The science behind the report:

A faster, longer running, entry-level mobile workstation

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 A faster, longer running, entry-level mobile workstation.

We concluded our hands-on testing on September 26, 2019. 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 August 27, 2019 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

The table below presents our findings in detail.

	Dell Precision 3541 Mobile Workstation	HP ZBook 15v Mobile Workstation
SPECworkstation 3.0.2 Benchmark median scores (higher is better)		
Media and entertainment	1.52	1.42
Product development	1.69	1.44
Life sciences	1.27	1.15
Financial services	1.43	1.43
Energy	0.96	0.80
General operations	1.71	1.63
GPU compute	0.96	0.84
Average time to complete SPECworkstation 3 benchmark tests		
Time in seconds	18,075	22,181
Time in hrs:min:sec	5:01:10	6:09:41
Time difference compared to Dell and HP	-	1:08:31

	Dell Precision 3541 Mobile Workstation	HP ZBook 15v Mobile Workstation
Average time spent in TurboBoost mode by CPU core (seconds)		
Core #0	15,462	20,902
Core #1	15,521	20,909
Core #2	15,544	20,902
Core #3	15,548	20,918
Core #4	15,563	20,921
Core #5	15,521	20,912
Average time spent in TurboBoost mode by CPU core (percentage)		
Core #0	86%	94%
Core #1	86%	94%
Core #2	86%	94%
Core #3	86%	94%
Core #4	86%	94%
Core #5	86%	94%
MobileMark 2018 Battery Life (higher is better)		
Median Battery life (hours:minutes)	9:14	6:48
Performance Qualification	1,161	1,005

System configuration information

The table below presents detailed information on the systems we tested.

System	Dell Precision 3541 Mobile Workstation	HP ZBook 15v Mobile Workstation
Processor		
Vendor	Intel	Intel
Name	Xeon	Xeon
Model number	E-2276M	E-2176M
Core frequency (GHz)	2.80 – 4.70	2.70 – 4.40
Number of cores	6	6
Cache	12 MB SmartCache	12 MB SmartCache
Memory		
Amount (GB)	16	16
Type	DDR4	DDR4
Speed (MHz)	2,666	2,666
Graphics		
Vendor	NVIDIA	NVIDIA
Model number	Quadro P620	Quadro P600
RAM	4 GB GDDR5	4 GB GDDR5
Driver	NVIDIA 26.21.14.3170	NVIDIA 26.21.14.3170
Storage		
Amount (GB)	512	512
Type	M.2 PCIe NVMe	M.2 PCIe NVMe
Connectivity/expansion		
Wireless	Intel Wi-Fi 6 AX200	Intel Dual Band Wireless AC 9560
Bluetooth	5.0	5.0
USB	3 x USB 3.1, 1 x USB-C	3 x USB 3.0, 1 x USB-C
Video	HDMI	HDMI
Battery		
Type	Lithium Ion Polymer	Lithium Ion Polymer
Rated capacity (Wh)	97	70
Display		
Size (in.)	15.6	15.6
Type	FHD	FHD
Resolution	1920 x 1080	1920 x 1080
Touchscreen	Yes	Yes

System	Dell Precision 3541 Mobile Workstation	HP ZBook 15v Mobile Workstation
Operating system		
Vendor	Microsoft	Microsoft
Name	Windows 10 Pro	Windows 10 Pro for Workstations
Build number or version	18362	18362
BIOS		
BIOS name and version	Dell 1.2.11	HP Insyde F.20
Dimensions & Weight		
Height (in)	0.86	1.00
Width (in)	13.85	14.37
Depth (in)	9.29	10.10
Weight (lbs.)	4.34	4.72

How we tested

Test requirements

- HWiNFO64
- SPECworkstation 3 benchmark

General setup

1. Set DPI scaling to 100%, and set Screen and Sleep options to Never.
   a. Select Windows Start, type `display settings`, and press Enter.
   b. Under the Scale and layout section, for the Change the size of text, apps, and other items option, select 100%.
   c. From the left-hand column, select Power & Sleep.
   d. For all power options listed under Screen and Sleep, select Never.
2. 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.
3. Disable Windows Firewall.
   a. Select Windows Start, type `Windows Firewall`, and press the Enter key.
   b. From the left-hand column, select Turn Windows Defender Firewall on or off.
   c. Under Private and Public network settings, select Turn off Windows Defender Firewall.

Setting up HWiNFO64

1. Download HWiNFO64 from https://www.hwinfo.com/download/, and install it with the default options.
2. Launch HWiNFO64.
3. Select Sensors-only.
4. If a warning appears click Do not monitor this sensor.
5. Click the gear icon for Configure Sensors.
   a. Change the Global Polling Period to 1000 ms, and click OK.
6. Close HWiNFO64.

Setting up the SPECworkstation 3 benchmark

1. Download SPECworkstation 3 from https://www.spec.org/gwpg/wpc.static/workstation3-info.html, and install it with the default options.

Measuring performance and observing TurboBoost using SPECworkstation 3 benchmark and HWiNFO64

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `Cmd.exe /c start /wait 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.
6. Launch HWiNFO64, and position it in the lower right-hand corner of the screen.
7. Launch the SPECworkstation 3 benchmark as an administrator.
8. Select 1 iteration, and check the box next to Official Run.
9. Click the OpenCL/CUDA Configuration button, and select the discrete graphics card option.
10. In HWiNFO64, click the Logging Start icon.
11. Wait 30 seconds.
12. On the SPECworkstation 3 benchmark, click Run Benchmark.
13. When the benchmark finishes, stop the HWiNFO64 log recording and record the SPECworkstation 3 benchmark results.
14. Repeat steps 1 through 13 twice more.

Measuring battery life with MobileMark 2018

Avoiding antivirus software conflicts

MobileMark 2018 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 2018 installs the following applications, which its test scripts employ:

Productivity

- Adobe® Acrobat® Pro DC
- AutoIT 3.3.14.2
- Google® Chrome®
- Microsoft Excel 2016
- Microsoft OneNote 2016
- Microsoft Outlook 2016
- Microsoft PowerPoint 2016
- Microsoft Word 2016
- Windows Zip

Creativity

- Adobe® Photoshop® CC
- Adobe® Lightroom® Classic CC
- CyberLink PowerDirector® 2015

Web Browsing

- Google Chrome
- Microsoft Movies & TV

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 2018 uses—before we installed the benchmark.

Adjusting display brightness and power settings

The brightness of a notebook's display affects its battery life. Therefore, BAPCo requires that, before you test with MobileMark 2018, you ensure the brightness of the notebook's monitor is greater than or equal to 200 nits in the center of a completely white screen while the notebook is unplugged and running on battery power. The measurement follows the standards from the Video Electronics Standards Association (www.vesa.org).

We complied with this standard for all our tests by setting each notebook PC's brightness as close to 200 nits as we could without going below that level. We used the following procedure before we started each test. Note: This procedure assumes we began with the notebook plugged into the power supply.

1. To create a completely blank, white screen, open Microsoft Paint by clicking Start→All Programs→Accessories→Paint.
2. Press Ctrl+W to open the Resize and Skew dialog.
3. Under Horizontal and Vertical, enter 200, and click OK.
4. Click the View tab.
5. Click Full screen to view a white screen.
6. Wait 45 minutes to allow the screen to warm.
7. Unplug the notebook from the power supply, and measure the display's brightness using a luminance meter in the center of the screen. (We used a Gossen Mavolux5032C luxmeter.)
8. If the reading is below or significantly greater than 200 nits, adjust the screen brightness to as close to 200 nits as you can without going under, and retest:
   a. Click the Windows start button.
   b. In the Windows Start search box, type `display settings.`
   c. Adjust the slider to change the Display brightness to the correct percentage that produces no less than 200 nits.
9. Allow the notebook to run on battery power for 10 minutes, re-measure the display, and adjust the brightness up or down as necessary.
10. Verify that the notebook saved the brightness setting by plugging in the system, unplugging it, and taking another reading.

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

Level 2 - Recommended

- Create BAPCo power scheme
- Set Power Plan Type to balanced
- Sets CPU Adaptive Mode
- Disables Battery Saver Dimming
- Verifies Battery Saver Threshold
- Disables Disk Defrag
- Disables Windows Error Reporting
- Disables Windows Lock Screen
- Disables Windows Pop-ups
- Disables Screen Saver and Monitor Timeout
- Disables Windows Sidebar/Gadgets
- Disables Desktop Slideshow
- Disables Windows Defender
- Disables Windows Firewall
- Set Font Smoothing

Level 3 - Optional

- Disables Hard Disk Timeout
- Disables System Restore
- Ignores Laptop Lid Close

We chose the official BAPCo 'Run Benchmark' default as outlined in the BAPCo MobileMark2018 User Guide http://bapco.com/wp-content/uploads/2019/03/BAPCo_MobileMark2018_user_guide_v1.3.pdf which runs the benchmark using the Required and Recommended options.

Performing setup

1. Verify that the wireless adapter is enabled and connected to a wireless router that is not connected to the Internet.
2. Verify that the screen brightness is set to no less than 200 nits.
3. Install MobileMark 2018 with the default options.

Measuring battery life with MobileMark 2018

We performed the following steps to run the MobileMark 2018 benchmark:

1. Launch MobileMark 2018.
2. Click Run Benchmark.
3. When prompted, unplug the AC power adapter. The test will begin immediately.
4. The benchmark is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

We executed the MobileMark 2018 benchmark three times on the system and took the median battery life run as the representative score for that test.

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Read the report at http://facts.pt/pq7h2au ▶
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