



## Fuel your imagination with a Microsoft Surface Laptop Studio

We measured system performance on two 14.4-inch Surface Laptop Studio models powered by Intel Core i7 compute and NVIDIA discrete graphics processors vs. comparable M1 Pro powered MacBook Pro laptops

The 14.4-inch Surface Laptop Studio includes two discrete graphics options in its new, versatile form factor. But how could the combination of 11<sup>th</sup> Gen Intel® Core™ i7 compute and NVIDIA® dedicated graphics processors benefit consumers, hobbyists, gamers, and content creators?

To see how the Surface Laptop Studio equipped with an Intel Core i7-11370H processor and NVIDIA GeForce RTX™ 3050 Ti laptop GPU with 4GB GDDR6 GPU memory fared against the Apple® MacBook Pro® powered by an M1 Pro 10-core CPU with 16-core GPU, we conducted a general purpose performance comparison. This comparison cites scores from multiple industry-standard benchmarks that focus on different aspects of GPU performance, three in-game benchmark comparisons, and our own hands-on timings of multiple Blender 3D rendering tasks.

For serious computer-aided design (CAD) users, we also compared premium laptops with more memory and storage. In this design workflow comparison, we pitted the Surface Laptop Studio with an Intel Core i7-11370H processor and NVIDIA RTX A2000 laptop GPU with 4GB GDDR6 GPU memory against a similarly configured MacBook Pro powered by an M1 Pro 10-core CPU with 16-core GPU. This comparison cites Onshape, Blender, and Redshift benchmark scores as well as the time to complete an Autodesk® Maya® 2022 app-based rendering task.

We also examined app compatibility and found that the Windows-based Surface Laptop Studio models provided greater gaming and CAD software compatibility than the macOS® Monterey-based MacBook Pro models. Additionally, the Studio convertible touchscreen facilitated laptop, angled stage, and creative canvas interactions with Surface Pen (purchased separately) and inking compatibility right out of the box—things MacBook Pro users couldn't accomplish without touch-enabled peripherals.



### PERFORMANCE

Boost gaming, video processing, or video editing productivity with up to 59.8% better GPU responsiveness

*based on Geekbench 5 Pro average Compute OpenCL benchmark scores\**

Speed scene renders with up to 3.01x better GPU responsiveness

*based on Blender 3.1 benchmark rendering results\*\**

### COMPATIBILITY

Play 100% of the 50 most popular Steam® games

*vs. 36% gaming compatibility\*\*\**

Utilize 31 professional CAD applications

*vs. only 10 CAD app compatibility\*\*\**

*\*Surface Laptop Studio with NVIDIA RTX A2000 laptop GPU vs. MacBook Pro with M1 Pro 10-core CPU and 16-core GPU*

*\*\*Surface Laptop Studio with NVIDIA GeForce RTX 3050 Ti laptop GPU vs. MacBook Pro with M1 Pro 10-core CPU and 16-core GPU*

*\*\*\*Windows-based vs. macOS-based*

## What we tested

There is no one type of user, so we tested and researched a variety of things to provide the details consumers, hobbyists, gamers, and professional CAD users need to make an informed decision. Our results are the average across five runs on three identical systems for a total of 15 runs per test.

### General purpose performance comparison

We configured both sets of identical premium laptops with 16 GB of memory and 512 GB of PCIe® SSD storage. The Surface Laptop Studio devices were powered by an Intel Core i7-11370H processor and an NVIDIA GeForce RTX 3050 Ti laptop GPU with 4GB GDDR6 GPU memory. The MacBook Pro devices were powered by an Apple M1 Pro 10-core CPU with 16-core GPU. The cost per Surface Laptop Studio was \$2,099.99, and the cost per MacBook Pro was \$2,299.00. For this comparison, we ran Geekbench 5 Pro, Basemark GPU, Unigine Heaven, and Unigine Valley benchmarks. For a gaming perspective, we ran Sid Meier's Civilization VI and Deus Ex: Mankind Divided in-game benchmarks. Finally, we hand-timed multiple Blender 3D rendering tasks. See the [science behind the report](#) for more details.

### Design workflow performance comparison

We configured both sets of premium laptops with 32 GB of memory and 1 TB of PCIe SSD storage. The Surface Laptop Studio devices were powered by an Intel Core i7-11370H processor and an NVIDIA RTX A2000 laptop GPU with 4GB GDDR6 GPU memory. The MacBook Pro devices were powered by an Apple M1 Pro 10-core CPU with 16-core GPU. The cost per Surface Laptop Studio was \$3,399.99, and the cost per MacBook Pro was \$2,899.00. For this comparison, we ran Onshape, Blender, and Redshift benchmarks. 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. See the [science behind the report](#) for more details.

The benchmark scores we report reflect the specific configurations we tested. Any difference in the configurations you test, as well as screen brightness, network traffic, or software additions, can affect these results. For a deeper dive into our testing parameters and procedures, see the [science behind the report](#).

In addition to our two system performance comparisons, we researched published Surface Laptop Studio and MacBook Pro platform features as well as Windows and macOS gaming app and CAD software compatibility.

### About the Microsoft Surface Laptop Studio



Microsoft designed this 14.4-inch 120Hz touchscreen for creatives of all types. According to Microsoft, the "boundary-pushing design" allows you to transition "from laptop to entertainment-ready stage to portable creative canvas." They also say the passive cooling and industry-leading thermal design help keep the device cool under pressure.<sup>1</sup>

### Microsoft Surface Laptop Studio vs. Apple MacBook Pro<sup>2,3</sup>

- Flexible form factor vs. laptop
- PixelSense™ Flow touch display capability vs. no touch screen
- Surface Pen capability with integrated pen storage vs. cannot draw with pen or stylus onscreen
- NVIDIA GeForce RTX 3050 Ti or RTX A2000 laptop GPU vs. integrated graphics card
- 3:2 screen ratio vs. 16:10 screen ratio
- Windows Hello Face ID vs. Apple Touch ID

To learn more about the Surface Laptop Studio, visit <https://www.microsoft.com>.



## General purpose performance comparison

For this comparison of premium laptops with 16 GB of memory and 512 GB of PCIe SSD storage, we used Geekbench 5 Pro, Basemark GPU, Unigine Heaven, and Unigine Valley industry-standard benchmarks as well as Sid Meier's Civilization VI and Deus Ex: Mankind Divided in-game benchmarks to look at system performance from consumer, hobbyist, and gamer perspectives. The Surface Laptop Studio, powered by an Intel Core i7-11370H processor and NVIDIA GeForce RTX 3050 Ti laptop GPU, scored higher in all seven benchmark comparisons than the MacBook pro powered by an Apple M1 Pro 10-core CPU with 16-core GPU. In real-life work and play situations, these higher scores could translate to quicker response times and less waiting for users.

### Geekbench 5 Pro Compute OpenCL benchmark results

The Geekbench 5 Pro Compute OpenCL benchmark measures the performance of GPUs performing common compute tasks, such as image processing.<sup>4</sup>

Average Compute OpenCL score | Higher is better

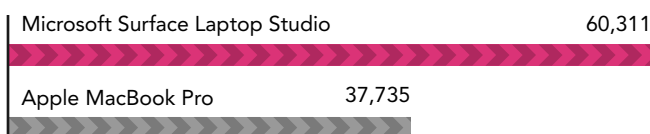


Figure 1: Geekbench 5 Pro average compute OpenCL score. Higher is better. Source: Principled Technologies.

### Unigine Heaven benchmark results

The Unigine Heaven is a 100 percent GPU-bound benchmark that puts the device under test through extreme hardware stability testing.<sup>6</sup>

Average overall score | Higher is better

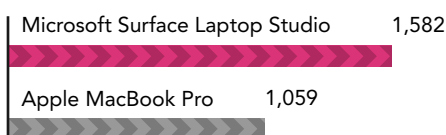


Figure 3: Unigine Heaven average overall score. The MacBook Pro ran this app in the Rosetta 2 translation layer. Higher is better. Source: Principled Technologies.

### Basemark GPU benchmark results

The Basemark GPU benchmark measures graphics card performance on multiple operating systems and graphics APIs.<sup>5</sup>

Average high content quality score | Higher is better

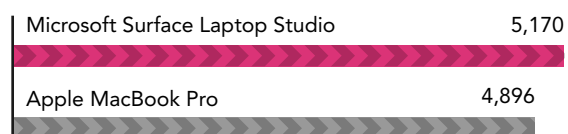


Figure 2: Basemark GPU v1.2.3 average high content quality score. Higher is better. Source: Principled Technologies.

### Unigine Valley benchmark results

The Unigine Valley benchmark measures hardware performance and stability under extremely stressful gaming conditions.<sup>7</sup>

Average overall score | Higher is better

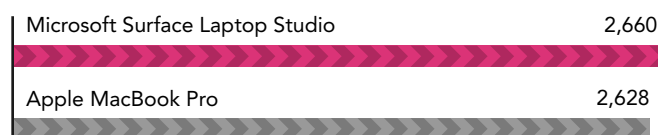


Figure 4: Unigine Valley average overall score. The MacBook Pro ran this app in the Rosetta 2 translation layer. Higher is better. Source: Principled Technologies.

## Sid Meier's Civilization VI benchmark results

We chose these in-game benchmarks because, while the graphics card is usually the bottleneck in online games, Sid Meier's Civilization VI demands as much from the processor as it does from the graphics card.<sup>8</sup> The graphics benchmark measures the in-game frame times, and the AI benchmark measures the in-game AI turn times—both under stressful gaming conditions.<sup>9</sup>

■ Microsoft Surface Laptop Studio ■ Apple MacBook Pro

### Graphics benchmark

Average frame time (ms) | Lower is better



### AI benchmark

Average turn time (ms) | Lower is better



Figure 5: Sid Meier's Civilization VI built-in Graphics benchmark average frame time and AI benchmark average turn time. Time (milliseconds). The MacBook Pro ran these apps in the Rosetta 2 translation layer. Lower is better. Source: Principled Technologies.

## Deus Ex: Mankind Divided benchmark results

The Deus Ex: Mankind Divided built-in benchmark measures the in-game frame rate (expressed in frames per second) under extremely punishing gaming conditions.<sup>10</sup>

Average frames per second | Higher is better

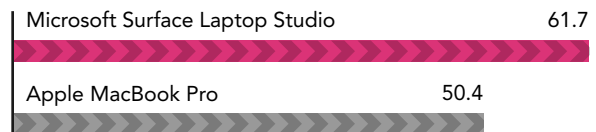


Figure 6: Average frames per second from the Deus Ex: Mankind Divided built in benchmark. The MacBook Pro ran this app in the Rosetta 2 translation layer. Higher is better. Source: Principled Technologies.

### Rosetta 2 and M1-based MacBook Pro systems

Apps, such as the benchmarks we used for the system responsiveness comparisons, as well as the top 50 Steam and professional CAD apps we list in Tables 1 and 2, are built to work on specific processors. The relatively new Apple M1 processor is not yet on the compatible-processor list for many apps. At the time of testing, April 1, 2022, macOS Monterey loaded some of our benchmark software into Rosetta 2. Rosetta 2 enables M1-based Macs to use apps built for Macs powered by Intel processors. According to Apple documentation, "To the user, Rosetta is mostly transparent. If an executable contains only Intel instructions, macOS automatically launches Rosetta and begins the translation process. When translation finishes, the system launches the translated executable in place of the original. However, the translation process takes time, so users might perceive that translated apps launch or run more slowly at times."<sup>11</sup>



## Hand-timed 3D content rendering results

For this hand-timed task comparison, we completed multiple Blender 3D content rendering tasks for performance information from a creative's perspective. When using the Surface Laptop Studio, powered by an Intel Core i7-11370H processor and NVIDIA GeForce RTX 3050 Ti laptop GPU, we completed all four of the Blender 3D content rendering tasks in less time than when we used the MacBook Pro powered by an Apple M1 Pro 10-core CPU with 16-core GPU. One reason the Surface Laptop Studio performed so much better in these tasks is that the Blender app was able to utilize the ray tracing cores of the NVIDIA discrete graphics processor. For more details, read the [science behind the report](#).

## Blender app 3D CG content rendering results

Average time (seconds) | Lower is better

■ Microsoft Surface Laptop Studio ■ Apple MacBook Pro

### BMW render



### Splash Fox render



### PartyTug render



### Classroom render



Figure 7: Blender 3D CG content rendering times (seconds). Lower is better. Source: Principled Technologies.

## Design workflow performance comparison

For this comparison of premium laptops with 32 GB of memory and 1 TB of PCIe SSD storage, we ran Onshape, Blender, and Redshift benchmarks to compare system performance 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. The Surface Laptop Studio, powered by an Intel Core i7-11370H processor and NVIDIA RTX A2000 laptop GPU, scored higher in five of the six benchmark comparisons than the MacBook Pro by an Apple M1 Pro 10-core CPU with 16-core GPU. In real-world content creation scenarios, these higher benchmark scores and faster Maya 2022 render times could help get projects out the door faster.

## Onshape benchmark results

The Onshape performance check benchmark determines a device's limits by engaging the browser, in our case Chrome, and GPU. Then, the benchmark increases the CAD workload until the framerate starts to drop.<sup>12</sup>

Average benchmark results | Higher is better

■ Microsoft Surface Laptop Studio ■ Apple MacBook Pro

### Average triangles per second (million+)



### Average lines per second (million+)



Figure 8: Onshape CAD performance check results. Higher is better. Source: Principled Technologies.

## Blender benchmark results

The Blender benchmark measures rendering performance and speed by evaluating how many samples per minute each device can handle.<sup>13</sup>

Average samples per minute | Higher is better

Microsoft Surface Laptop Studio Apple MacBook Pro

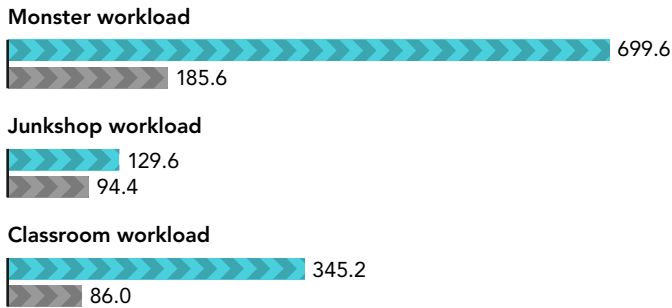


Figure 9: Blender 3.1 results. Higher is better. Source: Principled Technologies.



## Redshift benchmark results

The Redshift benchmark is a fully GPU-based rendering engine that measures the time it takes to render a scene.<sup>14</sup>

Average render time (minutes:seconds) | Lower is better

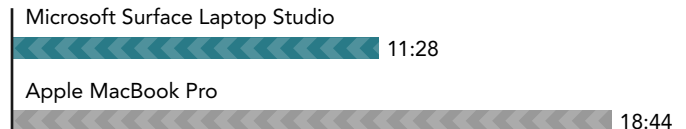


Figure 10: Redshift 3.0.66 production rendering results. Lower is better. Source: Principled Technologies

## Hand-timed Maya 2022 rendering results

For this hand-timed task comparison, 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 using the Arnold rendering tool. The Surface Laptop Studio, powered by an Intel Core i7-11370H processor and NVIDIA RTX A2000 laptop GPU, completed this task in less time than the similarly configured MacBook Pro powered by an Apple M1 Pro 10-core CPU and 16-core GPU.

## Autodesk Maya 2022 custom workload results

Average render time (minutes) | Lower is better

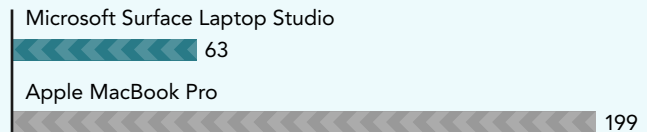


Figure 11: Autodesk Maya 2022 with Arnold v. 2022 render times. Lower is better. Source: Principled Technologies.



## Comparing popular gaming app compatibility

Our research shows that, as of April 1, 2022, the Windows-based Surface Laptop Studio models we tested were compatible with all of the 50 most popular games on Steam, and the macOS-based MacBook Pro models were only compatible with 18. Note: We did not install and test these games on the laptops we evaluated; we clicked through the Top 50 list available at <https://steamcharts.com/top> and clicked each game to a purchase page that noted Windows and/or macOS compatibility. For every macOS-compatible game, we then went to <https://applesilicongames.com/games> to verify that the game worked on Apple devices powered by M1 Pro chips. Table 1 shows the top 50 Steam games and their compatibility with each OS.

Table 1: Compatibility with the top 50 games on Steam, taken from <https://steamcharts.com/top> and <https://applesilicongames.com/games> on April 1, 2022. Source: Principled Technologies.

Steam Charts Top 50 Games	Windows 11 compatible	macOS compatible	macOS + Apple Silicon M1 Pro compatible
Counter-Strike: Global Offensive	✓	✓	✓
Dota 2	✓	✓	✓
PLAYERUNKNOWN'S BATTLEGROUNDS	✓	✗	✗
Elden Ring	✓	✗	✗
Apex Legends	✓	✗	✗
Lost Ark	✓	✗	✗
NARAKA: BLADEPOINT	✓	✗	✗
Grand Theft Auto V	✓	✗	✗
Dread Hunger	✓	✗	✗
Wallpaper Engine	✓	✗	✗
Rust	✓	✓	✓
Team Fortress 2	✓	✓	✓
Tom Clancy's Rainbow Six Siege	✓	✗	✗
War Thunder	✓	✓	✗
MIR4	✓	✗	✗
Destiny 2	✓	✗	✗
Yu-Gi-Oh! Master Duel	✓	✗	✗
Warframe	✓	✗	✗
Football Manager 2022	✓	✓	✓
Sid Meier's Civilization VI	✓	✓	✓
ARK: Survival Evolved	✓	✓	✗
FIFA 22	✓	✗	✗
Unturned	✓	✓	✓
Hearts of Iron IV	✓	✓	✓



Steam Charts Top 50 Games	Windows 11 compatible	macOS compatible	macOS + Apple Silicon M1 Pro compatible
Dead by Daylight	✓	✗	✗
Don't Starve Together	✓	✓	✓
Euro Truck Simulator 2	✓	✓	✓
Terraria	✓	✓	✓
World of Tanks Blitz	✓	✓	✓
DayZ	✓	✗	✗
Red Dead Redemption 2	✓	✗	✗
Stardew Valley	✓	✓	✓
NBA 2K22	✓	✗	✗
PAYDAY 2	✓	✗	✗
Battlefield V	✓	✗	✗
Cities: Skylines	✓	✓	✓
Garry's Mod	✓	✓	✗
Monster Hunter: World	✓	✗	✗
Vampire Survivors	✓	✓	✗
7 Days to Die	✓	✓	✓
Space Wars	✓	✗	✗
New World	✓	✗	✗
Hunt: Showdown	✓	✗	✗
Rocket League	✓	✗	✗
The Witcher: Wild Hunt	✓	✗	✗
SCUM	✓	✗	✗
Europa Universalis IV	✓	✓	✓
Farming Simulator 22	✓	✓	✓
Left 4 Dead 2	✓	✓	✓
Arma 3	✓	✗	✗



## Comparing professional CAD software capability

Our research shows that, as of April 1, 2022, the Windows-based Surface Laptop Studio models we tested were compatible with all 31 Rhino®, Autodesk, Dassault Systemes, and Siemens professional CAD apps and the macOS-based MacBook Pro models we tested were only compatible with 10. Note: We did not install and test the apps on the laptops we evaluated.



Table 2: Compatibility with professional CAD apps on April 1, 2022. Source: Principled Technologies.

Professional CAD applications	Windows 11 compatible	macOS compatible	macOS + Apple Silicon M1 Pro compatible
Rhino 7	✓	✓	✓
Autodesk AutoCAD®	✓	✓	✓
Autodesk Revit®	✓	✗	✗
Autodesk Civil 3D®	✓	✓	✗
Autodesk AutoCAD LT®	✓	✓	✓
Autodesk BIM Collaborate Pro	✓	✓	✓
Autodesk Inventor®	✓	✗	✗
Autodesk Fusion 360®	✓	✓	✓
Autodesk Navisworks®	✓	✗	✗
Autodesk 3ds Max®	✓	✗	✗
Autodesk Maya	✓	✓	✓
Autodesk Arnold	✓	✓	✗
Autodesk Mudbox®	✓	✓	✗
Autodesk ShotGrid	✓	✓	✓
Dassault Systemes CATIA®	✓	✗	✗
Dassault Systemes BIOVIA®	✓	✗	✗
Dassault Systemes GEOVIA®	✓	✗	✗
Dassault Systemes SOLIDWORKS®	✓	✗	✗
Dassault Systemes 3DVIA®	✓	✗	✗
Dassault Systemes ENOVIA®	✓	✗	✗
Dassault Systemes CENTRIC PLM®	✓	✓	✓
Dassault Systemes Medidata	✓	✓	✓
Dassault Systemes 3DEXCITE®	✓	✗	✗
Dassault Systemes SIMULIA®	✓	✗	✗
Dassault Systemes DELMIA®	✓	✗	✗
Siemens Solid Edge®	✓	✗	✗
Siemens NX™	✓	✗	✗
Siemens Tecnomatix®	✓	✗	✗
Siemens Femap™	✓	✗	✗
Siemens Simcenter™	✓	✗	✗
Siemens Parasolid®	✓	✓	✓



## Conclusion

In our general purpose performance comparison, we found that the Surface Laptop Studio powered by an Intel Core i7 processor and NVIDIA GeForce RTX 3050 Ti laptop GPU with 4GB GDDR6 GPU memory, in addition to 16 GB of memory and 512 GB of PCIe SSD storage, received higher Geekbench 5 Pro, Basemark GPU, Unigine Heaven, and Unigine Valley benchmark scores than the MacBook Pro powered by an Apple M1 Pro 10-core CPU with 16-core GPU. This Surface Laptop Studio configuration also outperformed its similarly configured MacBook Pro competitor in three in-game benchmark comparisons as well as completing multiple Blender 3D rendering tasks in less time.

In our design workflow performance comparison, we found that the Surface Laptop Studio powered by an Intel Core i7 processor and NVIDIA RTX A2000 laptop GPU with 4GB GDDR6 GPU memory, in addition to 32 GB of memory and 1 TB of PCIe SSD storage, received higher benchmark scores in five of six comparisons and completed a Maya 2022 app-based rendering task in less time than the similarly configured MacBook Pro powered by an Apple M1 Pro 10-core CPU with 16-core GPU.

These wins, as well as the greater gaming app and professional CAD software compatibility we found with the Windows-based Surface Laptop Studio models, could benefit consumers, hobbyists, gamers, and professional CAD users alike.

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