



The science behind the report:

# Fuel your imagination with a Microsoft Surface Laptop Studio

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report [Fuel your imagination with a Microsoft Surface Laptop Studio](#).

We concluded our hands-on testing on April 1, 2022. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on March 11, 2022 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

## Our results

To learn more about how we have calculated the wins in this report, go to <http://facts.pt/calculating-and-highlighting-wins>. Unless we state otherwise, we have followed the rules and principles we outline in that document.

Table 1: Results of our general purpose performance-related cross-platform testing. For the general purpose comparison, we configured both premium laptops with 16 GB of memory and 512 GB of PCIe<sup>®</sup> SSD storage. The Surface Laptop Studio was powered by an Intel<sup>®</sup> Core™ i7-11370H processor and an NVIDIA<sup>®</sup> GeForce RTX™ 3050 Ti laptop GPU with 4GB GDDR6 GPU memory. The Apple<sup>®</sup> MacBook Pro<sup>®</sup> was powered by an Apple M1 Pro 10-core CPU with 16-core GPU. These results are the average across five runs on three identical systems for a total of 15 runs.

General purpose: Performance benchmarks	Microsoft Surface Laptop Studio 14.4-inch	Apple MacBook Pro 14-inch
<b>Geekbench 5 Pro</b>   Higher is better		
Average Compute OpenCL score	60,311	37,735
<b>Basemark GPU v1.2.3</b>   Higher is better		
Average high content quality score	5,170	4,896
<b>Unigine Heaven benchmark</b>   Higher is better		
Average overall score	1,582	1,059
<b>Unigine Valley benchmark</b>   Higher is better		
Average overall score	2,660	2,628

Table 2: Results of our general purpose real world game benchmark testing.

General purpose: In-game benchmarks	Microsoft Surface Laptop Studio 14.4-inch	Apple MacBook Pro 14-inch
<b>Sid Meier's Civilization VI</b>   Lower is better		
Graphics benchmark - Average frame time (ms)	15.023	20.511
AI benchmark - Average turn time (ms)	8.10	10.50
<b>Deus Ex: Mankind Divided</b>   Higher is better		
Average frames per second	61.7	50.4

Table 3: Results of our general purpose performance-related hand-timed testing.

General purpose: Hand-timed tests	Microsoft Surface Laptop Studio 14.4-inch	Apple MacBook Pro 14-inch
<b>Blender app 3D CG content rendering results</b>   Lower is better		
BMW render	22.4	202.1
Splash Fox render	50.2	318.0
PartyTug render	63.8	413.5
Classroom render	53.1	483.6

Table 4: Results of our design workflow performance-related cross-platform testing. For the design workflow comparison, we configured both premium laptops with 32 GB of memory and 1 TB of PCIe SSD storage. The Surface Laptop Studio was powered by an Intel Core i7-11370H processor and an NVIDIA RTX A2000 laptop GPU with 4GB GDDR6 GPU memory. The Apple MacBook Pro was powered by an Apple M1 Pro 10-core CPU with 16-core GPU. These results are the average across five runs on three identical systems for a total of 15 runs.

Design workflow: performance benchmarks	Microsoft Surface Laptop Studio 14.4-inch	Apple MacBook Pro 14-inch
<b>Onshape online performance check benchmark</b>   Google Chrome™ browser v99.0.4844.74   Higher is better		
Average triangles per second (million+)	809.9	819.0
Average lines per second (million+)	461.9	366.2
<b>Blender benchmark v3.1.0</b>   Higher is better		
Monter workload (Average samples per minute)	699.6	185.6
Junkshop workload (Average samples per minute)	129.6	94.4
Classroom workload (Average samples per minute)	345.2	86.0
<b>RedShift benchmark v3.0.66</b>   Lower is better		
Average render time (min:sec)	11:28	18:44
<b>Autodesk® Maya® 2022 with Arnold Render v.2022.1</b>   Lower is better		
Average render time (min)	63	199

## System configuration information

Table 5: Detailed information on the general purpose performance comparison laptops we tested. We used three identical systems for each competitor.

System configuration information	3 x Microsoft Surface Laptop Studio 14.4-inch	3 x Apple MacBook Pro 14-inch (model #A2442)
Processor		
Vendor	Intel	Apple
Model number	Core i7-11370H	M1 Pro
Core frequency (GHz)	3.3 – 4.8	3.2
Number of cores	4	10
Memory		
Amount (GB)	16	16
Type	LPDDR4X	Unified
Integrated Graphics		
Vendor	Intel	Apple
Model number	Intel Iris™ Xe Graphics	M1 Pro 16-core GPU
Dedicated Graphics		
Vendor	NVIDIA	N/A
Model number	GeForce RTX 3050 Ti laptop GPU with 4GB GDDR6 GPU memory	N/A
Storage		
Amount (GB)	512	512
Type	PCIe SSD (removable)	PCIe SSD (soldered)
Connectivity/expansion		
Wireless internet	Wi-Fi 6 802.11ax	Wi-Fi 6 802.11ax
Bluetooth	5.0	5.0
Ports	2 x Thunderbolt™ 4 (USB-C) 1 x Surface Connect port 1 x 3.5mm headphone jack	3 x Thunderbolt 4 (USB-C) 1 x SDXC-capable SD card slot 1 x HDMI 2.0 1 x Magsafe 3 power connector 1 x 3.5mm headphone jack
Battery		
Type	Integrated lithium-polymer	Integrated lithium-polymer
Rated capacity (Whr)	58	70
Display		
Size (in.)	14.4	14.2
Resolution	2,400 x 1,600	3,024 x 1,964

System configuration information	3 x Microsoft Surface Laptop Studio 14.4-inch	3 x Apple MacBook Pro 14-inch (model #A2442)
Operating system		
Vendor	Microsoft	Apple
Name	Windows 11 Home	macOS® Monterey
Version & build	10.0.22000 Build 22000.348	12.0.1
BIOS		
BIOS name and version	Microsoft 6.75.141	NA
Dimensions		
Height (in.)	0.75	0.61
Width (in.)	12.72	12.31
Depth (in.)	8.98	8.71
Weight (lbs.)	4.0	3.5
<b>Configuration cost</b>	<b>Microsoft Surface Laptop Studio 14.4-inch</b>	<b>Apple MacBook Pro 14-inch (model #A2442)</b>
Price (US dollars)	\$2,099.99*	\$2,299.00**

\*We received the Surface Laptop devices on which we tested from our client at Microsoft on 11/18/21. At that time, we did not record the cost of the devices. As of 4/26/22, the cost of the Surface Laptop configuration we tested was \$2,099.99 according to the following configuration tool from Microsoft: <https://www.microsoft.com/en-us/store/configure/Surface-Laptop-Studio/8SRDF62SWKPF?crosssellid=fbt-f5c&selectedColor=&preview=&previewModes=>. These prices do not include shipping or taxes.

\*\*We purchased the MacBook Pro devices on which we tested on 11/23/21 for \$2,299 per system. These prices do not include shipping or taxes. As of 4/16/22, these devices are no longer available for purchase through Apple.

Table 6: Detailed information on the design workflow performance comparison laptops we tested. We used three identical systems for each competitor.

System configuration information	3 x Microsoft Surface Laptop Studio 14.4-inch	3 x Apple MacBook Pro 14-inch (model #A2442)
Processor		
Vendor	Intel	Apple
Model number	Core i7-11370H	M1 Pro
Core frequency (GHz)	3.3 – 4.8	3.2
Number of cores	4	10
Memory		
Amount (GB)	32	32
Type	LPDDR4X	Unified
Integrated Graphics		
Vendor	Intel	Apple
Model number	Intel Iris Xe Graphics	M1 Pro 16 core GPU
Dedicated Graphics		
Vendor	NVIDIA	N/A

System configuration information	3 x Microsoft Surface Laptop Studio 14.4-inch	3 x Apple MacBook Pro 14-inch (model #A2442)
Model number	RTX A2000 laptop GPU with 4GB GDDR6 GPU memory	N/A
Storage		
Amount (TB)	1	1
Type	PCIe SSD (removable)	PCIe SSD (soldered)
Connectivity/expansion		
Wireless internet	Wi-Fi 6 802.11ax	Wi-Fi 6 802.11ax
Bluetooth	5.0	5.0
Ports	2 x Thunderbolt 4 (USB-C) 1 x Surface Connect port 1 x 3.5 mm headphone jack	3 x Thunderbolt 4 (USB-C) 1 x SDXC-capable SD card slot 1 x HDMI 2.0 1 x Magsafe 3 power connector 1 x 3.5 mm headphone jack
Battery		
Type	Integrated Lithium-polymer	Integrated Lithium-polymer
Rated capacity (Whr)	58	70
Display		
Size (in.)	14.4	14.2
Resolution	2,400 x 1,600	3,024 x 1,964
Operating system		
Vendor	Microsoft	Apple
Name	Windows 11 Pro	macOS Monterey
Version & Build	10.0.22000 Build 22000.556	12.3
BIOS		
BIOS name and version	Microsoft 18.101.141	N/A
Dimensions		
Height (in.)	0.75	0.61
Width (in.)	12.72	12.31
Depth (in.)	8.98	8.71
Weight (lbs.)	4.0	3.5
<b>Configuration cost</b>	<b>Microsoft Surface Laptop Studio 14.4-inch</b>	<b>Apple MacBook Pro 14-inch (model #A2442)</b>
Price (US dollars)	\$3,399.99*	\$2,899.00**

\*We purchased one Surface Laptop device on 3/11/22 for \$3,399.99. See here for the configuration tool through which we purchased: <https://www.microsoft.com/en-us/store/configure/Surface-Laptop-Studio-for-Business/8wj5p8dd2?crosssellid=&selectedColor=> . These prices do not include shipping or taxes. Because we ran our tests on multiple of the same devices, our client at Microsoft also provided two Surface Laptops with the same configuration. We assume that the cost of these laptops was the same as the cost of the laptop with the same configuration that we purchased.

\*\*We purchased the MacBook Pro devices on which we tested on 3/11/22 for \$2,899 per system. These prices do not include shipping or taxes. See here for the configuration tool through which we purchased: <https://www.apple.com/shop/buy-mac/macbook-pro/14-inch-space-gray-10-core-cpu-16-core-gpu-1tb>

## How we tested

**General purpose performance comparison:** We configured twelve premium laptops (3 identical Surface Laptop Studio devices and 3 identical MacBook Pro devices) with 16 GB of memory and 512 GB of PCIe SSD storage. The identical Surface Laptop Studio devices were powered by Intel Core i7-11370H processors and NVIDIA GeForce RTX 3050 Ti laptop GPUs with 4GB GDDR6 GPU memory. The identical Apple MacBook Pro devices were powered by Apple M1 Pro 10-core CPU with 16-core GPU. For this comparison, we ran Geekbench 5 Pro, Basemark GPU, Unigine Heaven, and Unigine Valley benchmarks on each device. For a gaming perspective, we ran Sid Meier's Civilization VI and Deux Ex: Mankind Divided in-game benchmarks on each device. Finally, we hand-timed multiple Blender 3D rendering tasks to compare system performance on each device. Our results are the average across five runs on the three identical systems.

**Design workflow performance comparison:** We configured twelve premium laptops (3 identical Surface Laptop Studio devices and 3 identical MacBook Pro devices) with 32 GB of memory and 1 TB of PCIe SSD storage. The identical Surface Laptop Studio devices were powered by Intel Core i7-11370H processors and NVIDIA RTX A2000 laptop GPUs with 4GB GDDR6 GPU memory. The Apple MacBook Pro devices were powered by Apple M1 Pro 10-core CPU with 16-core GPU. For this comparison, we ran Onshape, Blender, and Redshift benchmarks on each device. Then, we created a custom Maya 2022 test workload scene and timed how long it took each laptop to render that scene into a 250-frame movie on each device. Our results are the average across five runs on the three identical systems.

## General purpose performance comparison

### Setting up the 3 identical systems (Windows)

#### Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set the Windows (plugged in) Power Mode to Best Performance.
  - a. In the bottom right-hand corner, click the battery icon, and move the slider to Best Performance.
4. Set Screen and Sleep options to Never.
  - a. Right-click the desktop, and select Display settings.
  - b. From the left-hand column, select Power & Sleep.
  - c. For all power options listed under Screen and Sleep, select Never.
5. Disable User Account Control notifications.
  - Select Windows Start, type UAC, and press the Enter key.
  - Move the slider control to Never notify, and click OK.
6. Run Windows Update, and install all updates available.
7. Launch the Windows Store app, and install all Store app updates.
8. Verify the date and time are correct, and synchronize the system clock with the time server.
9. Disable Automatic Windows Update.
  - a. Right-click the Windows Start button.
  - b. Select Computer Management.
  - c. Select Services and Applications.
  - d. Select Services.
  - e. Scroll down, and double-click Windows Update.
  - f. Click Stop.
  - g. From the Startup type drop-down menu, select Disabled.

### Setting up the 3 identical systems (macOS)

#### Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set Screen and Sleep options to Never.
  - a. Select System Preferences.
  - b. Select Desktop & Screensaver.
  - c. Uncheck the box next to Show Screensaver after.
  - d. Return to System Preferences, and select Battery.
  - e. Select Power Adapter, and move the slider bar to Never.

4. Run Software Update, and install all updates available.
5. Launch the App Store, and install all App Store updates.
6. Verify the date and time are correct.
7. Disable Automatic Mac Updates.
  - a. In the top left corner, click the Apple icon, and select About This Mac.
  - b. Click Software Update.
  - c. Uncheck the box next to Automatically keep my Mac up to date.

## General purpose performance comparison benchmark tests

### Geekbench 5 OpenCL Compute benchmark

#### Setting up the test (Windows & macOS)

1. Download and install Geekbench 5 from <https://www.geekbench.com/download/>.

#### Running the test (Windows & macOS)

1. Launch Geekbench.
2. Click Compute.
3. Record the result.
4. Wait 5 minutes before re-running.
5. Repeat steps 1 through 4 four more times.

### Basemark GPU benchmark

#### Setting up the test (Windows & macOS)

1. Download and install the Basemark GPU benchmark from <https://basemark.com/benchmarks/basemark-gpu/>.

#### Running the High Content Quality test (Windows & macOS)

1. Launch the Basemark GPU benchmark.
2. Under the official tab, ensure that the Content Quality option is set to High, and leave all other options default.
3. Click Run Official Test.
4. Wait 5 minutes before re-running.
5. Repeat steps 1 through 4 four more times.

### Unigine Heaven benchmark

#### Setting up the test (Windows)

1. Purchase, download, and install the Heaven Professional benchmark from <https://benchmark.unigine.com/>.
2. Set the display screen resolution to 1830 x 1200.
  - a. Right-click the desktop.
  - b. Click Display settings.
  - c. From the Display resolution drop-down menu select 1830 x 1200.

#### Setting up the test (macOS)

1. Purchase, download, and install the Heaven Professional benchmark from <https://benchmark.unigine.com/>.
2. Set the display screen resolution to 1800 x 1169.
  - a. Click the System Preferences icon.
  - b. Click Displays.
  - c. Select Scaled, and choose 1800 x 1169.

## Running the test (Windows & macOS)

1. Launch the Heaven benchmark.
2. We used the following settings.
  - Preset: Custom
  - API: OpenGL
  - Quality: Ultra
  - Tessellation: Extreme
  - Stereo 3D: Disabled
  - Multi-monitor: Disabled
  - Anti-aliasing: 4x
  - Full screen: Enabled
  - Resolution Windows: 1830 x 1200
  - Resolution Mac: 1800 x 1169
3. Click Run.
4. Click the Benchmark button.
5. Record the result.
6. Wait 15 minutes before re-running.
7. Repeat steps 1 through 6 four more times.

## Unigine Valley Benchmark

### Setting up the test (Windows)

1. Purchase, download, and install the Valley Professional benchmark from <https://benchmark.unigine.com/>.
2. Set the display screen resolution to 1830 x 1200.
3. Right-click on the desktop.
4. Click Display settings.
5. From the Display resolution drop-down menu select 1830 x 1200.

### Setting up the test (macOS)

1. Purchase, download, and install the Valley Professional benchmark from <https://benchmark.unigine.com/>.
2. Set the display screen resolution to 1800 x 1169.
3. Click on the System Preferences icon.
4. Click Displays.
5. Select Scaled and choose looks like 1800 x 1169.

## Running the test (Windows & macOS)

1. Launch the Valley benchmark.
2. We used the following settings.
  - Preset: Custom
  - API: OpenGL
  - Quality: Ultra
  - Stereo 3D: Disabled
  - Monitor: Single
  - Anti-aliasing: 4x
  - Full screen: Enabled
  - Resolution Windows: 1830 x 1200
  - Resolution Mac: 1800 x 1169
3. Click Run.
4. Click the Benchmark button.
5. Record the result.
6. Wait 15 minutes before re-running.
7. Repeat steps 1 through 6 four more times.

## Sid Meier's Civilization VI in-game benchmarks

### Setting up the test (Windows & macOS)

1. Purchase, download, and install Sid Meier's Civilization VI from <https://store.steampowered.com/>.
2. Launch Sid Meier's Civilization VI. (Note: On Windows, choose DirectX 12. MacOS does not give this option.)
3. Click Game Options→Graphics. We used the following settings:
  - Resolution Windows: 1830 x 1200 (120Hz)
  - Resolution Mac: 1800 x 1169 (120Hz)
  - UI Upscaling: 100%
  - Window Mode: Full Screen
  - Anti-Aliasing: MSAA 4X
  - Performance Impact: Ultra
  - Memory Impact: Ultra
  - Advanced Options→Uncheck Vertical Sync
4. Click Confirm, and click the Back button.
5. Exit the game.

### Running the test (Windows & macOS)

1. Launch Sid Meier's Civilization VI. (Note: On Windows, choose DirectX 12. MacOS does not give this option.)
2. Click Benchmark→Graphics.
3. Record the Graphics benchmark result.
4. Click Benchmark→AI.
5. Record the AI benchmark result.
6. Wait 5 minutes before re-running.
7. Repeat steps 1 through 6 four more times.

## Deus Ex: Mankind Divided in-game benchmark

### Setting up the test (Windows & macOS)

1. Purchase, download, and install Deus Ex: Mankind Divided from <https://store.steampowered.com/>.
2. Launch Deus Ex: Mankind Divided. (Note: On Windows, choose DirectX 12. MacOS does not give this option.)
3. Click Play.
4. Click Options→Display. We used the following settings that were closest supported by both systems:
  - Fullscreen: On
  - Resolution: 1,920 x 1,200
  - Refresh Rate: 120 Hz
  - VSYNC: Off
5. Click Apply Changes, and click the Back button.
6. Click Graphics, select the High Preset, and click Back.
7. Exit the game.

### Running the test (Windows & macOS)

1. Launch Deus Ex: Mankind Divided. (Note: On Windows, choose DirectX 12. MacOS does not give this option.)
2. Click Extras.
3. Click Benchmark.
4. Record the benchmark result.
5. Wait 5 minutes before re-running.
6. Repeat steps 1 through 5 four more times.

## General purpose performance comparison hand-timed tests

### Blender (3D CG rendering)

We recorded how long it took to render various Blender workloads.

We used the following application:

- Blender v3.0

#### Setting up the test (Windows & macOS)

1. Download and install Blender from <https://www.blender.org/download/>.
2. Download the following Blender workloads from <https://www.blender.org/download/demo-files/>.
  - Car Demo
  - Splash Fox
  - PartyTug
  - Classroom
3. Launch Blender and go to Edit→Preferences→System.
4. Select OptiX, and check the box next to the discrete graphics card option. If OptiX is not available, make sure the latest NVIDIA graphics drivers are installed.
5. Close Blender.

#### Running the test (Windows & macOS)

1. Launch Blender.
2. Click Open, and browse to the test workload.
3. Click on the Render Properties tab.
4. Verify that the Render Engine is set to Cycles.
5. Verify that the Feature set is set to Experimental.
6. Verify that the Device is set to GPU Compute.
7. Click Render→Render Image.
8. Record the elapsed time result.
9. Wait 5 minutes before performing the next run.
10. Repeat steps 1 through 9 four more times.

## Design workflow performance comparison

### Setting up the system (Windows)

#### Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set the Windows (plugged in) Power Mode to Best Performance.
  - a. In the bottom right-hand corner, click the battery icon, and move the slider to Best Performance.
4. Set Screen and Sleep options to Never.
  - a. Right-click the desktop, and select Display settings.
  - b. From the left-hand column, select Power & Sleep.
  - c. For all power options listed under Screen and Sleep, select Never.
5. Disable User Account Control notifications.
  - a. Select Windows Start, type UAC, and press the Enter key.
  - b. Move the slider control to Never notify, and click OK.
6. Run Windows Update, and install all updates available.
7. Launch the Windows Store app, and install all Store app updates.
8. Verify the date and time are correct, and synchronize the system clock with the time server.

9. Disable Automatic Windows Update.
  - a. Right-click the Windows Start button.
  - b. Select Computer Management.
  - c. Select Services and Applications.
  - d. Select Services.
  - e. Scroll down, and double-click Windows Update.
  - f. Click Stop.
  - g. From the Startup type drop-down menu, select Disabled.

## Setting up the system (macOS)

### Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set Screen and Sleep options to Never.
  - a. Select System Preferences.
  - b. Select Desktop & Screensaver.
  - c. Uncheck the box next to Show Screensaver after.
  - d. Return to System Preferences, and select Battery.
  - e. Select Power Adapter, and move the slider bar to Never.
4. Run Software Update, and install all updates available.
5. Launch the App Store, and install all App Store updates.
6. Verify the date and time are correct.
7. Disable Automatic Mac Updates.
  - a. In the top left corner, click the Apple icon, and select About This Mac.
  - b. Click Software Update.
  - c. Uncheck the box next to Automatically keep my Mac up to date.

## Design workflow performance comparison hand-timed test

### Autodesk Maya 2022 with Arnold renderer

#### Setting up the test (Windows & macOS)

1. Download and install the Maya 2022 30-day trial from <https://www.autodesk.com/products/maya/free-trial>. During installation, verify that Arnold renderer is selected for installation as an additional component.
2. Launch Maya 2022 and point the Project Window to the correct directory.
  - a. Go to File→Project Window.
  - b. Click New, and enter the name Dinner\_scene.
  - c. Set the Location to Documents/maya/projects.
  - d. Click Accept.
3. Create a Maya 2022 test workload scene named Dinner\_scene. We used the YouTube tutorial created by [Creative Tap](#).
4. Copy the Maya 2022 Dinner\_scene test workload to the Documents\maya\projects directory onto the other test system. When prompted, select Yes to overwrite the Dinner\_scene directory.
5. Close Maya 2022.

## Running the test (Windows & macOS)

1. Launch Maya 2022, and select the test workload scene by browsing to Documents\maya\projects\Dinner\_scene\Dinner\_scene\_v1.mb.
2. From the top menu bar, select the Display render settings icon.
3. Next to the Render Using field, select Arnold Renderer.
4. Under the Common tab, select the following settings:
  - a. Next to File name prefix, type a project name.
  - b. Next to Image Format, select PNG.
  - c. Next to Frame/Animation ext, select name\_#.ext.
  - d. Next to Start frame, select 1.000.
  - e. Next to End frame, select 250.000.
  - f. Next to Renderable Camera, select camera1.
  - g. Next to Image Size Presets, select HD\_1080.
5. Under the Arnold Renderer tab, select the following settings:
  - Camera (AA)= 3
  - Diffuse= 2
  - Specular= 2
  - Transmission= 2
  - SSS= 2
  - Volume Indirect= 2
6. Under the System tab, select GPU as the Render Device, if available.
7. Close the Render Settings dialog.
8. From the top menu, select Open Render View.
9. Click Render, and, to the right of Render Sequence, click the small square.
10. In the Current Camera field, select camera1.
11. Simultaneously start the stopwatch and click Render Sequence.
12. Repeat steps 1 through 11 four more times.

## Design workflow performance comparison benchmark tests

### Onshape online benchmark using the Chrome web browser

#### Setting up the test (Windows)

1. On systems with dual graphic capabilities, verify that the Chrome web browser is using the discrete GPU.
  - a. In the Windows Search Box, type Graphics Settings and press Enter.
  - b. Under the Custom options for apps heading click Browse and Add C:\Program Files\Google\Chrome\Application\Chrome.exe
  - c. Click the newly added Chrome application and click Options.
  - d. Select discrete graphics option and select Save.

#### Running the High Content Quality test (Windows & macOS)

1. Go to <https://cad.onshape.com/check>
2. Record the Performance Check results.
3. Repeat steps 1 through 2 four more times.

### Blender benchmark

#### Setting up the test (Windows & macOS)

1. Download the Blender benchmark from <https://opendata.blender.org/>.

#### Running the test (Windows & macOS)

1. Launch the Blender benchmark.
2. At the Welcome screen, click Next.
3. Select Blender version 3.1.0 and click Next.
4. Click Next at the Benchmark Scenes screen.

5. At the Benchmark Device screen, select the GPU option and click Start Benchmark.
6. Record the results.
7. Wait 5 minutes before performing the next run.
8. Repeat steps 1 through 7 four more times.

## Redshift benchmark

### Setting up the test (Windows & macOS)

1. Download and install the Maxon App from <https://www.maxon.net/en/try>.
2. Click the Maxon One 14-day trial and download and install the Redshift application.

### Running the test (Windows)

1. Open a command prompt by clicking the Windows icon on the bottom left of your desktop, typing `cmd` and pressing Enter.
2. Inside the command prompt, type `cd C:\ProgramData\Redshift\bin` and press Enter.
3. To start the benchmark, type `RunBenchmark.bat` and press Enter.
4. Record the results.
5. Wait 5 minutes before performing the next run.
6. Repeat steps 1 through 4 four more times.

### Running the test (macOS)

1. Open a terminal window by opening the Launchpad, typing `Terminal` and pressing Enter.
2. Inside the Terminal, type `cd /Applications/redshift/bin` and press Enter.
3. To start the benchmark, type `sh runBenchmark.sh` and press Enter.
4. Record the results.
5. Wait 5 minutes before performing the next run.
6. Repeat steps 1 through 4 four more times.

Read the report at <https://facts.pt/4jaDWvU> ▶

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