



For this issue of Notebook Thermodynamics, we are wrapping up the Intel Alder Lake business class laptop sweep with the **Dell Latitude 9430**, **Lenovo X1 Gen10**, and **HP EliteBook 1040 G9** which all fall into the 'ultra-premium' business class of notebooks. The 'ultra-premium' notebooks typically include the latest technology features like Intel vPro and premium construction technologies such as CNC-machined aluminum and carbon fiber chassis to take the user experience to the next level for styling and weight savings.

Let's go ahead and clear the air right up front. The article you are about to read might sound like a Dell sales pitch. In fact, if you read through to the back of this article (we both know you weren't planning on it) and several others we have published, you will notice that Dell actually commissions many of these studies. Furthermore, the truly astute investigator would quickly find out via LinkedIn that the author of this article spent many glorious years working at Dell. The skeptical reader would then easily be tempted to believe that these articles contain bias in the presentation of data and conclusions. I agree with you, it looks bad.

With that in mind, Strategic Thermal Labs is an independent thermal engineering design firm with deep expertise in electronic cooling design and testing. We are engineers first and authors second. Every effort is made to create high precision, repeatable, transparent, testing environments and provide sufficient information in our articles for any reader to reproduce results.

That's sort of a weird way to start an article, why the build up?

The objective truth is that the Dell Latitude 9430 literally wins 3 out of 4 Thermal Performance Indicator categories and for the 4th category, skin temperature, results of all 3 systems are below typical user "annoyance" thresholds so the outcome of that test is, arguably, of minor significance. Compared with the competition for this generation, the Dell Latitude 9430 is faster. It is quieter. It lasts longer on battery. The field doesn't always look this way. Dell came to play and it paid off.

While that might all *sound* like a sales pitch, as a veteran thermal engineer, I will just say "Nice job thermal engineering team at Dell". Now let's get to it.

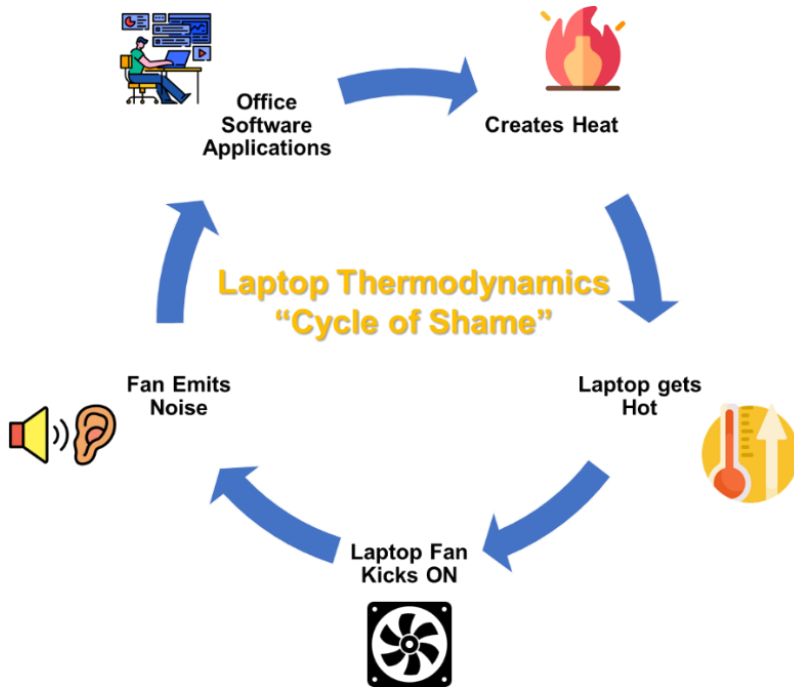
Introduction

In the previous installment of this series called Notebook Thermodynamics, we coined the facetious expression “Laptop Thermodynamics Cycle of Shame”. If you’re in the mood for a laugh, we recommend checking out that article [here](#). While

that phrasing was made in jest, the bare truth is that the very laws of nature work against the ambitions of notebook users and designers alike. Everyone *wants* their notebook to be faster but doing so creates more heat which leads to louder fans, hot surface temperatures, and/or shorter battery life. It is the thermal engineer’s job to create balance between these competing physics barriers in a manner that, hopefully, resonates well with customer preferences.

As before, we have notebooks from each of the top 3 business-class notebook brands, configured as similarly as their respective sales tools will allow, pitted against one another in a winner-take-all thermal engineering deathmatch. To the death.

As a quick reminder, here are the 4 Thermal Performance Indicator (TPI) categories we are testing for:



- **Application Performance:** how “fast” the system feels
- **Skin Temperature:** how hot the surface is getting that you touch
- **Sound Output:** how loud is the system under various conditions (aka fan noise)
- **Battery Performance:** how much time can you remain productive while unplugged

Table 1. System configuration details for the three business-class notebooks included in this study

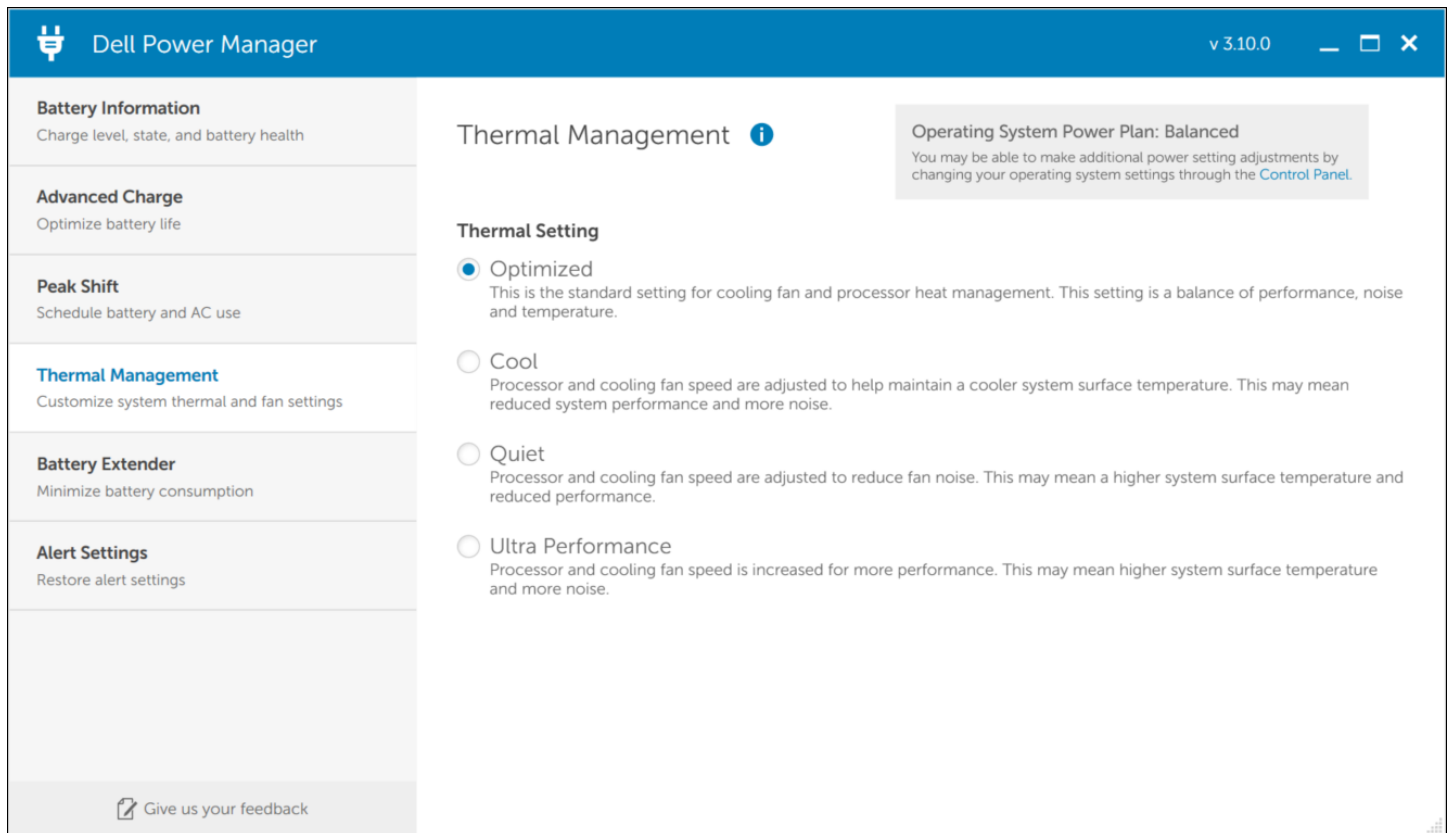
	Dell Latitude 9430	Lenovo X1 Gen10	HP EliteBook 1040 G9
Chassis Material	Aluminum	Carbon Fiber + Magnesium	Aluminum
Processor	Intel i7-1265U	Intel i7-1265U	Intel i7-1255U
Memory	16GB DDR5 5200MHZ	16GB DDR5 5200MHZ	16GB DDR5 5200MHZ
Storage	256GB M.2 NVMe	256GB M.2 NVMe	256GB M.2 NVMe
Battery Capacity (Whr)	59.6	57	51.3
Display Type	14" QHD 2560x1600	14" UHD 1920x1200	14" UHD 1920x1200
BIOS Version	Dell Inc. 1.6.0	Lenovo N3AET65W 1.30	HP U70 01.02.04
Windows Power Mode	Balanced	Balanced	Balanced
Windows Version	Win 11 Pro v10.0.22000	Win 11 Pro v10.0.22000	Win 11 Pro v10.0.22000

Dell's User Selectable Thermal Tables (USTT)

This is at least the third article we've written about Dell's innovative User Selectable Thermal Tables (USTTs). Why do we keep bringing it up? Because it is an extremely powerful feature that most users still probably don't know about or how to use. HP and Lenovo do not have this feature. We did a fairly detailed write-up on the technology [here](#). Let's go ahead and further debunk any myths that we are biased Dell cohorts with this next statement that probably gets us fired from future projects: ***Dell has not done nearly a good enough job educating their customers about the incredible value that their own USTTs bring to this product segment.***

OK buddy, how do the USTT's work?

If you are reading this on a Dell Latitude notebook right now, you can hit the Windows key on your keyboard and type "Dell Power Manager". From the menu that pops up, click on "Thermal Management" and you will see the menu options shown in the image below:



"Optimized" is the default mode that your Dell notebook ships in out of the box. It reflects a balance of all previously established thermal constraints impacting application performance, fan noise, skin temperatures, and battery life.

Is your work laptop currently sitting on your lap while you are on an airplane, in a coffee shop, or sitting in the back of a conference room wishing you had gotten there early enough to sit at the table? Click **"Cool"** mode to bring those skin temperatures down and make yourself more comfortable.

Are you working in a library? Or maybe you're the one presenting in that same conference room and suddenly the room is so quiet that everyone can hear your notebook fan spinning up. Hit the **"Quiet"** mode button and instantly you have the quietest business notebook in class.

What about those jumbo Excel spreadsheets seeking to destroy your computer or that photo you need to get rendered for a customer deliverable? Shift into **"Ultra Performance"** mode to get the job done faster than any other laptop in this segment.

It's that simple. With the Dell Latitude 9430, you are really just one button click away from your notebook being best in class in whichever category you need at that moment thanks to Dell's USTT.

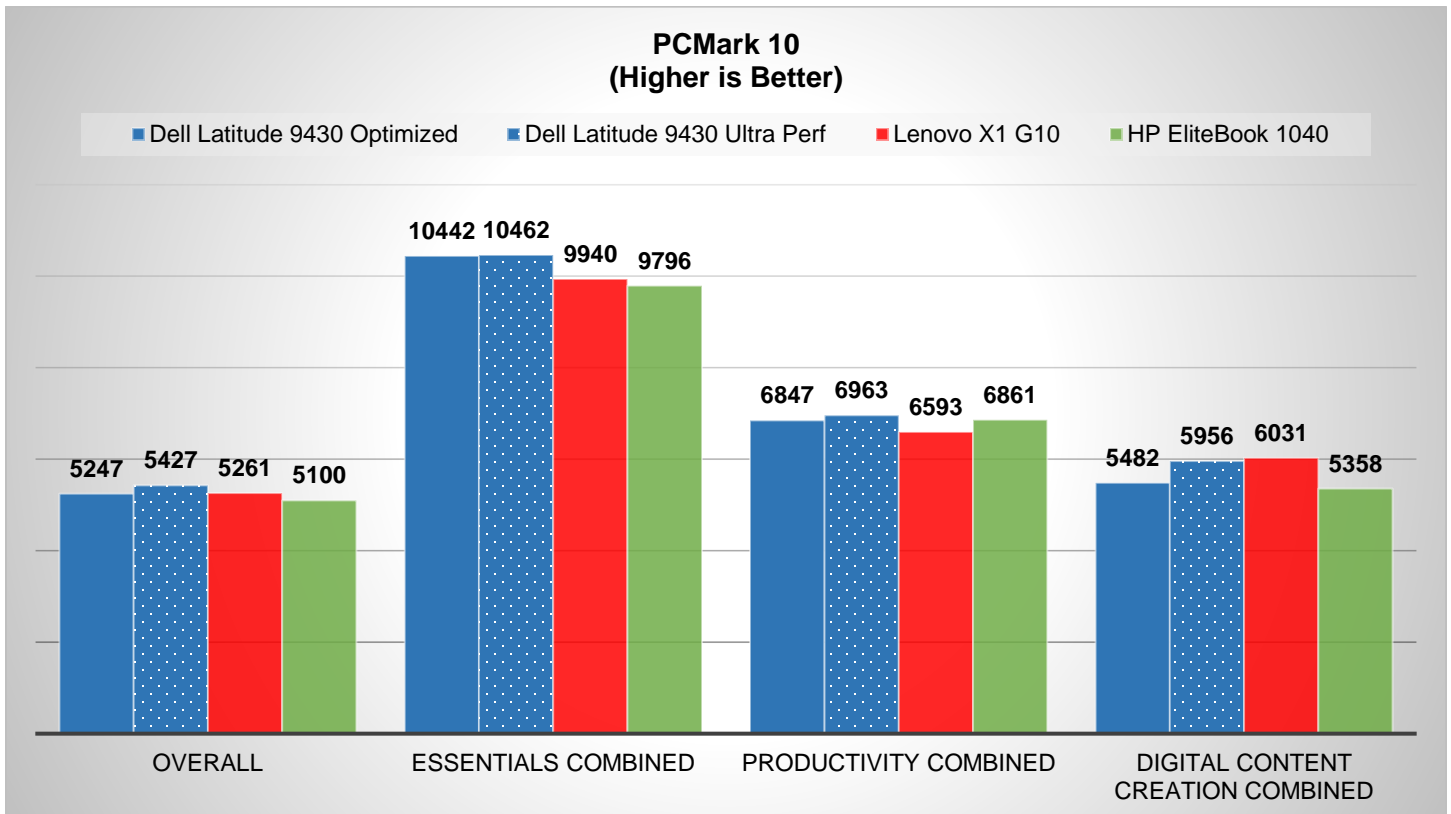
Application Performance

For the previous article, we performed a broad user survey amongst our dozen of reader and it was dually established that customers want their business laptops to be fast. Nobody likes waiting for anything and least of all for their PC to finish doing its dang job (“*What is it doing back there? I never know what it’s doing!*”).

The following 3 tried and true benchmarks allow us to translate the sensation of *computer-waiting-anxiety* into quantifiable, objective, data that can be compared amongst notebooks to establish dominance.

- PCMark 10:
 - Mixed-use office productivity including video conferencing, web browsing, app start-up, word processing, spreadsheets, photo editing, video editing, and professional graphics.
- SYSMark 25
 - Library of pre-recorded usage scenario scripts on actual copies of the most commonly used office software suites including Microsoft Office, Adobe Creative Suite, Google Chrome, and more.
- Cinebench R23
 - Timed photo rendering using the popular Cinema 4D image rendering engine.

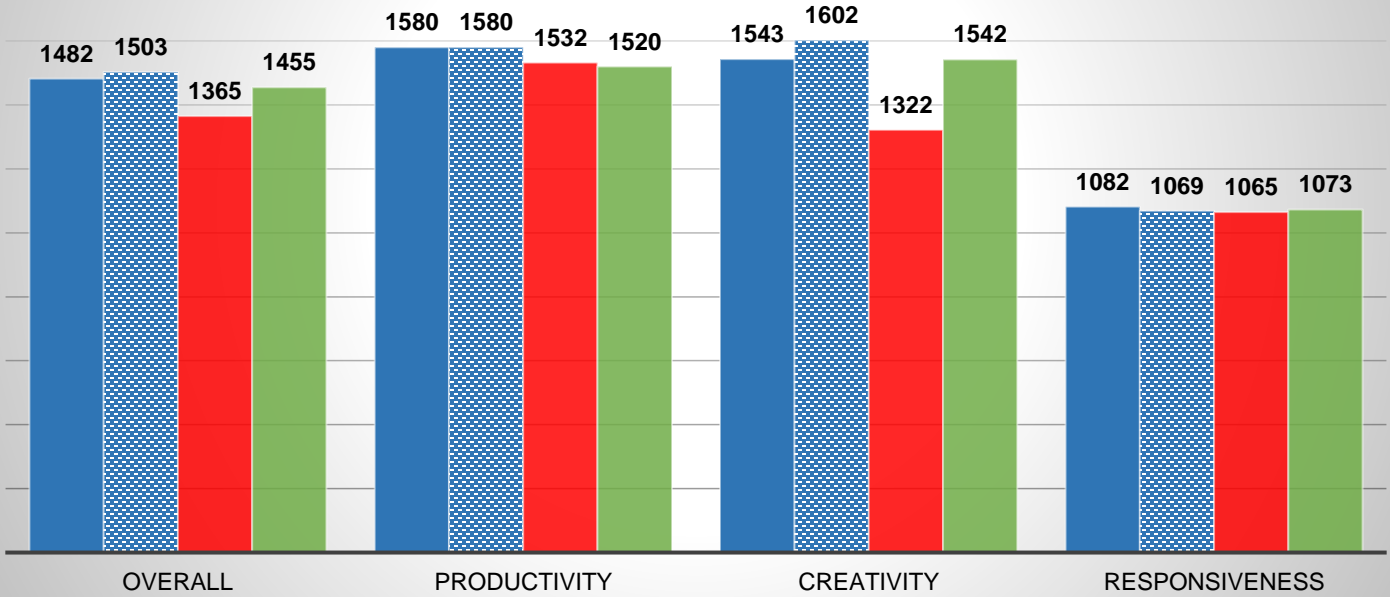
Each of these benchmark suites is attempting to associate a numerical score with how fast your laptop performs the jobs that you ask of the system dozens, if not hundreds, of times per day. Find a more thorough explanation of how these benchmarks work [here](#).



Winner: Dell Latitude 9430

SYSmark 25 Application Performance (Higher is Better)

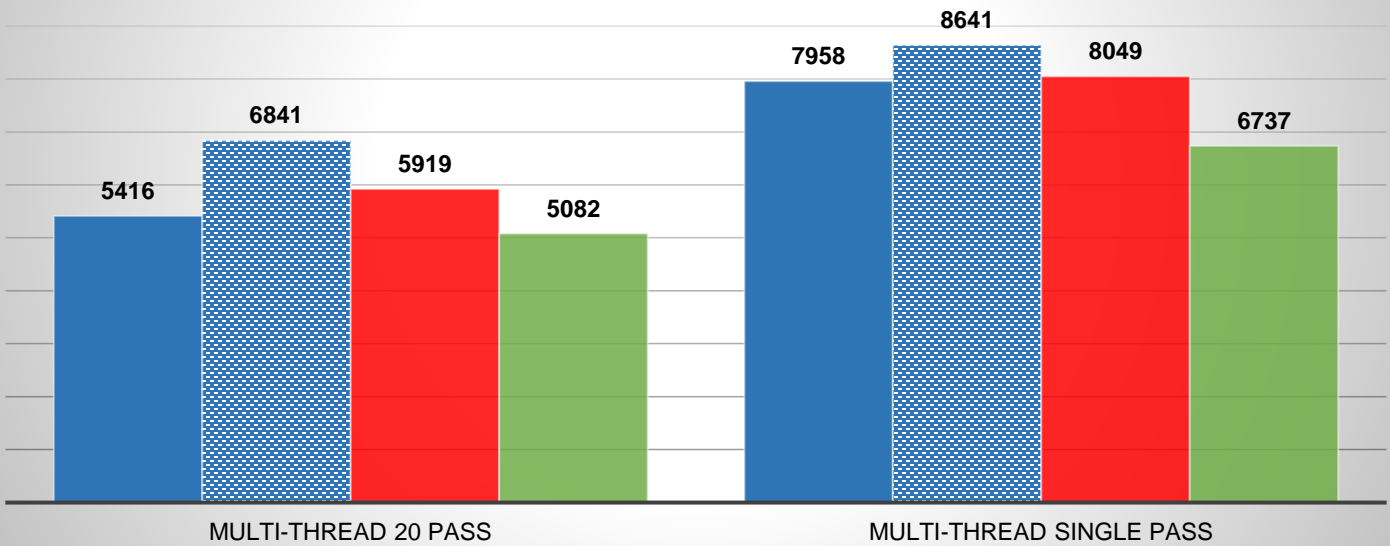
■ Dell Latitude 9430 Optimized ■ Dell Latitude 9430 Ultra Perf ■ Lenovo X1 G10 ■ HP EliteBook 1040



Winner: Dell Latitude 9430

Cinebench R23 Performance (Higher is Better)

■ Dell Latitude 9430 Optimized ■ Dell Latitude 9430 Ultra Perf ■ Lenovo X1 G10 ■ HP EliteBook 1040



Winner: Dell Latitude 9430

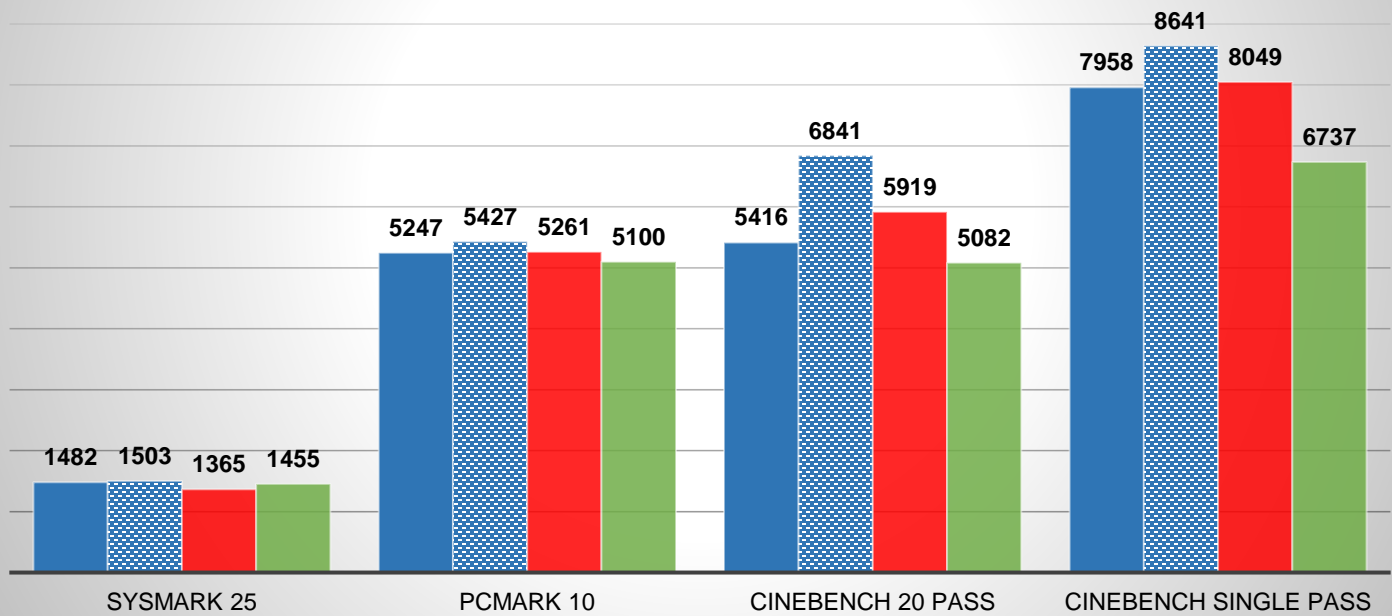
Application Performance Summary (Higher is Better)

■ Dell Latitude 9430 Optimized

■ Dell Latitude 9430 Ultra Perf

■ Lenovo X1 G10

■ HP EliteBook 1040

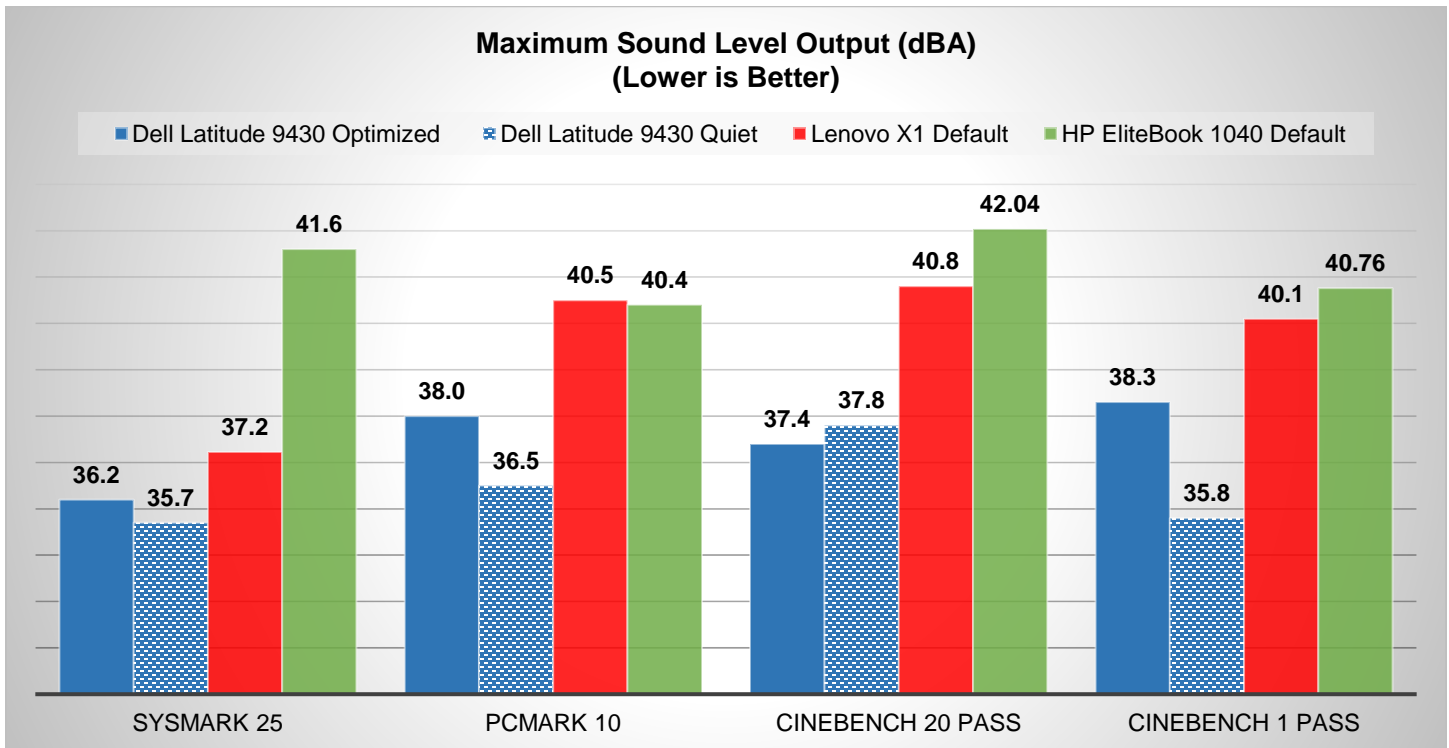
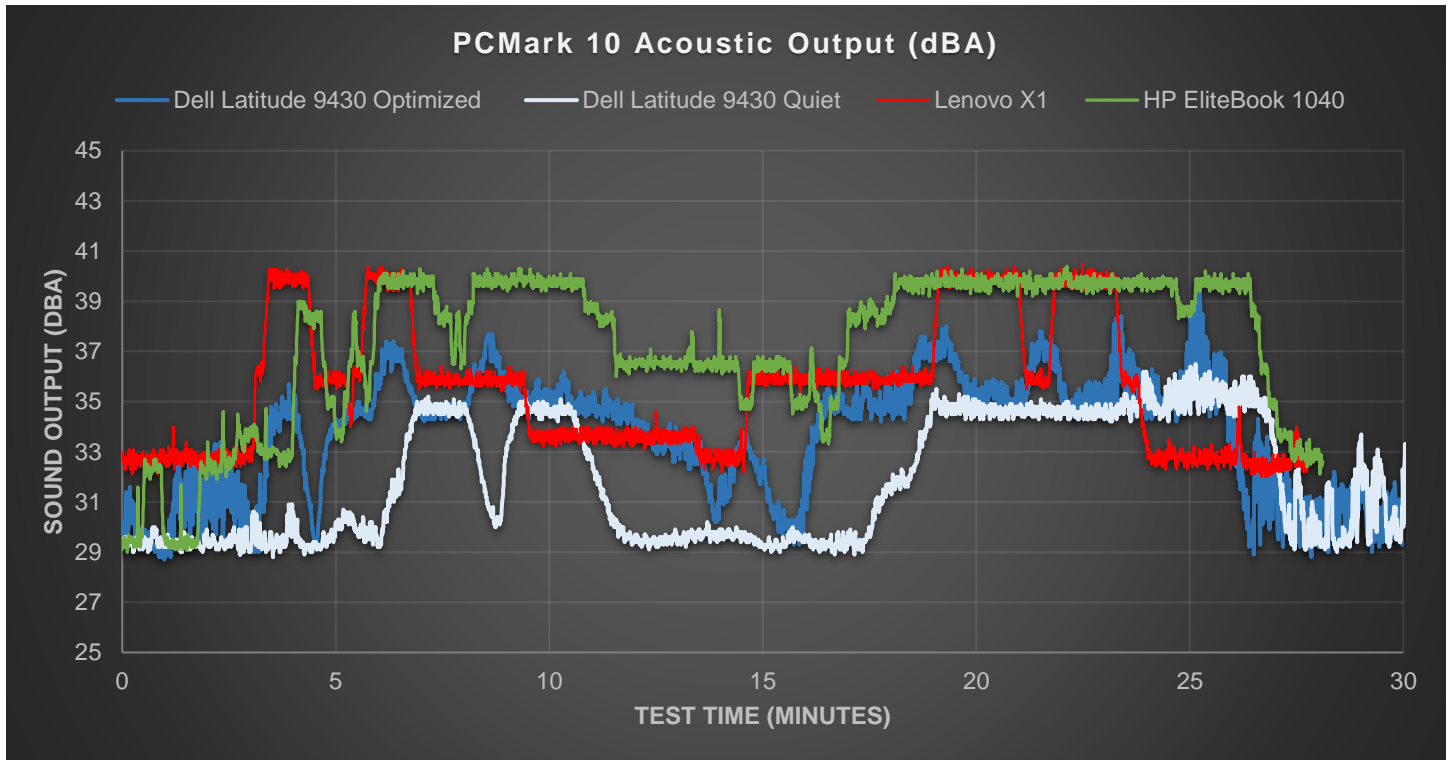


Winner: Dell Latitude 9430

Typically, Application Performance testing is a mixed bag of results with top notebook brands trading wins in various benchmark types. This isn't unexpected because we always try to purchase systems that are equipped with identical CPUs, Memory, and Storage devices to ensure a solid apples-to-apples comparison. In this case, the Dell Latitude 9430 wins every single performance benchmark in our stack. Whether you are routinely performing photo render operations or if you spend most of your time in the mainstay Office suite apps, the Latitude 9430 is simply faster than its competitors.

Sound Output

Like skin temperature, sound output, or, more specifically, fan noise, is rarely a concern until it becomes a huge annoying concern. For some users, this is akin to a glass-shattering type of event where once you become aware of the fan noise being emitted by your laptop in a quiet environment, you can no longer *not hear* it and will thenceforth be bothered by that pesky buzzing.



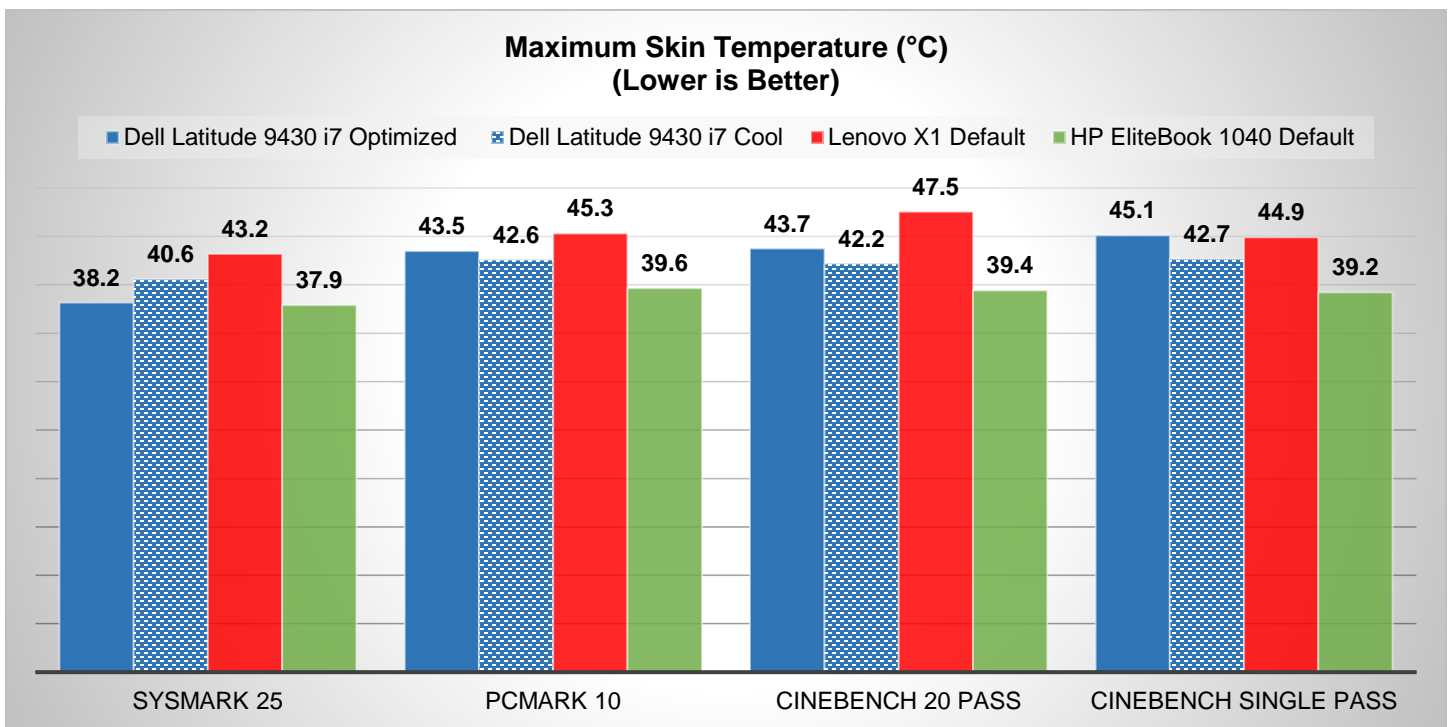
Winner: Dell Latitude 9430

Skin Temperature

The skin temperature of a notebook is something users really don't think much about until that system is either sitting in their lap or the keyboard they are pecking away at for hours on end starts to get noticeably warm to the touch. A lesser-known detail to end users is that keeping the skin temperatures of their notebooks "reasonably" cool to the touch can often be the limiting factor in how much performance that system can provide. In our previous survey, 66% of users responded that performance or "being fast" was their number one most important laptop characteristic but would you still say that if it meant the laptop was going to get hotter to the touch?

To further complicate matters for the thermal engineer, the definition of "reasonably cool" is highly subjective and varies from person to person. Humans are incredibly complex creatures capable of sensing temperature differences as small as 0.02C through their skin. We know the temperatures of various surface types that can cause injury. What can't be known with any certainty is the exact skin temperature which you, the reader or laptop user, considers to be "annoyingly warm". In fact, if you were to ask yourself this question, you likely couldn't answer it.

Whether they are right, wrong, or somewhere in the middle, the International Electrotechnical Commission (IEC) has attempted to create an upper limit for consumer electronics skin temperatures in their 62368-1 specification based on Hazard-Based Safety Engineering (HBSE) principles. That value is 48C for electronics in this class of products and, fortunately, all models included in this study are below that value for all tests.



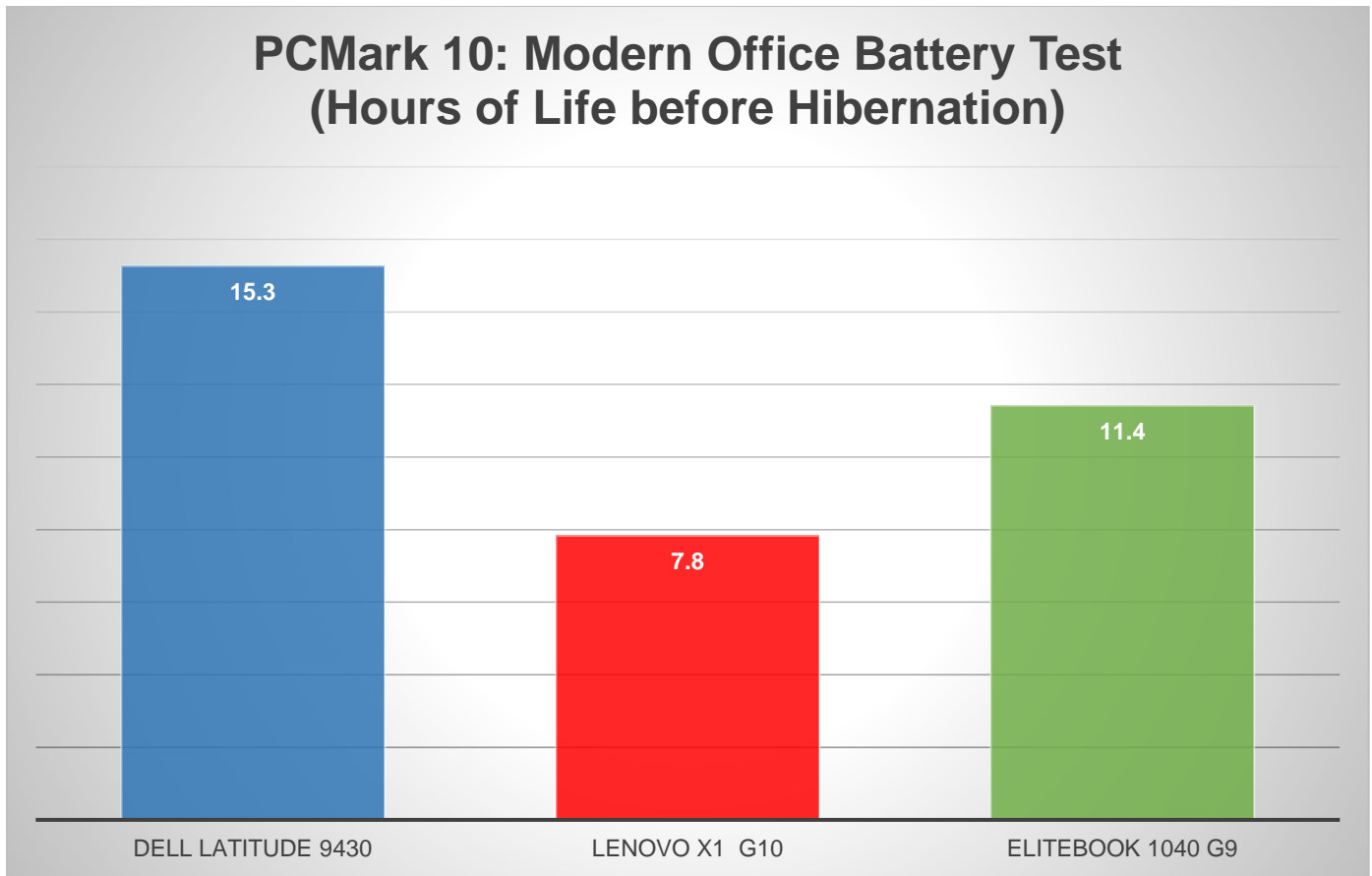
Winner: HP EliteBook 1040 G9

This story looks similar to the skin temperature results from part 1 of this series. Lenovo's business class notebooks tend to run fairly warm skin temperatures flirting with the too hot for comfort line. HP technically wins the skin temperature category but both Dell and HP have skin temperatures that are significantly lower than the 48°C IEC threshold and HP has given up so much ground in application performance and sound output that it's hard to see this as a real win.

Battery Performance

Battery life on a business notebook is critical. Most users, at some point, just come to accept that needing to be near an AC outlet while working in the airport waiting for a flight is just a fact of life. If it were possible to trust that your notebook could actually remain productive for several hours at a time while on the go without having to be tethered to a wall outlet would be, in a word, freeing.

The PCMark 10 Modern Office battery test is designed to predict performance in that exact scenario. You want to know how long your notebook's battery will last while you are *doing work*, not staring at an idle screen. All 3 of these notebooks do offer fantastic battery performance while running office applications but Dell absolutely crushes this delivery with over 15 hours of true mobile, cord-free productivity! That effectively amounts to being able to get work done for the entirety of a flight half way around the world without ever needing to search for an AC outlet on the crowded, dark, airplane seat in coach.



Winner: Dell Latitude 9430

Result Discussion

To recap here:

- The Dell Latitude 9430 is the quietest tested notebook in all 4 application coming in **almost 6 dBa quieter than the HP EliteBook 1040 G9** in the SYSMark 25 Office benchmark.
- The Dell Latitude 9430 is the fastest tested notebook in all 4 application performance benchmarks **besting the HP EliteBook 1040 G9 by 34%** on Cinebench R23.
- The Dell Latitude 9430 has the longest operational, productive-usage, battery life at 15.3 hours which is close enough to call it **2x the battery life of the Lenovo X1 Gen 10**.
- All 3 of these systems are below the 48°C skin temperature threshold established by IEC though the Lenovo X1 Gen 10 flirts pretty close to the line. The **HP EliteBook 1040 G9 has the coolest skin temperatures in the bunch**, however, being a few degrees cooler than an already comfortable skin temperature probably isn't worth the penalty HP suffered in fan noise and application performance losses. The last half of that statement was purely subjective.

So, after all of that, while I can certainly see a reader's tendency to question whether or not they just read a Dell advertisement, we have nothing more to do than just look at the data. In this case, the data is convincing. Dell has done a fantastic job differentiating themselves with the thermal design on the Latitude 9430.

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