Microsoft Surface Book successfully mixes battery life, display quality, performance, and portability

Real-world evaluation of seven top-selling Windows 10 devices

Choosing the Windows® 10 device that best suits your specific needs can be challenging. There are countless options available and a wide range of factors to consider. Content creators, engineers, and other mobile professionals depend on powerful processors and great graphics but might regret choosing a Windows 10 laptop, convertible, or 2-in-1 based on graphics alone when their shoulders are aching from carrying around a heavy laptop bag all day. And a device with tons of computing power might lose some of its appeal if the battery dies in the middle of an important meeting. These considerations can make the successful mix of battery life, display quality, performance, and portability more important than any one individual feature.

To show you how seven top-selling 13" Windows 10 devices handled real-world, everyday use, we evaluated them in the Principled Technologies testing facilities. We ran down their batteries, examined their displays, put them through a series of performance tests, and verified the size and weight of each device. Microsoft Surface Book delivered the factors that on-the-go professionals look for when choosing a new digital workmate.

Read on to see how these seven Windows 10 devices compare.

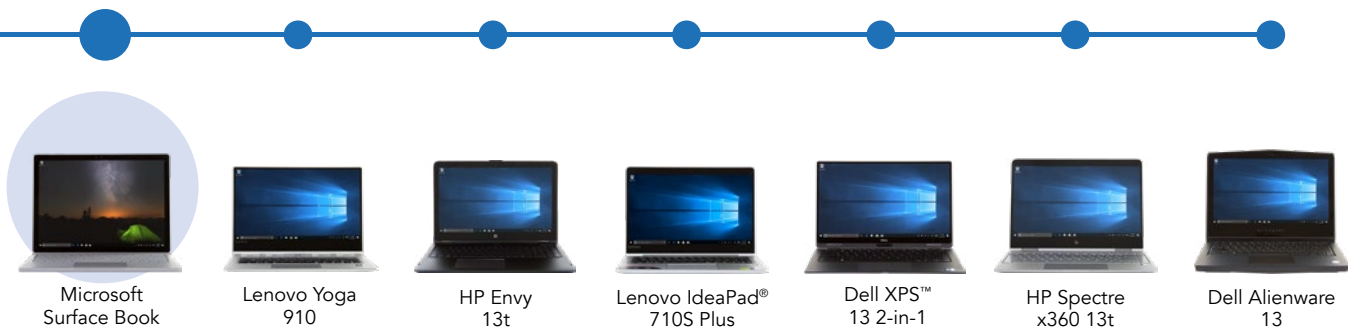|			
Battery life	Display quality	Performance	Portability

Battery life

Whether you're working or playing, you don't want to go searching for a power outlet at an inopportune time, so having a device that can get you through a typical day of work or a cross-country flight is a big deal. We performed two battery life tests to represent different types of device use that drain your battery at different rates.

We used a typical evaluation tool that measured battery life by playing a movie on repeat until the battery dies. Microsoft Surface Book delivered significantly longer plug-free time than any of the competitors. In fact, at almost two full work days, Microsoft Surface Book lasted four and a half hours longer than the Lenovo® Yoga™ 910 and more than a full workday longer than the Dell™ Alienware™ 13.

For the second evaluation, we bombarded each system with tasks like using Microsoft Office apps, browsing common websites, streaming video, and streaming audio. While every device experienced a dramatically shorter battery life under this extreme use case scenario, Microsoft Surface Book still lasted longer than the rest.

Microsoft Surface Book	Lenovo Yoga 910	HP Envy 13t	Lenovo IdeaPad® 710S Plus	Dell XPS™ 13 2-in-1	HP Spectre x360 13t	Dell Alienware 13

Battery life rankings – *Lower is better*

1	2	3	4	5	6	7

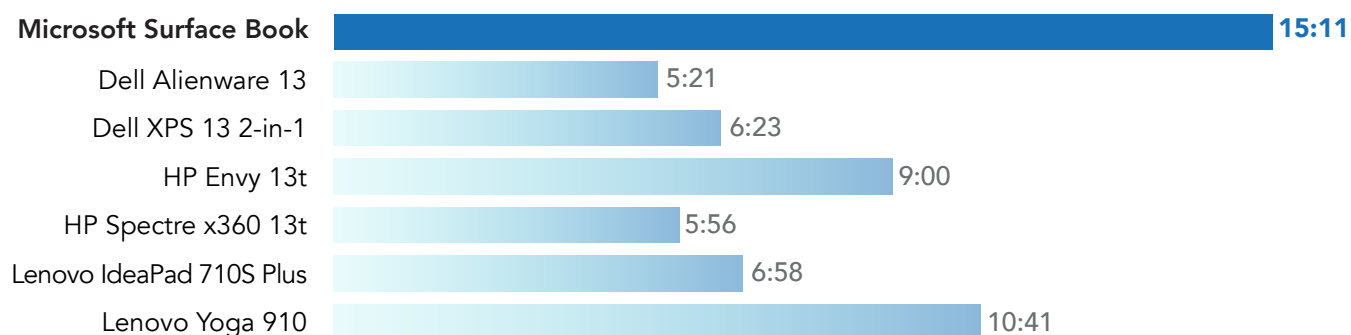Battery life radar chart scores – *Higher is better**

7	6	5	4	3	2	1

* Go to page 15 to see the radar chart results on each device.

Battery life

Measured in hours:minutes — Higher is better

Microsoft Surface Book	**15:11**
Dell Alienware 13	5:21
Dell XPS 13 2-in-1	6:23
HP Envy 13t	9:00
HP Spectre x360 13t	5:56
Lenovo IdeaPad 710S Plus	6:58
Lenovo Yoga 910	10:41

Custom battery life

Measured in hours:minutes — Higher is better

Microsoft Surface Book	**7:01**
Dell Alienware 13	3:51
Dell XPS 13 2-in-1	5:10
HP Envy 13t	5:21
HP Spectre x360 13t	4:35
Lenovo IdeaPad 710S Plus	4:41
Lenovo Yoga 910	5:25
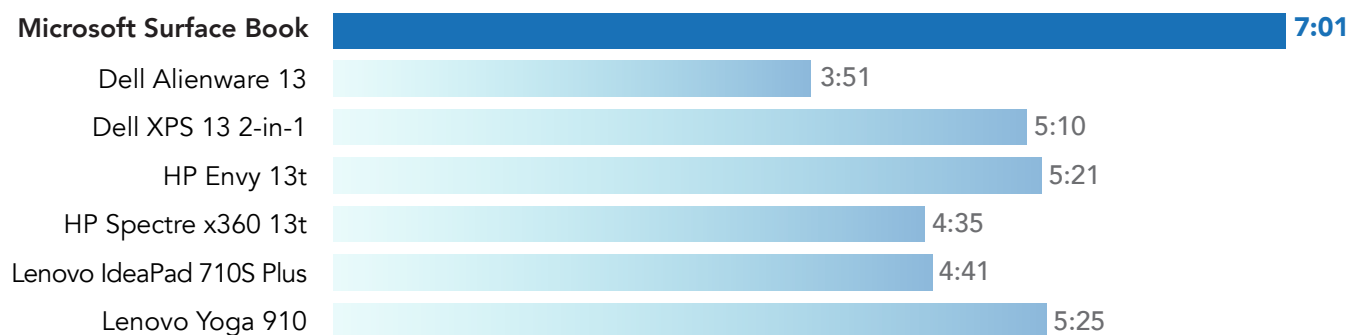
Display quality

A good user experience depends on a wide range of colors on a screen (gamut coverage) and sharp graphics and text. Microsoft Surface Book had a high number of pixels per inch (PPI) and a high contrast ratio, both of which contribute to a better user experience. The Dell Alienware 13 was the only device to deliver a higher contrast ratio than Microsoft Surface Book, but its display wasn't as sharp because it had a lower PPI value. The HP Spectre x360 13t exhibited a sharper display than Microsoft Surface Book, but Microsoft device reproduced a wider range of colors, giving viewers a richer tapestry to work with.
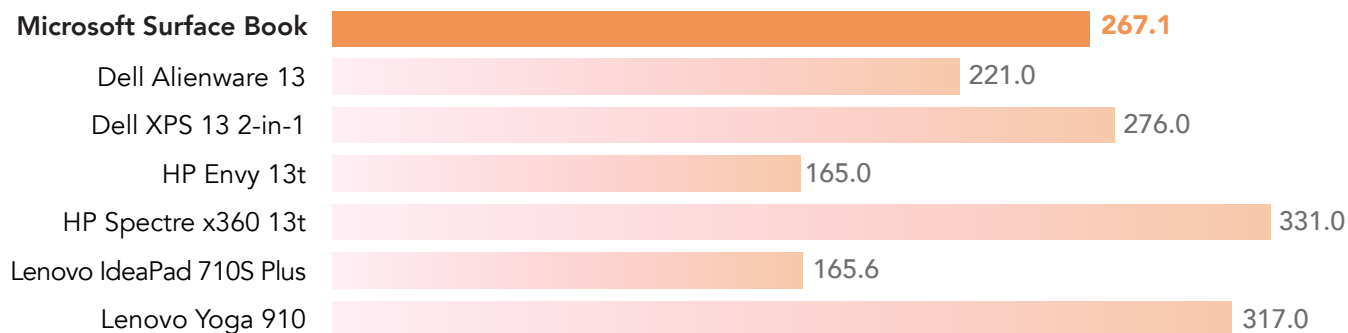
| Dell Alienware 13 | Microsoft Surface Book | Lenovo Yoga 910 | Dell XPS 13 2-in-1 | HP Spectre x360 13t | Lenovo IdeaPad 710S Plus | HP Envy 13t |

Display quality rankings – *Lower is better*

| 1 | 2 Tied | 2 | 4 | 4 | 6 | 7 |

Display quality radar chart scores – *Higher is better**

| 7 | 6 | 6 | 4 | 4 | 2 | 1 |

* Go to page 15 to see the radar chart results on each device.

Display resolution

Measured in PPI — Higher is better

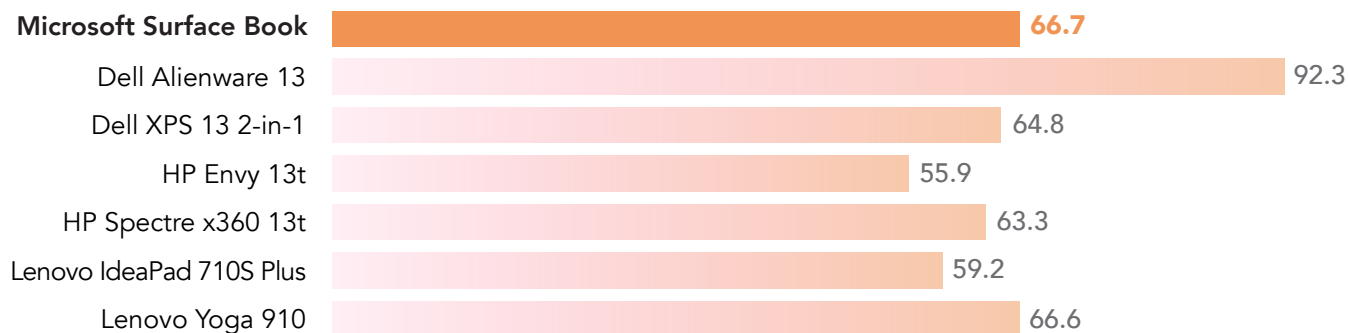|	
Microsoft Surface Book	**267.1**
Dell Alienware 13	221.0
Dell XPS 13 2-in-1	276.0
HP Envy 13t	165.0
HP Spectre x360 13t	331.0
Lenovo IdeaPad 710S Plus	165.6
Lenovo Yoga 910	317.0

Gamut coverage sRGB

Overall score — Higher is better

Microsoft Surface Book	**89.0**
Dell Alienware 13	100.0
Dell XPS 13 2-in-1	89.5
HP Envy 13t	76.5
HP Spectre x360 13t	91.9
Lenovo IdeaPad 710S Plus	80.9
Lenovo Yoga 910	91.3
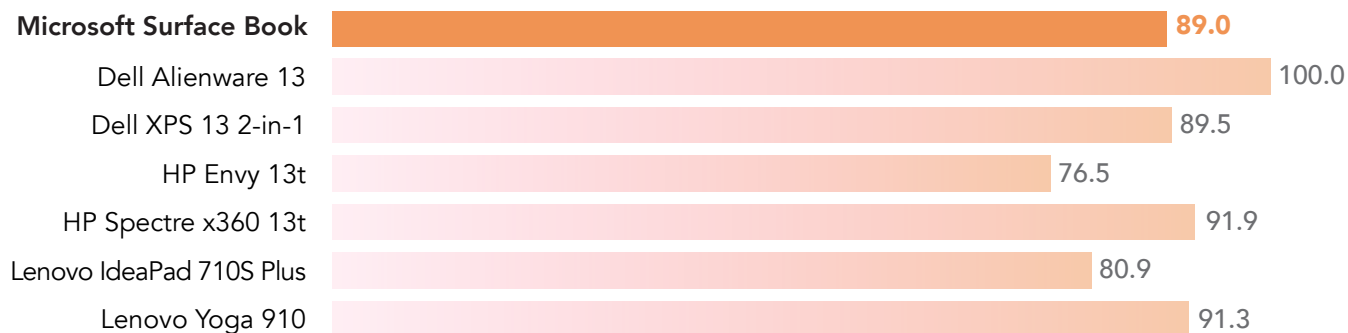
Gamut coverage Adobe RGB

Overall score — Higher is better

Microsoft Surface Book	**66.7**
Dell Alienware 13	92.3
Dell XPS 13 2-in-1	64.8
HP Envy 13t	55.9
HP Spectre x360 13t	63.3
Lenovo IdeaPad 710S Plus	59.2
Lenovo Yoga 910	66.6

Gamut coverage DCI P3

Overall score — Higher is better

Microsoft Surface Book	**68.2**
Dell Alienware 13	99.2
Dell XPS 13 2-in-1	68.0
HP Envy 13t	61.4
HP Spectre x360 13t	65.1
Lenovo IdeaPad 710S Plus	66.5
Lenovo Yoga 910	68.5
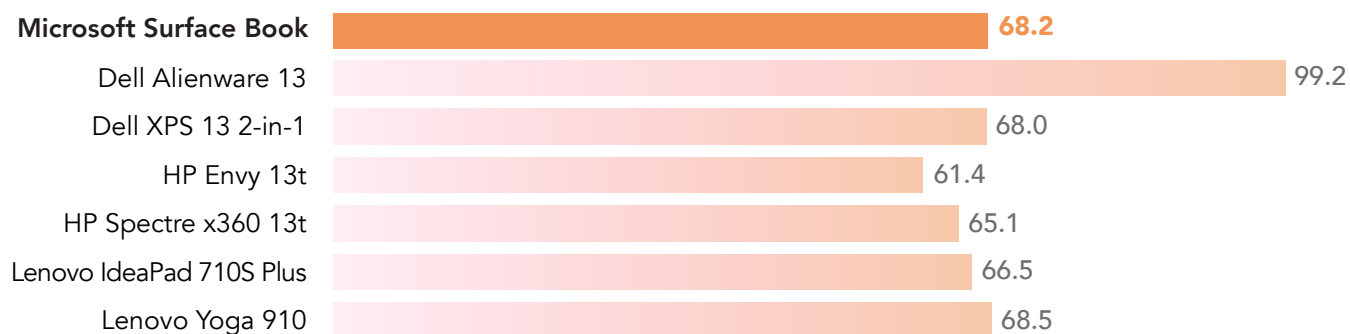
Contrast ratio

Overall score — Higher is better

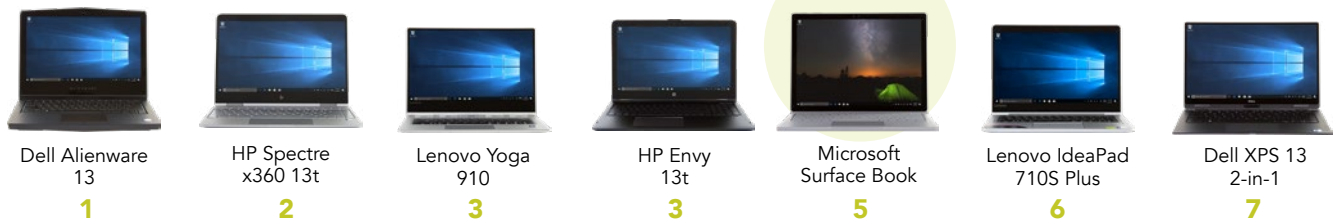|	
Microsoft Surface Book	**1507**
Dell Alienware 13	Infinite*
Dell XPS 13 2-in-1	1289
HP Envy 13t	1136
HP Spectre x360 13t	1203
Lenovo IdeaPad 710S Plus	1001
Lenovo Yoga 910	1023
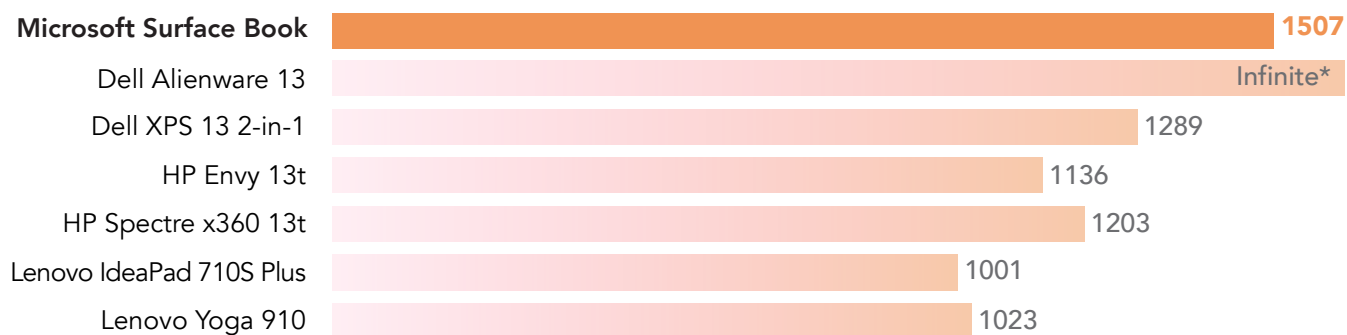
*Alienware has an OLED display, which means the light sensor doesn't detect any light when measuring black, so the resulting contrast ratio is divided by zero (infinite).

Performance

Out of the 13 different performance tests we ran, Microsoft Surface Book received the best score in a test measuring multi-core processor and memory performance. It ultimately ended up in the middle of the pack, coming in right behind the HP Envy 13t and the Lenovo Yoga 910.

Dell Alienware 13	HP Spectre x360 13t	Lenovo Yoga 910	HP Envy 13t	Microsoft Surface Book	Lenovo IdeaPad 710S Plus	Dell XPS 13 2-in-1
1	**2**	**3**	**3**	**5**	**6**	**7**

Performance rankings – *Lower is better*

1	2	3 Tied 3		5	6	7

Performance radar chart scores – *Higher is better**
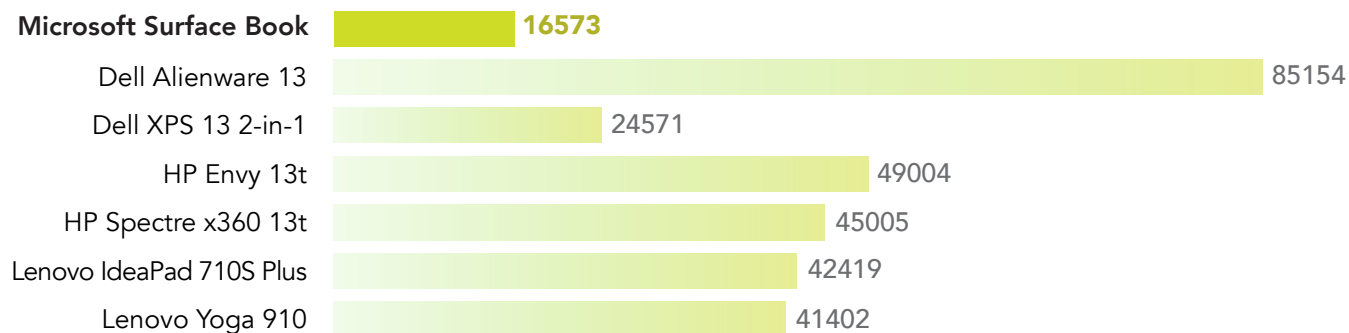
7	7	4	4	4	2	1

> * Go to page 15 to see the radar chart results on each device.

3DMark Ice Storm Extreme

Overall score — Higher is better

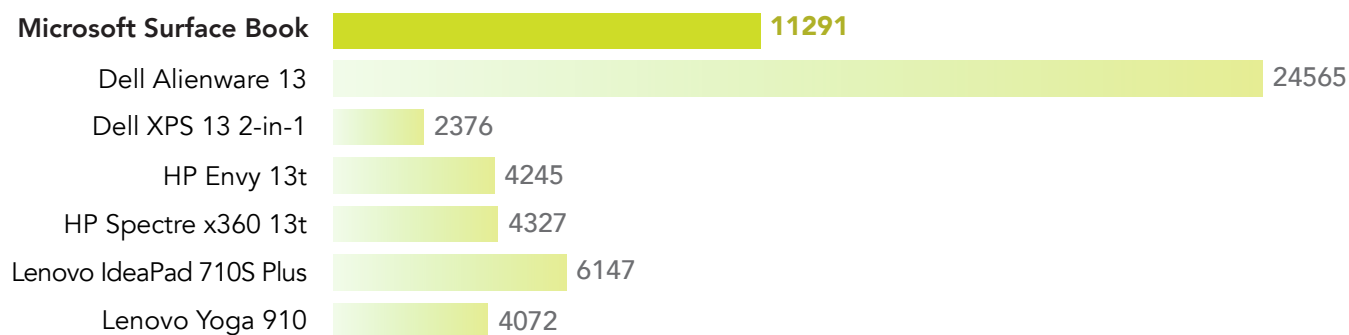|	
Microsoft Surface Book	**16573**
Dell Alienware 13	85154
Dell XPS 13 2-in-1	24571
HP Envy 13t	49004
HP Spectre x360 13t	45005
Lenovo IdeaPad 710S Plus	42419
Lenovo Yoga 910	41402

3DMark Cloud Gate

Overall score — Higher is better

Microsoft Surface Book	**9064**
Dell Alienware 13	25387
Dell XPS 13 2-in-1	4098
HP Envy 13t	6920
HP Spectre x360 13t	6616
Lenovo IdeaPad 710S Plus	7586
Lenovo Yoga 910	6688
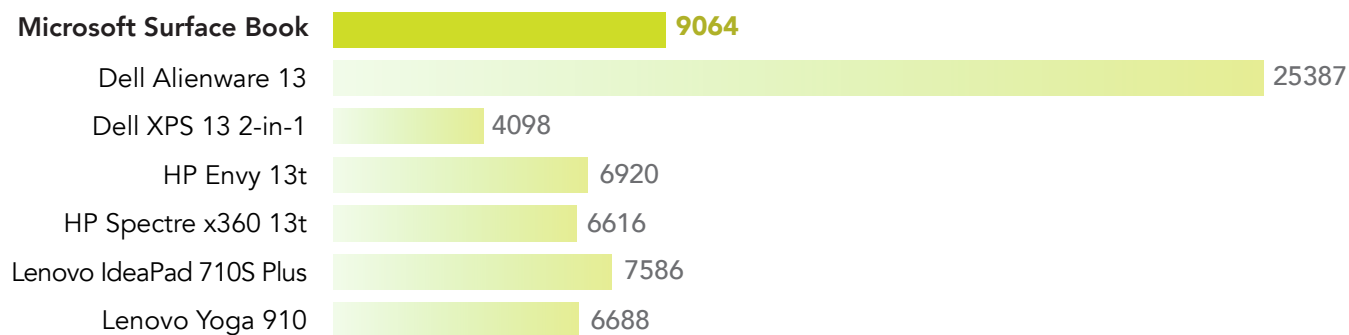
3DMark Sky Diver

Overall score — Higher is better

Microsoft Surface Book	**11291**
Dell Alienware 13	24565
Dell XPS 13 2-in-1	2376
HP Envy 13t	4245
HP Spectre x360 13t	4327
Lenovo IdeaPad 710S Plus	6147
Lenovo Yoga 910	4072

3DMark Fire Strike

Overall score — Higher is better

Microsoft Surface Book	**4400**
Dell Alienware 13	9223
Dell XPS 13 2-in-1	603
HP Envy 13t	990
HP Spectre x360 13t	10087
Lenovo IdeaPad 710S Plus	1816
Lenovo Yoga 910	986
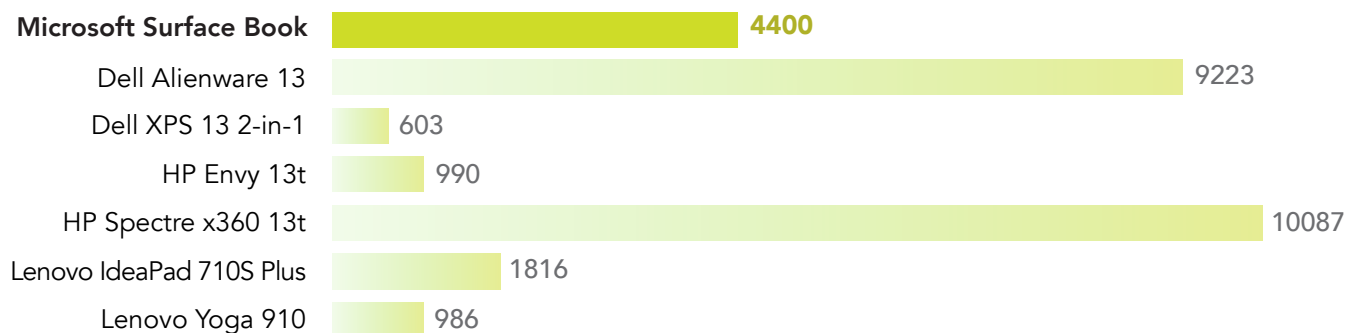
Cinebench R15 OpenGL

Measured in fps — Higher is better

Microsoft Surface Book	**76.24**
Dell Alienware 13	90.00
Dell XPS 13 2-in-1	27.93
HP Envy 13t	46.16
HP Spectre x360 13t	47.86
Lenovo IdeaPad 710S Plus	57.18
Lenovo Yoga 910	45.77
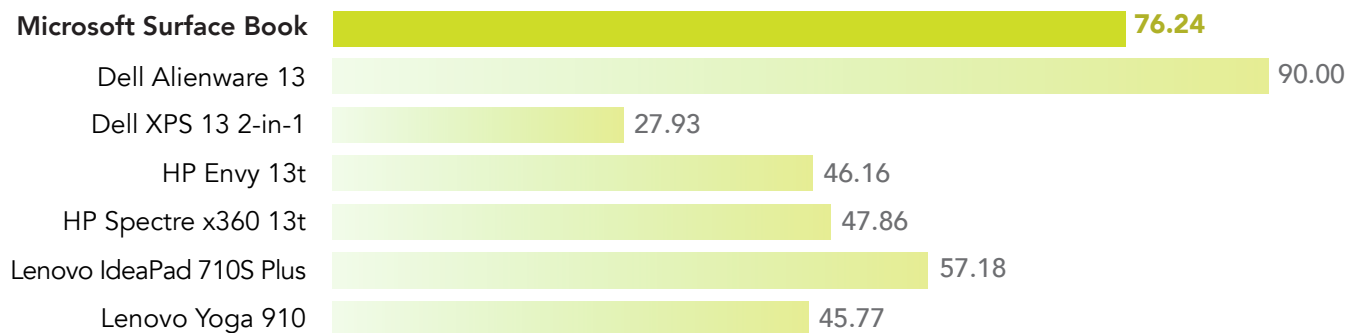
Cinebench R15 CPU

Overall score — Higher is better

Microsoft Surface Book	**249**
Dell Alienware 13	658
Dell XPS 13 2-in-1	208
HP Envy 13t	332
HP Spectre x360 13t	340
Lenovo IdeaPad 710S Plus	290
Lenovo Yoga 910	359
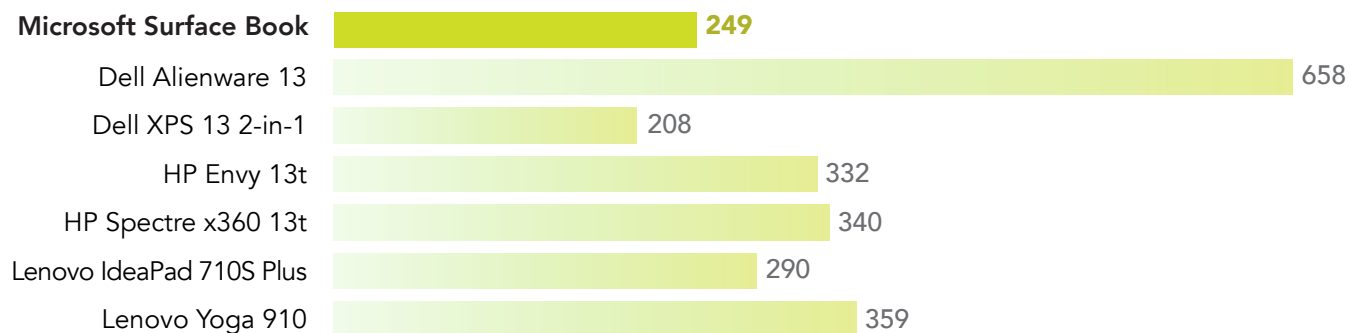
Geekbench 4.0.1 single-core

Overall score — Higher is better

Microsoft Surface Book	**4631**
Dell Alienware 13	4480
Dell XPS 13 2-in-1	4694
HP Envy 13t	4526
HP Spectre x360 13t	4216
Lenovo IdeaPad 710S Plus	4245
Lenovo Yoga 910	4545

Geekbench 4.0.1 multi-core

Overall score — Higher is better

Microsoft Surface Book	**9362**
Dell Alienware 13	8438
Dell XPS 13 2-in-1	9281
HP Envy 13t	8700
HP Spectre x360 13t	7953
Lenovo IdeaPad 710S Plus	8483
Lenovo Yoga 910	8484

JetStream v1.1

Overall score — Higher is better

Microsoft Surface Book	**223.17**
Dell Alienware 13	263.78
Dell XPS 13 2-in-1	185.06
HP Envy 13t	238.90
HP Spectre x360 13t	257.02
Lenovo IdeaPad 710S Plus	221.12
Lenovo Yoga 910	246.19

Kraken v1.1

Overall score — Lower is better

Microsoft Surface Book	**1110.3**
Dell Alienware 13	958.7
Dell XPS 13 2-in-1	1314.2
HP Envy 13t	1062.4
HP Spectre x360 13t	980.0
Lenovo IdeaPad 710S Plus	1088.8
Lenovo Yoga 910	1029.5

SYSmark 2014 SE

Overall score — Higher is better

Microsoft Surface Book	716
Dell Alienware 13	1106
Dell XPS 13 2-in-1	679
HP Envy 13t	863
HP Spectre x360 13t	896
Lenovo IdeaPad 710S Plus	721
Lenovo Yoga 910	870

TouchXPRT 2016

Overall score — Higher is better

Microsoft Surface Book	247
Dell Alienware 13	292
Dell XPS 13 2-in-1	242
HP Envy 13t	269
HP Spectre x360 13t	277
Lenovo IdeaPad 710S Plus	228
Lenovo Yoga 910	271

WebXPRT 2015

Overall score — Higher is better

Microsoft Surface Book	471
Dell Alienware 13	490
Dell XPS 13 2-in-1	420
HP Envy 13t	496
HP Spectre x360 13t	526
Lenovo IdeaPad 710S Plus	397
Lenovo Yoga 910	505

Portability

We tested Windows 10 devices that weighed between two and six pounds, which classifies all of them as lightweights. But how does the lightest device fair in other areas? While the Dell XPS 13 2-in-1 was the lightest device, Microsoft Surface Book beat it in the display, battery life, and performance categories.

| Dell XPS 13 2-in-1 | HP Spectre x360 13t | HP Envy 13t | Lenovo IdeaPad 710S Plus | Lenovo Yoga 910 | Microsoft Surface Book | Dell Alienware 13 |

Portability rankings – *Lower is better*

1	2	3	4	5	6	7

Portability radar chart scores – *Higher is better**

7	6	5	4	3	2	1

Weight

Measured in pounds — Lower is better

Microsoft Surface Book	**3.63**
Dell Alienware 13	5.41
Dell XPS 13 2-in-1	2.66
HP Envy 13t	2.90
HP Spectre x360 13t	2.86
Lenovo IdeaPad 710S Plus	2.79
Lenovo Yoga 910	2.94
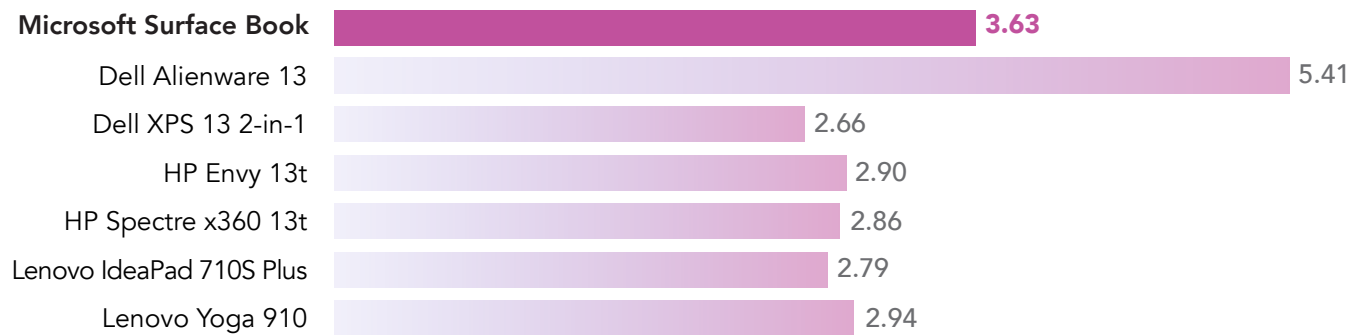
Thinness

Measured in inches with keyboard — Lower is better

Microsoft Surface Book	**0.94**
Dell Alienware 13	1.18
Dell XPS 13 2-in-1	0.69
HP Envy 13t	0.63
HP Spectre x360 13t	0.59
Lenovo IdeaPad 710S Plus	0.72
Lenovo Yoga 910	0.64
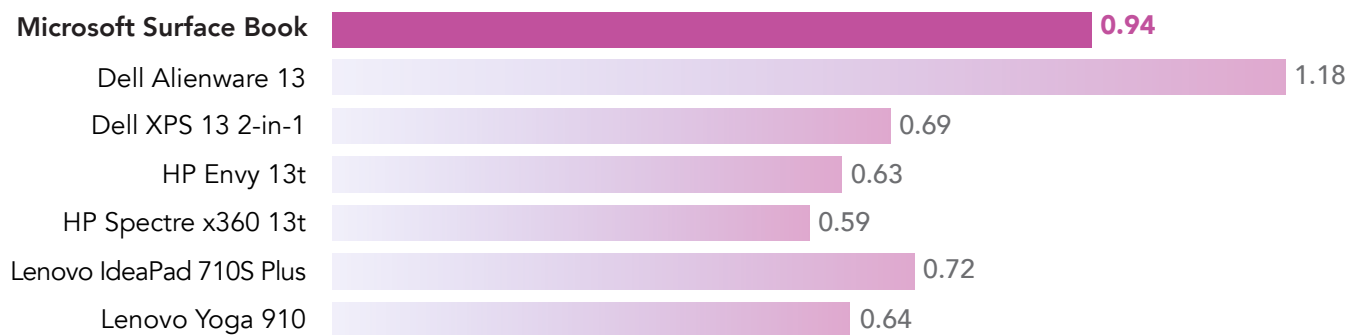
Footprint

Measured in total square inches with keyboard — Lower is better

Microsoft Surface Book	**112.06**
Dell Alienware 13	136.88
Dell XPS 13 2-in-1	93.25
HP Envy 13t	102.74
HP Spectre x360 13t	104.02
Lenovo IdeaPad 710S Plus	106.52
Lenovo Yoga 910	112.83
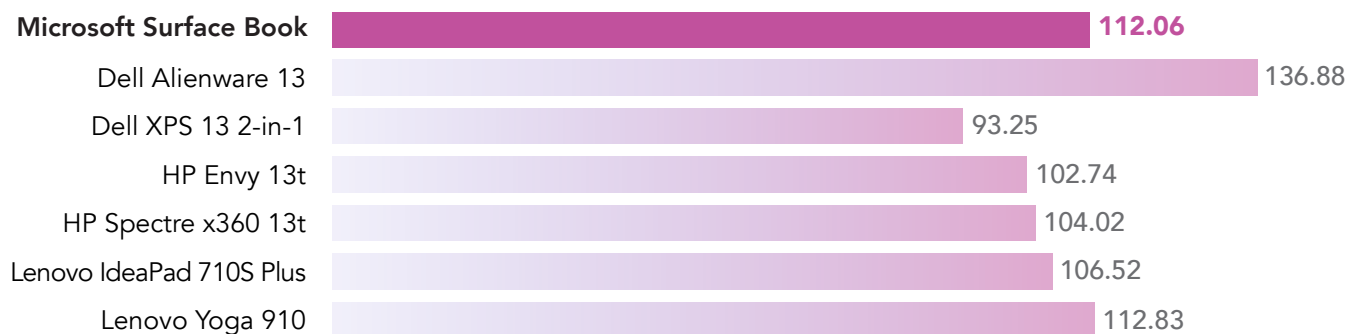
A balancing act

To illustrate how the devices compared, we assigned each device a score based on the results from the hands-on evaluation already outlined in this report. This score is the reverse of the numbers on previous pages because this page reflects how each device scored in each category (higher scores are better) instead of the ranking system used previously (lower is better). For example, Microsoft Surface Book ranked number one in the earlier battery life section of this report, but received a score of 7 in battery life here, as it had the best battery life of the seven devices.

Microsoft Surface Book

Battery life: 7
Display quality: 6
Performance: 4
Portability: 2

Dell Alienware 13

Battery life: 1
Display quality: 7
Performance: 7
Portability: 1

Dell XPS 13 2-in-1

Battery life: 3
Display quality: 4
Performance: 1
Portability: 7

HP Envy 13t

Battery life: 5
Display quality: 1
Performance: 4
Portability: 5

HP Spectre x360 13t

Battery life: 2
Display quality: 4
Performance: 7
Portability: 6

Lenovo IdeaPad 710S Plus

Battery life: 4
Display quality: 2
Performance: 2
Portability: 4

Lenovo Yoga 910

Battery life: 6
Display quality: 6
Performance: 4
Portability: 3

Battery life

Performance

Display quality

Portability

Microsoft
Surface Book

Dell Alienware
13

Dell XPS 13
2-in-1

HP Envy
13t

HP Spectre
x360 13t

Lenovo IdeaPad
710S Plus

Lenovo Yoga
910

Conclusion

According to our analysis, Microsoft Surface Book delivered a balance of battery life, display quality, performance, and portability that many mobile professionals are looking for.

Microsoft Surface Book
a balanced option
compared to the devices below

| Dell Alienware 13 | Dell XPS 13 2-in-1 | HP Envy 13t | HP Spectre x360 13t | Lenovo IdeaPad 710S Plus | Lenovo Yoga 910 |

On June 28, 2017, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. For older systems, we chose configurations representative of typical purchases of those systems. We concluded hands-on testing on September 20, 2017.

Since we kicked off this research, Microsoft announced the Surface Book 2, claiming that it's "the most powerful Surface Book ever" with "all-day battery life:" https://blogs.windows.com/devices/2017/10/17/introducing-surface-book-2-the-most-powerful-surface-book-ever/. We can't wait to get our hands on it.

Appendix A: System configuration information

System	Microsoft Surface Book	Dell Alienware 13	Dell XPS 13 2-in-1	HP Envy 13t	HP Spectre x360 13t	Lenovo IdeaPad 710S Plus	Lenovo Yoga 910
Processor							
Vendor	Intel®	Intel	Intel	Intel	Intel	Intel	Intel
Name	Core™ i7	Core i7	Core i7	Core i7	Core i7	Core i7	Core i7
Model number	6600U	7700HQ	7Y75	7500U	7560U	7500U	7500U
Core frequency (GHz)	2.6 – 3.4	2.8 – 3.8	1.3 – 3.6	2.7 – 3.5	2.4 – 3.8	2.70 – 3.50	2.70 – 3.50
Number of cores	2	4	2	2	2	2	2
Cache	4 MB L3	6 MB L3	4 MB L3	4 MB L3	4 MB L3	4 MB L3	4 MB L3
Memory							
Amount (GB)	16 GB	32	16	16	16	8	16
Type	DDR3	DDR4	DDR3	DDR3	DDR3	DDR4	DDR4
Speed (MHz)	1,866	2,400	1,866	1,866	1,866	2,400	2,133
Graphics							
Vendor	Intel / NVIDIA®	NVIDIA	Intel	Intel	Intel	Intel / NVIDIA	Intel
Model number	HD Graphics 520 / GeForce® GTX 965M	GTX 1060	HD Graphics 615	HD Graphics 620	HD Graphics 640	HD Graphics 620 / GeForce GT 940MX	HD Graphics 620
Storage							
Amount	1 TB	1 TB	1 TB	1 TB	1 TB	512 GB	1 TB
Type	SSD	SSD	SSD	SSD	SSD	NVMe SSD	NVMe SSD
Connectivity/expansion							
Wired internet	N/A	Killer E2500 Gigabit Ethernet	N/A	N/A	N/A	N/A	N/A
Wireless internet	Marvell® AVASTAR® Wireless-AC	Killer Wireless-n/a/ac 1535	Intel AC 8265	Intel AC 7265	Intel AC 8265	Intel Dual Band Wireless-AC 8265	Intel Dual Band Wireless-AC 8265
Bluetooth	4.0	4.1	4.2	4.2	4.2	4.0	4.1

System	Microsoft Surface Book	Dell Alienware 13	Dell XPS 13 2-in-1	HP Envy 13t	HP Spectre x360 13t	Lenovo IdeaPad 710S Plus	Lenovo Yoga 910
USB	2 x USB 3.0, 1 x SD card reader, 1 x Surface Connect	2 x USB 3.0, 2 x USB-C	2 x USB-C	2 x USB 3.1, 2 x USB-C	1 x USB 3.1, 2 x USB-C	1 x USB-C, 1 x USB 3.0, 1 x USB 2.0, 4-in-1 Card Reader	1 x USB-C, 1 x USB 3.0, 1 x USB 2.0
Video	1 x Mini DisplayPort	1 x Mini DisplayPort, 1 x HDMI, 1 x Thunderbolt™ 3 USB-C	1 x Thunderbolt USB-C	1 x USB-C HDMI	2 x Thunderbolt USB-C	1 x USB-C (DisplayPort)	1 x USB 3.0 Type-C with video-out
Battery							
Type	Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer	Lithium-polymer
Rated capacity (Wh)	N/A	76.0	46.0	53.6	57.8	46.0	78.0
Display							
Size (in.)	13.5	13.3	13.3	13.3	13.3	13.3	13.9
Type	PixelSense® Display	OLED	InfinityEdge	IPS BrightView	UWVA BrightView WLED-backlit	FHD IPS AntiGlare Multitouch	UHD IPS Multitouch
Resolution	3,000 x 2,000	2,560 x 1,440	3,200 x 1,800	1,920 x 1,080	3,840 x 2,160	1,920 x 1,080	3,840 x 2,160
Touchscreen	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Operating system							
Vendor	Microsoft	Microsoft	Microsoft	Microsoft	Microsoft	Microsoft	Microsoft
Name	Windows 10 Pro	Windows 10 Pro	Windows 10 Pro	Windows 10 Pro	Windows 10 Pro	Windows 10 Pro	Windows 10 Pro
Build number or version	10.0.15063	10.0.15063	10.0.15063	10.0.15063	10.0.15063	10.0.15063	10.0.15063
BIOS							
BIOS name and version	Microsoft 90.1427.768	Alienware 1.1.5	Dell Inc. 01.00.15	Insyde F.04	American Megatrends® Inc. F.33	Lenovo 3NCN20WW (V2.03)	Lenovo 2JCN39WW
Dimensions with keyboard							
Height (in.)	0.9	1.2	0.7	0.6	0.6	0.7	0.6
Width (in.)	12.3	13.0	12.0	12.0	12.1	12.2	12.7
Depth (in.)	9.1	10.6	7.8	8.5	8.6	8.7	8.9
Weight (lbs.)	3.6	5.4	2.7	2.9	2.9	2.8	2.9
Dimensions without keyboard							
Height (in.)	0.3	N/A	N/A	N/A	N/A	N/A	N/A
Width (in.)	12.3	N/A	N/A	N/A	N/A	N/A	N/A
Depth (in.)	8.6	N/A	N/A	N/A	N/A	N/A	N/A
Weight (lbs.)	1.6	N/A	N/A	N/A	N/A	N/A	N/A

Appendix B: How we tested

Setting up the systems

Capturing driver information from the OEM factory image

1. Connect an external HDD to the system.
2. On the external drive, create a directory named Drivers.
3. Hold the Shift key, and restart the system.
4. Choose Troubleshoot→Advanced options→Command prompt.
5. Type `DISM /image:C: /export-driver /destination:D:\drivers` (Note: In this scenario the external drive is labeled D; however, this name may be different depending on the configuration of the system.)

Installing Windows 10 Pro

1. In the BIOS, disable SecureBoot.
2. Install a clean version of Windows 10 Pro onto the test system.
3. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
4. Open Device Manager, and use the OEM factory drivers captured onto the external HDD to install any missing drivers. (Note: Also, be sure to install the video driver.)
5. Run the Windows Update, and install all updates available.
6. Launch the Windows Store app, and install all Store app updates.
7. Verify the date and time are correct, and synchronize the system clock with the time server.
8. 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.

Capturing an image

1. Connect the external HDD to the test system.
2. Right-click on the desktop, and select Personalize→Home→Update & security→Backup→More options→See advanced settings→System Image Backup→Create a system image.
3. Verify that the external HDD is selected as the save drive, and click Next.
4. Verify that all drives are selected to back up, and click Next.
5. Click Start backup.
6. At Do you want to create a system repair disc, select No, and close the dialogs.

Restoring an image

1. Connect the external HDD to the test system.
2. Right-click the desktop, and select Personalize→Home→Update & security→Recovery.
3. Under Advanced startup, click Restart now.
4. Select Troubleshoot.
5. Select Advanced options.
6. Select System image recovery.
7. Select the User account.
8. Enter the system password, and click Continue.
9. Verify that the external HDD is selected, and click Next.
10. Once the recovery has completed, click Finish.

Performing battery life testing

Note: Performing this test requires the following items:

- A Gossen Mavolux 5032C USB luminance meter
- A five-minute 1080p .MP4 (329 MB) test video
- An external timer for noting the passage of time
- A video camera for capturing the runs

Performing the first battery life test

Setting up the test

1. Turn on the systems.
2. Copy the .MP4 file to each system, and verify that the video player is set to loop the video.
3. Verify that the displays will remain on, and disable power saving options.

   - For Windows:
     a. Right-click the desktop, and select Display settings.
     b. Select Power & sleep.
     c. Select Additional power settings.
     d. Select Change plan settings.
     e. Select Change advanced power settings, and make the following changes:

       - Display: Turn off Display = Never
       - Display: Dimmed display brightness = 0
       - Display: Enable adaptive brightness = Off
       - Battery: Critical battery action = Shutdown
       - Battery: Critical battery level = 2% (Note: If system doesn't allow 2%, select the next lowest value.)
       - Battery: Low battery notification = Off

     f. To save the above changes, click Apply.

   - For macOS:
     a. Select System Preferences.
     b. Select Desktop & Screensaver.
     c. Set Start Screensaver to Never.
     d. Return to System Preferences, and select Energy Saver.
       - Select Battery, and move the slider bar to Never.
       - Uncheck Slightly dim the display while on battery power.
     e. Go back to System Preferences, and select Displays.
       - Uncheck Automatically adjust brightness.
   - For iOS:
     a. Select Settings.
     b. Select Display & Brightness.
       - Disable Auto-Brightness.
       - Set Auto-Lock to Never.

4. To bring up a white screen, open a web browser, and type `about:blank` into the address bar.
5. Unplug the systems.
6. Allow the screens to warm up for 30 minutes.
7. Use the luminance meter to adjust each screen to a brightness as close to 200 nits as possible without going lower.

   - For Windows:
     a. Right-click the desktop, and select Display settings.
     b. Adjust the slider bar until the luminance meter reads 200 nits.

   - For macOS:
     a. Select System Preferences.
     b. Select Displays.
     c. Adjust the slider bar until the luminance meter reads 200 nits.

   - For iOS:
     a. Select Settings.
     b. Select Display & Brightness.
     c. Adjust the slider bar until the luminance meter reads 200 nits.

Running the test

1. Verify that the system's battery is fully charged.
2. Launch the test .MP4 video in full screen mode.
3. Start the video camera and the external timer.
4. Note the time, and unplug the system.
5. When all the systems have finished, stop the video camera.
6. Review the video camera footage, and report the battery life result.
7. Repeat steps 1 through 6 two times.

Performing the custom battery life test

Setting up the test

1. Turn on the systems.
2. Extract the PT Battery Test zip file onto the system.
3. From the extracted PT Battery Test file, copy the BatteryTest.exe, Office Content directory, and Browser Efficiency directory to the desktop.
4. In the Browser Efficiency directory right-click on the credentials.json file and edit the file in Notepad with the correct login information for Gmail and Facebook.
5. Install Office 2016 onto each system.
6. Launch Outlook and create a user account with three messages in the inbox, and then close Outlook.
7. Launch Word and complete any setup that may be required, and then close Word.
8. Launch PowerPoint and complete any setup that may be required, and then close PowerPoint.
9. Install the Pandora app from the Windows Store.
10. Launch Pandora and click Create Station and select "Classical for Studying", and exit Pandora.
11. Launch Microsoft Edge Browser and click on …→Settings→View advanced Settings→Set Block pop-ups to Off, and close Microsoft Edge Browser.
12. Verify that the displays will remain on, and disable power saving options.
    a. Right-click the desktop, and select Display settings.
    b. Select Power & sleep.
    c. Select Additional power settings.
    d. Select Change plan settings.
    e. Select Change advanced power settings, and make the following changes:

    • Display: Turn off Display = Never
    • Display: Dimmed display brightness = 0
    • Display: Enable adaptive brightness = Off
    • Battery: Critical battery action = Shutdown
    • Battery: Critical battery level = 2% (Note: If system doesn't allow 2%, select the next lowest value.)
    • Battery: Low battery notification = Off
    f. To save the above changes, click Apply.
13. To bring up a white screen, open a web browser, and type about:blank into the address bar.
14. Unplug the systems.
15. Allow the screens to warm up for 30 minutes.
16. Use the luminance meter to adjust each screen to a brightness as close to 200 nits as possible without going lower.
    a. Right-click the desktop, and select Display settings.
    b. Adjust the slider bar until the luminance meter reads 200 nits.

Running the test

1. Verify that the system's battery is fully charged.
2. Launch the BatteryTest.exe.
3. Start the video camera and the external timer.
4. Note the time and, unplug the system.
5. When all the systems have finished, stop the video camera.
6. Review the video camera footage, and report the battery life result.
7. Repeat steps 1 through 6 two times.

Performing display quality testing

Note: Performing this test requires an X-Rite i1Display Pro colorimeter.

Setting up the test

1. From https://displaycal.net/#download, download DisplayCAL3.
2. Install DisplayCAL3 with the default options.
3. Connect the X-Rite i1Display Pro colorimeter to the test system, and launch DisplayCAL3.
4. To download the ArgyllCMS color engine needed for the test at the prompt, click Download.
5. At the Import colorimeter corrections from other display profiling software dialog, click Auto, and click OK.
6. Click the Settings drop-down menu, and select Office & Web (D65, Gamma 2.2).
7. Verify that the Display and Instrument show the correct hardware for the test.
8. For the Mode, set LCD (generic).
9. Set Correction to Auto (None).
10. Exit DisplayCAL3.

Running the test

1. Launch DisplayCAL3.
2. Click Calibrate & Profile.
3. Place the colorimeter on the screen so that the center aligns with the Measurement area. If necessary, adjust the window size to within a safe margin.
4. Click Start measurement.
5. When the test pauses on the grey screen, click Start measurement.
6. When the test pauses and starts chirping, click Stop measurement, and click Continue on to calibration.
7. Allow the test to run.
8. Take a screenshot, and record Gamut Coverage results.
9. Click Install Profile.
10. Click Verification.
11. From the drop-down menu, select Extended verification testchart.
12. Click Measurement Report, and click Save to the desktop.
13. Place the colorimeter on the screen, and click Start measurement.
14. Record the contrast ratio result.

Running the performance benchmarks

Performing the 3DMark v2.3.3693 test

Setting up the test

1. From http://www.futuremark.com/benchmarks/3dmark/all, download 3DMark.
2. Install 3DMark with the default options.
3. Launch 3DMark, and click UNLOCK MORE TESTS. Enter the registration code, and click Register.
4. Exit 3DMark.

Running the test

1. Launch 3DMark.
2. From the top menu, at the 3DMark Welcome screen, click the Benchmarks.
3. Select either Ice Storm, Cloud Gate, Sky Diver, Fire Strike, or Time Spy.
4. When the benchmark run completes, record the results.
5. For each benchmark, repeat steps 3 and 4.
6. Repeat steps 1 through 5 two times.

Performing the CineBench R15.038 test

Setting up the test

1. From https://www.maxon.net/en/products/cinebench/, download the CineBench R15.
2. Unzip the CineBench R15 Windows package to the desktop.
3. To launch CineBench from inside the unzipped directory, double-click the CINEBENCH Windows 64-Bit icon.
4. Click Agree to the EULA.
5. Exit CineBench.

Running the test

1. Launch CINEBENCH.
2. Select File→Run all selected tests.
3. When the benchmark run completes, record the results.
4. Repeat steps 1 through 3 two times.

Performing the Geekbench v4.0.1 test

Setting up the test

1. From http://geekbench.com/download, download Geekbench 4.
2. Install the benchmark with default options.
3. Exit Geekbench.

Running the test

1. Launch Geekbench 4.
2. Click Run CPU Benchmark.
3. When the test completes, record the results.
4. Click Run Compute Benchmark.
5. When the test completes, record the results.
6. Repeat steps 1 through 5 two times.

Performing the JetStream v1.1 test

1. Open the web browser under test, and go to http://browserbench.org/JetStream/.
2. Click Start Test.
3. When the test completes, record the results.
4. Repeat steps 1 through 3 two times.

Performing the Kraken v1.1 test

1. Open the web browser under test, and go to https://krakenbenchmark.mozilla.org/kraken-1.1/driver.html. (Note: The test will run automatically.)
2. When the test completes, record the results.
3. Repeat steps 1 and 2 two times.

Performing the SYSmark 2014 SE v2.0.1.78 test

Setting up the test

1. From https://bapco.com/products/sysmark-2014-se/, purchase and install SYSmark 2014 SE with default options.
2. Download and install Patch v2.0.1.78 with default options.
3. Exit SYSMark.

Running the test

1. Launch SYSmark.
2. Click Configuration, accept the default settings, and click Save.
3. Enter a Project name.
4. Select 3 Iterations, check Conditioning Run and Process Idle Tasks, and click Run Benchmark.
5. When the benchmark completes, record the results.

Performing the TouchXPRT 2016 test

Setting up the test
1. Go to http://www.principledtechnologies.com/benchmarkxprt/touchxprt/.
2. Click Download from the Windows Store.
3. Click Get the app.
4. Click Get.
5. Click Launch.
6. Click Download.
7. Exit TouchXPRT.

Running the test
1. Launch TouchXPRT 2016.
2. Click the red Start Test play icon.
3. When the test completes, record the results.
4. Repeat steps 1 through 3 two times.

Performing the WebXPRT 2015 test

1. Open the web browser under test, and go to www.principledtechnologies.com/benchmarkxprt/webxprt/.
2. Click Run WebXPRT 2015.
3. At the Ready to test your browser screen, click Continue.
4. Click the red play icon.
5. When the test completes, record the results.
6. Repeat steps 1 through 5 two times.

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