The science behind the report:

# Get more done with an HP ZBook Firefly G11 A Mobile Workstation PC

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 [Get more done with an HP ZBook Firefly G11 A Mobile Workstation PC](#).

We concluded our hands-on testing on August 14, 2024. 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 October 24, 2024 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](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 hands-on benchmark and AI tool testing. Higher benchmark scores and lower times to complete tasks are better.

| | HP ZBook Firefly 14-inch G11 A Mobile Workstation PC | Dell™ Precision® 3490 Mobile Workstation | Lenovo® ThinkPad® P14s Gen 5 Mobile Workstation |
|---|---|---|---|
| Passmark PerformanceTest 11.0 (higher is better) | | | |
| **Overall rating** | **7,883** | **7,011** | **7,605** |
| CPU Mark score | 29,613 | 29,541 | 31,824 |
| 2D Graphics Mark score | 814 | 805 | 633 |
| 3D Graphics Mark score | 7,246 | 5,802 | 6,441 |
| Memory Mark score | 3,132 | 3,198 | 3,259 |
| Disk Mark score | 41,554 | 34,594 | 44,793 |
| SPECworkstation® 3.1 (higher is better) | | | |
| Media and Entertainment overall score | 2.45 | 1.91 | 2.27 |
| Financial Services overall score | 3.53 | 2.53 | 3.50 |
| Blender Benchmark (higher is better) | | | |
| Classroom workload score | 45.73 | 39.81 | 45.41 |
| Maxon Redshift Benchmark (less time is better) | | | |
| Rendering time (h:mm:ss) | 0:59:17 | 1:11:20 | 1:01:20 |

| | HP ZBook Firefly 14-inch G11 A Mobile Workstation PC | Dell™ Precision® 3490 Mobile Workstation | Lenovo® ThinkPad® P14s Gen 5 Mobile Workstation |
|---|---|---|---|
| SPECapc® for Creo 9 (higher is better) | | | |
| CPU composite score | 2.08 | 1.89 | 1.97 |
| GPU composite score | 1.47 | 0.84 | 0.84 |
| Multitasking: Revit 2024 RFO benchmark and Chaos V-Ray model creation times (seconds; less time is better) | | | |
| Model creation test time | 162.87 | 221.88 | 175.45 |
| Rendering test time | 90.66 | 112.57 | 81.29 |
| Graphics (Standard view) test time | 48.54 | 71.99 | 58.45 |
| Geekbench AI (higher is better) | | | |
| Single Precision score | 6,470 | 3,248 | 2,495 |
| Half Precision score | 8,976 | 1,284 | 2,510 |
| Quantized score | 4,865 | 2,488 | 2,510 |
| LM Studio | | | |
| Tokens per second (higher is better) | 9.43 | 7.64 | 7.41 |
| Battery life - Total duration (h:mm, more time is better) | | | |
| UL Procyon Battery Life Benchmark (Office Productivity, Best power efficiency power mode) | 13:08 | 10:21 | 9:13 |
| Microsoft Teams 3x3 video conference (Best power efficiency power mode) | 5:36 | 4:09 | 4:04 |
| MobileMark 30 v1.0.0.17 (Best power efficiency power mode) | 12:23 | 9:56 | 8:49 |
| MobileMark 30 v1.0.0.17 (Balanced power mode) | 11:20 | 9:09 | 8:48 |
| Battery life - Minutes per WHr (higher is better) | | | |
| UL Procyon Battery Life Benchmark (Office Productivity, Best power efficiency mode) | 14.1 | 11.5 | 9.7 |
| Microsoft Teams 3x3 video conference (Best power efficiency power mode) | 6.0 | 4.6 | 4.3 |
| MobileMark 30 v1.0.0.17 (Best power efficiency power mode) | 13.3 | 11.0 | 9.3 |
| MobileMark 30 v1.0.0.17 (Balanced power mode) | 12.1 | 10.2 | 9.3 |
| Noise levels under load | | | |
| Cinebench 2024 CPU multi-core score (higher is better) | 847 | 674 | 908 |
| Average dBA (lower is better) | 31.7 | 31.6 | 34.0 |

# System configuration information

Table 2: Detailed information on the systems we tested.

| | HP ZBook Firefly 14-inch G11 A Mobile Workstation PC | Dell Precision 3490 Mobile Workstation | Lenovo ThinkPad P14s Gen 5 Mobile Workstation |
|---|---|---|---|
| **Processor** | | | |
| Vendor | AMD® | Intel® | Intel |
| Model number | Ryzen™ 7 PRO 8840HS | Core™ Ultra 7 165H vPro Enterprise | Core Ultra 7 165H vPro Enterprise |
| Core frequency (GHz) | 3.3 – 5.1 | 1.4 – 5.0 | 1.4 – 5.0 |
| Number of cores | 8 | 16 | 16 |
| Logical Processors | 16 | 22 | 22 |
| Cache (MB) | 16 | 24 | 24 |
| AI Technology | Integrated Ryzen AI NPU | Integrated Intel AI Boost NPU | Integrated Intel AI Boost NPU |
| **Memory** | | | |
| Amount (GB) | 32  (2 x 16 ) | 32  (2 x 16 ) | 32  (2 x 16 ) |
| Type | DDR-5600 | DDR-5600 | DDR-5600 |
| **Integrated graphics** | | | |
| Vendor | AMD | Intel | Intel |
| Model number | Radeon™ 780M Graphics | Intel Arc™ Graphics | Intel Arc Graphics |
| **Storage** | | | |
| Model | Samsung MZVL2512HCJQ-00BH1 | KIOXIA BG6 | SKHynix HFS512GEJ9X162N |
| Amount (GB) | 512 | 512 | 512 |
| Type (SSD) | PCIe® Gen4 x4 NVMe M.2 2280 | PCIe Gen4 x4 NVMe M.2 2280 | PCIe Gen4 x4 NVMe M.2 2280 |
| **Display** | | | |
| Specifications | 14" WUXGA 1,920 x 12,00 resolution, 400 nits, non-touch | 14" FHD 1,920 x 1,080 resolution, 400 nits, non-touch | 14.5" WUXGA 1,920 x 1,200 resolution, 300 nits, non-touch |
| **Connectivity/expansion** | | | |
| Wired internet | N/A | Intel Ethernet Connection I219-LM | Intel Ethernet Connection I219-LM |
| Wireless internet | MediaTek Wi-Fi 6E MT7922 (RZ616) | Intel Wi-Fi 6E AX211 | Intel Wi-Fi 6E AX211 |
| Bluetooth | 5.3 | 5.3 | 5.3 |
| # of USB Type A | 2 | 2 | 2 |
| # of USB Type C | 2 | 2 | 2 |
| Video outputs | 1 x HDMI® | 1 x HDMI | 1 x HDMI |

|  | HP ZBook Firefly 14-inch G11 A Mobile Workstation PC | Dell Precision 3490 Mobile Workstation | Lenovo ThinkPad P14s Gen 5 Mobile Workstation |
|---|---|---|---|
| **OS** | | | |
| Vendor | Microsoft | Microsoft | Microsoft |
| Name | Windows 11 Pro | Windows 11 Pro | Windows 11 Pro |
| Build number or version | 10.0.22631.4037 (23H2) | 10.0.22631.4037 (23H2) | 10.0.22631.4037 (23H2) |
| **BIOS** | | | |
| BIOS name and version | HP W82 Ver. 01.01.06 (06/19/2024) | Dell Inc 1.5.0 (06/07/2024) | Lenovo 1.15 (07/26/2024) |
| **Battery** | | | |
| Number of cells | 3 | 3 | 3 |
| Capacity (WHr) | 56 | 54 | 57 |
| **Dimensions** | | | |
| Height (in.) | 0.78 | 0.75 – 0.83 | 0.73 |
| Width (in.) | 12.42 | 12.65 | 12.81 |
| Depth (in.) | 8.80 | 8.35 | 8.96 |
| Weight (lbs.) | 3.24 | 3.27 | 3.77 |

# How we tested

## Setting up the systems

When running the tests, we used a factory-provided image. To prevent software from corrupting the test image, we reset the system image between tests.

### Setting up and updating the OEM image

1.  Boot the system.
2.  To complete installation, follow the on-screen instructions, using the default selections when appropriate.
3.  Set the Windows Power Plan 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 System.
    c.  Click Power.
    d.  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 Enter.
    b.  Move the slider control to Never notify, and click OK.

6.  Run Windows Update, and install all updates available.
7.  Launch each vendor proprietary utility app installed on each system, and update any drivers or BIOS files:

    • For Dell, run the Dell Command | Update utility.
    • For Lenovo, run the Lenovo Commercial Vantage application. Run all Critical and Recommended Updates.
    • For HP, Check for updates using HP PC Hardware Diagnostics Windows. Then run the HP Support Assistant Application, using a guest login, and run updates. After running updates, disable automatic software updates in application settings.

8.  For systems with NVIDIA graphics cards, update the NVIDIA graphics card drivers at https://www.nvidia.com/en-us/drivers/.
9.  Verify the date and time are correct, and synchronize the system clock with the time server.
10. Pause Automatic Windows Updates:

    a.  Click Windows Start.
    b.  Type `Windows Update settings`, and press Enter.
    c.  From the Pause updates drop-down menu, select Pause for 5 weeks.

## Capturing an image

1.  Connect an external HDD to the system.
2.  Click Windows Menu button.
3.  In the search bar, type `Control Panel`. Click Control Panel→System and Security→Backup and Restore (Windows 7)→Create a system image.
4.  Verify that the external HDD is selected as the save drive, and click Next.
5.  Verify that all drives are selected to back up, and click Next.
6.  Click Start backup.
7.  At Do you want to create a system repair disc, select No, and close the dialogs.

## Restoring an image

1.  Connect an external HDD to the system.
2.  While Restarting the system, press and hold the Shift key.
3.  Select Troubleshoot.
4.  Select Advanced options.
5.  Select See more recovery options.
6.  Select System image recovery.
7.  Select the User account.
8.  Enter the system password, and click Continue.

9.  At the Restore system files and settings screen, select Next.
10. Verify that the external HDD is selected, and click Next.
11. Once the recovery has completed, click Finish.

### Running process idle tasks

Once every 24-hour period, before testing, we reboot the system and run the ProcessIdleTasks command which forces idle processes to complete. This minimizes the chance of background tasks affecting test runs.

1.  Boot the system.
2.  Select Windows Start.
3.  Type `cmd`, and press Ctrl+Shift+Enter.
4.  Type `Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5.  After the command completes, wait 5 minutes before running the test.

## Measuring performance with benchmarks and AI tools

### Blender Benchmark testing

**Setting up the test**

1.  Download the Blender Benchmark from https://opendata.blender.org/.

**Running the test**

1.  Launch the Blender Benchmark.
2.  At the Welcome screen, click Next.
3.  Select Blender version 4.2.0, and click Next.
4.  At the Benchmark Scenes screen, click Next.
5.  At the Benchmark Device screen, select either the CPU or GPU option, and click Start Benchmark.
6.  Record the results.
7.  Wait 15 minutes before rerunning the test.
8.  Repeat steps 1 through 7 two more times.
9.  Record the median result.

### Geekbench AI testing

**Setting up the test**

1.  Purchase and download a Geekbench AI Pro license from https://www.geekbench.com/ai/download/.
2.  Run the installer, and install using all defaults.

**Running the test**

1.  Launch Geekbench AI.
2.  Enter the license key.
3.  In Geekbench AI, select ONNX and DirectML
4.  For Inference Device, if the device has a discrete GPU, select the GPU.
5.  Click Run AI Benchmark.
6.  Wait 5 minutes before rerunning the test.
7.  Repeat steps 3 through 6 two more times.
8.  Record the median result.

## LM Studio testing

**Setting up the test**

1. Download LM Studio from https://lmstudio.ai
2. Run the installer, and install using all defaults.
3. Launch LM Studio.
4. In the Select a model to load field, download the Llama 3.1 8B model.

**Running the test**

1. Launch LM Studio.
2. Select Load a model, and choose the Meta-Llama-3.1-8B-Instruct-Q4_K_M model.
3. When the model is fully loaded, type the question `How can AMD Ryzen Processors in HP Zbooks help enterprise customers deliver better user experience, productivity performance and ROI?` into the message field, and click Send.
4. When the test is complete, record the results.
5. Eject the model.
6. Delete the Chat messages.
7. To open a new chat, click the + icon, and reload the same model.
8. Wait 5 minutes before rerunning the test.
9. Open a new chat window, and repeat steps 2 through 8 two more times.
10. Report the median result.

## Maxon RedShift Benchmark testing

This benchmark runs the Vultures.rs scene in Maxon redshift. To render a scene, it uses all GPUs on the test system.

**Setting up the test**

1. Purchase, download, and install a 1 month license for Maxon Redshift fro https://wwww.maxon.net/en/buy#monthly.
2. Launch the Maxon App, and install the Redshift license onto the system under test.

**Running the test**

1. To open a command prompt, click the Window icon, type `cmd`, and press 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 rerunning the test.
6. Repeat steps 1 through 5 two more times.

7. Record the median result.

## PassMark PerformanceTest 11 testing

**Setting up the test**

1. Install PassMark PerformanceTEST.
2. Download PassMark PerformanceTest from https://www.passmark.com/products/performancetest/download.php.
3. To begin the installation, press Install.
4. Select Accept to accept the license agreement, and press Next.
5. After the installation is complete, deselect Launch Performance Test, and press Finish.

**Running the test**

1. To launch PassMark PerformanceTest, press the PassMark PerformanceTest icon.
2. To start the benchmark, press Run Benchmark.
3. When the test completes, record the results.
4. Repeat steps 1 through 3 two more times.
5. Record the median result.

## SPECapc for Creo 9 testing

**Setting up the test**

1. Purchase a license for Creo 9.
2. To log into your PTC account, use the Welcome email, and designate a site administrator.
3. Download the Win64 Creo 9.0 installer from here https://support.ptc.com/appserver/auth/it/esd/product.jsp?prodFamily=ENG. We download Creo 9.0.9.0.
4. Extract the Creo 9.0.9.0 zip file.
5. Inside the extracted file, copy the install_license_server.exe onto a separate Windows system.
6. On a separate Windows system, run install_license_server.exe.
7. In the Creo Installation Assistant – Creo 9.0.9.0 Window, select Install License Server, and click Next.
8. Accept the Software License Agreement, and click Next.
9. On the License Identification screen, select Simple license entry, and click Next.
10. Expand the drop-down menu next to License Generation for Server Install, and select Simple License entry.
11. Enter the sales order number located on your purchase order, and click Install License.
12. In the new window, log into PTC.com with your credentials.
13. Click Finish.
14. Verify that the license server is running by browsing to the server IP and port 8090 or [server_ip]:8090.
15. Login with the default credentials, admin/admin, enter a new Password, and verify that the license server is running with available licenses.
16. On, the system under test, copy the Creo Installation folder above to the target system.
17. Run Setup.exe.
18. At the Introduction screen, click Next.
19. At the Software License Agreement screen, accept the agreement, export the agreement, and click Next.
20. Add the license server using 7788@[ip_of_license server]. Select the License server, and click Next.
21. At the Application Selection screen, accept the Defaults, and click Next.
22. At the Customize Application screen, confirm that Creo Render Studio is selected, and click Install.
23. Once the installation completes, click Finish.
24. Launch Creo Parametric and close any prompts.
25. Download SPECapc for Creo 9 from https://gwpg.spec.org/benchmarks/benchmark/specapc-ptc-creo-9/.
26. Using all the default options, extract and complete the installation.

**Running the test**

1. Open SPECapc for Creo 9.
2. Click Run.
3. Repeat steps 1 and 2 two more times.
4. Record the median result.

## SPECworkstation 3.1 testing

**Setting up the test**

1. Go to https://www.spec.org/gwpg/wpc.static/workstation3-info.html, purchase, and download the vendor license of the benchmark.
2. Unzip the SPECworkstation_304.zip file to C:\.
3. To install, navigate to the extracted SPECworkstation_304 directory, and click SPECworkstation_304.exe.
4. Turn off Windows Defender Firewall.
5. Click Windows Menu button.
6. In the search bar, type `Firewall`.
7. Select Windows Defender Firewall.
8. In the left-hand column, select Turn Windows Defender Firewall on or off.
9. Under both Private and Public network settings, choose Turn off Windows Defender Firewall, and click OK.

**Running the test**

1. Launch SPECworkstation.
2. Next to Official Run, check the box.
3. Click the OpenCL Configuration button, and select the discrete graphics card option.

4. Click Run Benchmark.
5. Repeat steps 1 through 4 two more times.
6. Record the median result.

## Measuring multitasking performance

We ran the Revit 2024 RFO benchmark and the Chaos V-Ray benchmark simultaneously.

**Setting up the Revit 2024 RFO benchmark.**
1. Sign up for and download custom install Autodesk Revit 2024 from https://autodesk.com/products/revit/free-trial.
2. Using all defaults, complete the Revit 2024 installation.
3. After the installation is complete, click Launch Now.
4. At the Tutorial screen, click Don't show this again.
5. Close Revit 2024.
6. Download the Revit 2024 RFO Benchmark Tool from https://www.revitforum.org/forum/revit-all-flavors/hardware-and-infrastructure/36875-rfo-benchmark-v3.
7. Extract the Revit 2024 RFO Benchmark Tool.

**Setting up the Chaos V-Ray benchmark**
1. Download the V-Ray Benchmark from https://www.chaos.com/benchmark-download. We used version 6.00.01.

**Running Revit 2024 RFO benchmark + Chaos V-Ray benchmark simultaneously**
1. Launch the Chaos V-Ray benchmark.
2. For systems with integrated graphics, select V-Ray GPU + CUDA, and change Time duration to Infinite.
3. For systems with discrete graphics, select V-Ray GPU + RTX, and change Time duration to infinite.
4. Open the Extracted Revit 2024 RFO Benchmark Tool directory.
5. To start the Revit 2024 RFO benchmark, click RFO Benchmark – Full_Standard executable, start the V-Ray benchmark, and minimize it.
6. When the Revit 2024 RFO benchmark finishes, as indicated by the results text file appearing, stop the V-Ray benchmark.
7. Record the results for the Revit 2024 RFO benchmark.
8. Wait 30 minutes before performing the next run.
9. Repeat steps 1 through 8 two more times.
10. Record the median results.

## Measuring battery life

### MobileMark 30 testing
We performed this test in Windows 11 Balance and Best battery efficiency power mode.

This test requires an X-Rite - i1Display Plus colorimeter.

**Avoiding antivirus software conflicts**
MobileMark 30 is not compatible with any virus-scanning software, so we uninstalled any such software present on the notebook PCs before we installed the benchmark.

**Avoiding pre-installed software conflicts**
MobileMark 30 installs the following applications, which its test scripts employ:

Productivity
- Corel WinZip 26.0 Enterprise
- Microsoft Excel 2021 Professional Plus
- Microsoft Outlook 2021 Professional Plus
- Microsoft PowerPoint 2021 Professional Plus
- Microsoft Word 2021 Professional Plus

Creativity
- Adobe® Photoshop® CC

If any of these applications already exist on the system under test, they could cause problems with the benchmark due to software conflicts. To avoid any such issues, we uninstalled all conflicting pre-installed software applications—including different versions of any of the programs MobileMark 30 uses—before we installed the benchmark.

## Using the MobileMark built-in configuration tool

This tool supports three levels of configuration:

1. Only makes changes that are REQUIRED for the benchmark to run.
2. Additionally, makes changes that are RECOMMENDED for repeatable results.
3. Additionally, makes OPTIONAL changes that help ensure best results.

The configuration tool makes the following configuration changes at each of the three levels:

**Level 1 - Required**

- Disables User Account Control (UAC)
- Set DPI Scaling to 100%
- Disables Low Battery Actions
- Disables Network Proxies
- Disables System Sleep and Hibernate
- Disables Windows Update
- Enables Windows Search
- Disables WinSAT

**Level 2 - Recommended**

- Create BAPCo power scheme
- Set Power Plan Type to Balanced
- Set CPU Adaptive Mode
- Disables Battery Saver Dimming
- Verifies Battery Saver Threshold
- Disables Disk Defrag
- Disables Windows Error Reporting
- Disables Windows Lock Screen
- Disables Screen Saver and Monitor Timeout
- Set Font Smoothing

**Level 3 - Optional**

- Disables Battery Saver
- Disables Hard Disk Timeout
- Disables System Restore
- Ignores Laptop Lid Close
- Enables Dark Mode

For the Balanced runs, we chose the official BAPCo "Run Benchmark" default as outlined in the BAPCo MobileMark30 User Guide (https://bapco.com/wp-content/uploads/2024/04/BAPCo-MobileMark30_User-Guide-v1.0.pdf), which runs the benchmark using the Required and Recommended options. We disabled the recommended options for "Set Power Plan Type to balanced" and "Verify Battery Saver Threshold" options.

**Setting up the performance-qualified battery life test**

1. On a separate PC, install the i1Profiler software from https://www.xrite.com/categories/formulation-and-quality-assurance-software/i1profiler, and connect the X-Rite - i1Display Plus colorimeter to that PC.
2. On the system under test, verify that the wireless adapter is disabled.
3. For the Balanced battery life runs:

    a. Select Windows Start, type `Power, sleep, and battery settings`, and press the Enter key.
    b. From the Power mode drop-down menu select Balanced.
    c. Select Windows Start, type `Battery saver`, and press Enter.
    d. From the Battery saver drop-down menu, select Turns on at 20%, click the down arrow. Next to Lower screen brightness when using battery saver, toggle the button to Off.

4. For the Best power efficiency battery life runs:

    a. Select Windows Start, type `Power, sleep, and battery settings`, and press Enter.
    b. From the Power mode drop-down menu, select Best power efficiency.
    c. Select Windows Start, type `Battery saver`, and press Enter.
    d. From the Battery saver drop-down menu, select Turns on at Always (100%), click the down arrow. Next to Lower screen brightness when using battery saver, toggle the button to Off.

5. On the system under test, verify that the volume is set to 50%.
6. On systems with AMD processors, disable Vari-Bright to prevent the screen from dynamically changing the screen brightness based on content:

    a. Launch AMD Software.
    b. Click the Settings gear icon.
    c. Select the Display tab, and disable Vari-Bright.

7. On systems with Intel processors, disable Intel DPST to prevent the screen from dynamically changing the screen brightness based on content:

    a. Open the Intel Graphics Command Center, press the keyboard Windows button, and type `Intel`, choose Intel Graphics Command Center.
    b. Select System→Power.
    c. In On Battery, set Display Power Savings to Off.

8. Verify system brightness is no less than 250 nits.
9. On the system under test, install MobileMark 30 with the default options.

**Running the performance-qualified battery life test**

1. Boot the system.
2. Launch MobileMark 30.
3. Click Run Benchmark.
4. Click the Brightness Profiler button.

    a. Allow the white screen to warm up for 30 minutes. After 30 minutes click Skip.
    b. At the Panel Dark Luminance pop-up, to use the value that is queried from the display, select Yes.
    c. Place the X-Rite - i1Display Plus colorimeter in the outlined spot on the screen.
    d. On the test PC, to turn off the test overlay, toggle the F1 button.
    e. On the colorimeter PC, start i1Profiler program, and select Advanced.
    f. Click Display, and click Profiling.
    g. Next to Luminance, click the drop-down menu and select Measure.
    h. In the drop-down menu that appears below, select Paper in booth.
    i. In the box with the image that says Place your paper in the light booth, scroll down so that you can click the Measure button.
    j. On the test PC, adjust the slider until the Target White luminance is met on the colorimeter PC.
    k. Once the correct Target White luminance is met on the test PC, click Done.

5. The test will begin immediately. When prompted, unplug the AC power adapter.

The benchmark is complete when the system has fully depleted its battery and is no longer operational when running on battery power.

We executed the MobileMark 30 benchmark three times on the system and took the median battery life score run as the representative performance score result for that test.

## Procyon Battery Life Benchmark testing

### Setting up the test

1. Boot the system.
2. Verify the following display and power settings:

   a. Right-click the desktop, and select Display settings.
   b. Next to Change brightness automatically when lighting changes, if available, uncheck the box.
   c. Next to Change brightness based on content, if available, uncheck the box.
   d. In the Scale drop-down menu, select 100%.
   e. From the left-hand pane, select System.
   f. Click Power & Battery.
   g. For all power options listed under Screen and Sleep, select Never.
   h. Set Power mode while unplugged to the desired setting (i.e.- Best power efficiency).

3. On systems with AMD processors, disable Vari-Bright to prevent the screen from dynamically changing the screen brightness based on content:

   a. Launch AMD Software.
   b. Click the Settings gear icon.
   c. Select the Display tab, and disable Vari-Bright.

4. On systems with Intel processors, disable Intel DPST to prevent the screen from dynamically changing the screen brightness based on content:

   a. Open the Intel Graphics Command Center, press the keyboard Windows button, and type `Intel`, choose Intel Graphics Command Center.
   b. Select System→Power.
   c. In On Battery, set the Display Power Savings to Off.

5. To bring up a white screen, open a web browser, and into the address bar, type `about:blank`.
6. Unplug the system.
7. Using a nit meter, adjust the screen brightness to as close to 250 nits as possible.
8. Plug in the system.
9. Download and install Procyon.
10. Open Procyon.
11. Click Battery Life Office Productivity Benchmark.
12. Click Register.
13. Enter the license key for the Office Productivity Battery Life Benchmark, and click Register.
14. Close Procyon.
15. Before running the benchmark, install licensed versions of Microsoft 365 and open Word, Excel, PowerPoint, and Outlook applications, and disable tips when possible.

### Running the test

1. Boot the system.
2. Ensure the system is fully charged.
3. Launch Procyon.
4. Select the Procyon Battery Life option.
5. Under the Office Productivity tab, click Run.
6. When prompted, unplug the system.
7. When the benchmark completes, plug in the system, and power up the system.
8. Record the results.
9. Repeat steps 2 through 8 two more times.
10. Report the median result.

## Microsoft Teams meeting testing

This test requires the following:

- Nine non-testing systems as permanent meeting attendees; one of these with a licensed account to host.
- Microsoft Teams
- PT Internal battery life logger

### Setting up the test

1. Boot the systems under test.
2. Verify the following display and power settings:
    a. Right-click the desktop, and select Display settings.
    b. Next to Change brightness automatically when lighting changes, if available, uncheck the box.
    c. Next to Change brightness based on content, if available, uncheck the box.
    d. In the Scale drop-down menu, select 100%.
    e. From the left-hand pane, select System.
    f. Click Power & Battery.
    g. For all power options listed under Screen and Sleep, select Never.
    h. Set Power mode while unplugged to the desired setting.

3. On systems with AMD processors, disable Vari-Bright to prevent the screen from dynamically changing the screen brightness based on content:
    a. Launch AMD Software.
    b. Click the Settings gear icon.
    c. Select the Display tab, and disable Vari-Bright.

4. On systems with Intel processors, disable Intel DPST to prevent the screen from dynamically changing the screen brightness based on content:
    a. Open the Intel Graphics Command Center, press the keyboard Windows button, and type `Intel`, choose Intel Graphics Command Center.
    b. Select System➔Power.
    c. In On Battery, set the Display Power Savings to Off.

5. To bring up a white screen, open a web browser and, in the address bar, type `about:blank`.
6. Unplug the system.
7. Using a nit meter, adjust the screen brightness to as close to 250 nits as possible.
8. Plug in the system.
9. Open Settings, and click Bluetooth & Devices.
10. Click Cameras, and click the built-in connected camera.
11. Under Windows Studio Effects, turn on all settings.
12. Copy the battery life logger to each system under test.
13. As administrator, open PowerShell, and run Set-ExecutionPolicy Unrestricted
14. On one of the non-testing systems, launch Teams, and log in to a licensed Microsoft account.
15. In the left-hand pane, click Calendar
16. Click Meet Now, and click Start Meeting.
17. Ensure the camera is turned on, and click Join now.
18. In the top toolbar, click More, and click Meeting Info.
19. Note the Meeting ID and Passcode.
20. On the remaining eight non-testing systems, launch Teams, and click Join a meeting.
21. Enter the Meeting ID and Passcode, and click Join meeting.
22. Ensure the camera is turned on, and click Join now.

### Running the test

1. Verify that the system's battery is fully charged.
2. Launch Teams, and click Join a meeting.
3. Enter the Meeting ID and Passcode, and click Join meeting.
4. Ensure the camera and audio are turned on, and click Join now.
5. In the top toolbar, click View.

6.  Ensure Gallery View is selected, and set the Max Gallery Size to 9 people.
7.  As administrator, open PowerShell, and navigate to the directory containing the battery life logger script.
8.  To run the script, type `.\<battery_script_name>.ps1`, and press Enter.
9.  When prompted, unplug the system, and switch back to the Teams meeting.
10. When the system has shut down, plug in the system, and start it.
11. In Explorer, navigate to C:\ProgramData\ptbat\.
12. Open the folder corresponding with the date and time of the test, and from batresults_minutes.txt, record the results.
13. Repeat steps 1 through 12 two more times
14. Report the median result.

## Measuring system acoustics under load

We measured acoustics while running the Cinebench 2024 benchmark.

These tests require the following items:

- Extech SDL600 Sound Level Meter/Datalogger with SD card
- Cinebench 2024

### Setting up the test

1.  Place the system under test in a sound-proofed professional sound booth.
2.  Set the Extech SDL600 on a tripod so that it is 2 feet in front of, and 1 foot above the bottom of the system under test.
3.  Download and install Cinebench 2024 from https://www.maxon.net/en/downloads/cinebench-2024-downloads.
4.  Launch Cinebench 2024.
5.  Select File→Advanced benchmark.
6.  Select File→Preferences, change the Custom Minimum Test Duration to 90 minutes, and click OK.
7.  Exit Cinebench and shutdown the system.

### Running the test

1.  Boot the system.
2.  Launch Cinebench 2024.
3.  In the Minimum Test Duration field, select Custom (90 minutes).
4.  Start the Extech SDL600 Sound Level Meter/Datalogger.
5.  Click the Cinebench 2024 CPU (Multi Core) Start button.
6.  At the end of the 90-minute Cinebench 2024 run, stop the Extech SDL600, and record the average sound level (dB) while running Cinebench 2024.
7.  Shut down the system for 60 minutes, and let it return to room temperature.
8.  Repeat steps 1 through 7 two more times.
9.  Record the median result.

Read the report at https://facts.pt/NJYS7nN  ▶

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