumination phase to select for which pixels illumination is evaluated for all G-buffer samples. For pixels that are not considered edge pixels, illumination is evaluated only for the first G-buffer sample. Volume illumination is always evaluated only for the first G-buffer sample due to its low frequency nature.

FXAA is applied after tone mapping making it the final step in post processing.

Smoke simulation

The implementation of the smoke simulation is based on Ronald Fedkiw's paper "Visual Simulation of Smoke" with the addition of viscous term as in Jos Stam's "Stable Fluids" but
without a temperature simulation. Thus the smoke is simulated in a uniform grid where velocity is modeled with incompressible Euler equations. Advection is solved with a semi-Lagrangian method.

Vorticity confinement method is then applied to the velocity field to reinforce vortices. Diffusion and projection is then computed by the Jacobi iteration method. The simulation is done entirely with Compute Shaders. Cylinders that interact with the smoke are implicit objects which are voxelized into the velocity and density field in Compute Shaders.

Windows

On Windows and Windows RT, Fire Strike requires graphics hardware with full DirectX 11 feature support.

Change log

3DMark Windows Edition v1.1.0 – May 6, 2013

This update fixes issues when testing systems with multiple GPUs. Fire Strike and Fire Strike Extreme scores will increase slightly on systems with two GPUs and significantly on systems with three or four GPUs.

Fixed

- 3DMark now works correctly on systems with up to four GPUs.
- Fixed the issue caused by Windows update KB2670838, which added partial DX11.1 support to Windows 7.
- Fixed a problem with the bloom post-processing effect when using very high rendering resolutions in custom settings.

3DMark Windows Editions v1.0.0 – February 4, 2013

- Launch version
Benchmark Scores

How to report scores from 3DMark

Please follow these guidelines when including 3DMark scores in reviews or marketing materials to avoid confusing your customers and to ensure you represent our software correctly. Here's an example of how to do it right:

"Video card scores 5,800 in 3DMark Cloud Gate benchmark."

Do not use 3DMark as a unit of measurement.

CORRECT  "New video card scores 10,000 in 3DMark Fire Strike benchmark."
WRONG   "New video card scores 10,000 3DMarks."

Always include details of the hardware setup you used to obtain the score. Be sure to include the operating system, system hardware and version numbers for relevant drivers.

3DMark 11 score of P11865 achieved with air cooled AMD Radeon HD 6990 graphics card, AMD Catalyst 11.4 drivers, Windows 7 64-bit operating system, Intel Core i7 Extreme 990X, and ASUSTek Rampage III Extreme Motherboard.

World record scores

Futuremark's Hall of Fame is the only source of official 3DMark world record scores. You must not present scores from any other website or leaderboard as world records. In those cases we suggest using alternative wording such as:

"Video card takes the number one spot on [website] leaderboard."

Marketing guidelines

On the first mention of 3DMark in marketing text, such as an advertisement or product brochure, please write "3DMark benchmark" in order to protect our trademark. For example:

"We recommend 3DMark® benchmarks from Futuremark®."

Please include our legal text in your small print.

3DMark® is a registered trademark of Futuremark Corporation.
How 3DMark scores are calculated

3DMark includes three different tests, each designed for a specific type of hardware ranging from mobile devices to high-performance gaming PCs. When testing devices or components, make sure you use the most appropriate test for the hardware's capabilities.

Each test gives its own score, which you can use to compare similar devices or systems. Unlike previous versions, there is no overall 3DMark score. Scores from different tests and presets are not comparable.

Overall test score

The 3DMark score formula uses a weighted harmonic mean to calculate the overall score from the Graphics, Physics and Combined scores, when applicable.

$$3DMark = \frac{W_{\text{graphics}} + W_{\text{physics}} + W_{\text{combined}}}{W_{\text{graphics}} + W_{\text{physics}} + W_{\text{combined}}}$$

Where $W_{\text{graphics}}$ is the Graphics score weight for each test, $W_{\text{physics}}$ is the Physics score weight and $W_{\text{combined}}$ is the Combined score weight. The constants and weights in the score formulas are as shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Ice Storm</th>
<th>Cloud Gate</th>
<th>Fire Strike</th>
</tr>
</thead>
<tbody>
<tr>
<td>$W_{\text{graphics}}$</td>
<td>7/9</td>
<td>7/9</td>
<td>0.75</td>
</tr>
<tr>
<td>$W_{\text{physics}}$</td>
<td>2/9</td>
<td>2/9</td>
<td>0.15</td>
</tr>
<tr>
<td>$W_{\text{combined}}$</td>
<td>0.0</td>
<td>0.0</td>
<td>0.10</td>
</tr>
<tr>
<td>$C_{\text{graphics}}$</td>
<td>230</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>$C_{\text{physics}}$</td>
<td>315</td>
<td>315</td>
<td>315</td>
</tr>
<tr>
<td>$C_{\text{combined}}$</td>
<td>N/A</td>
<td>N/A</td>
<td>215</td>
</tr>
</tbody>
</table>

For a balanced system, with the weights in the score formula show the ratio between the effects of graphics and physics performance on the overall score. A balanced system in this sense is one where the Graphics and Physics sub-scores are roughly of the same magnitude.

For systems where either the Graphics or Physics sub-score is substantially higher than the other, the harmonic mean rewards boosting the side where the score is lower.
This reflects what users should see in games. For example, using an entry-level graphics card and doubling the CPU speed doesn't help much in games since the system is already limited by the GPU, and vice-versa on high-end graphics card systems with underpowered CPUs.

**Graphics test scoring**

Each Graphics test produces a raw performance result in frames per second (FPS). We then take a harmonic mean of these raw results and multiply it with a scaling constant to reach a graphics score \( S_{\text{graphics}} \) as follows:

\[
S_{\text{graphics}} = C_{\text{graphics}} \frac{2}{\frac{1}{F_{\text{gt1}}} + \frac{1}{F_{\text{gt2}}}}
\]

Where \( C_{\text{graphics}} \) is the scaling constant for the graphics score and \( F_{\text{gt1..2}} \) are the FPS results for Graphics Tests 1-2. The constant brings the score in line with traditional 3DMark score levels at the time of launch of the test.

**Physics test scoring**

The Physics Test will produce a raw performance result in frames per second (fps).

\[
S_{\text{physics}} = C_{\text{physics}}F_{\text{physics}}
\]

Where \( C_{\text{physics}} \) is the scaling constant and \( F_{\text{physics}} \) is the fps result for the Physics Test. As with the graphics tests, the scaling factor \( C_{\text{physics}} \) is used to bring the overall score into a traditional range.

**Combined test scoring**

The Combined Test will produce a raw performance result in frames per second (fps).

\[
S_{\text{combined}} = C_{\text{combined}}F_{\text{combined}}
\]

Where \( C_{\text{combined}} \) is the scaling constant and \( F_{\text{combined}} \) is the fps result for the Combined Test. As with the graphics tests, the scaling factor \( C_{\text{combined}} \) is used to bring the overall score into a traditional range.
Futuremark

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We work in cooperation with many of the world's leading technology companies to develop industry standard benchmarks that are relevant, accurate, and impartial. As a result, our benchmarks are widely used by the world's leading press publications and enthusiast review sites when testing the latest processors, graphics cards, notebooks and tablets. Futuremark maintains the world's largest and most comprehensive hardware performance database, using the results submitted by millions of users to drive innovative online solutions designed to help consumers make informed purchasing decisions.

Our headquarters are in Finland just outside the capital Helsinki. We also have a sales office in Silicon Valley and sales representatives in Taiwan.

Please don't hesitate to contact us if you have a question about 3DMark.

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Website: http://www.futuremark.com/

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