BIM BOX

Mystery Solved:

The Importance of Cooling Laptops & Desktops

Cooling is not sexy. Not many people ask how many case fans a system has, what size the radiator is, or at what temperature the processor will run; but once you understand the vital relationship between cooling and performance, you will. One of the biggest hurdles to overcome for any computer is keeping cool while being pushed. The performance of computers varies greatly and depends not only on the components selected (e.g. processor, graphics card, RAM, hard drive) but the ability to keep those components cool. Many computer components have built-in safety mechanisms to ensure they are not damaged from excessive heat. Like any other electronic device, computers require electricity to operate. The electricity being supplied to each of the components in a computer inherently generates heat. If the processor or graphics card get too hot, they engage in a process called thermal throttling.

THERMAL THROTTLING

Thermal throttling is a process that reduces the performance of computer components to lower their operating temperature. Perhaps the most troublesome component when it comes to thermal throttling is the processor (CPU). As the “brains” of a computer, the CPU is often taxed more heavily than other components, thus requiring a significant amount of power and ultimately generating a lot of heat. Below is an example of a CPU being thermally throttled due to the temperature of one of the cores nearing its thermal barrier. In order to prevent the processor from reducing its performance, heat must be transported away from the CPU. This heat transportation is most often aided by the use of thermal compounds, airflow via fans, and occasionally liquid cooling.

Processor #0: Temperature Readings

Power:	42.4W	35.2W	0.2W	7.0W	0.9W
Tj. Max:	100°C		Min.	Max.	Load
Core #0:	72°C (!)		51°C	100°C	3%
Core #1:	90°C (!)		53°C	100°C	36%
Core #2:	79°C (!)		52°C	100°C	11%
Core #3:	70°C (!)		50°C	100°C	4%
Core #4:	67°C		50°C	87°C	7%
Core #5:	69°C		51°C	93°C	4%

Example of processor core nearing max operating temperature

A stock Intel “desktop” processor does not hit boost speeds if it is over 75° Celsius. That number is 65°C in a laptop and many laptops run close to 80°C after just a few hours of use. A recent review of an Alienware desktop showed it ran 92°C right out of the box, which would mean little to no boost performance could be expected. This is one of the reasons gaming systems are not a great option for professional workflows. Gaming systems are built for users that will play for a few hours and then will cut the system off. They are not made for 8-10 hour rigorous workflows. This is where BIMBOX comes in. We use server-grade components and cooling, as well as gaming components to bring the absolute best performing systems to our clients.

THERMAL PASTE

Every computer requires a viscous thermal compound of some kind to be applied between the processor and heat-sink to help transfer heat away from the CPU. The most common solution used is called thermal paste, which is often a highly conductive substance composed of silicone, zinc oxide and aluminum nanoparticles. This paste serves as a bridge, filling in voids between the processor and heat-sink for heat to be transported away. Ideally, thermal paste aids in the dissipation of heat enough to prevent any thermal throttling from taking place.

Liquid metal has the same functionality as thermal paste, filling in the microscopic gaps between a computer's processor and its heat-sink. The difference in performance is inherently derived from its properties and metallic composition, often consisting of a proprietary blend of metals like tin, gallium, and indium. This results in providing significantly higher thermal conductivity and longer-term stability compared to thermal paste. More specifically, the thermal conductivity of thermal pastes ranges from 5 - 12.5 W/(mK), whereas liquid metal can provide up to 73 W/(mK).

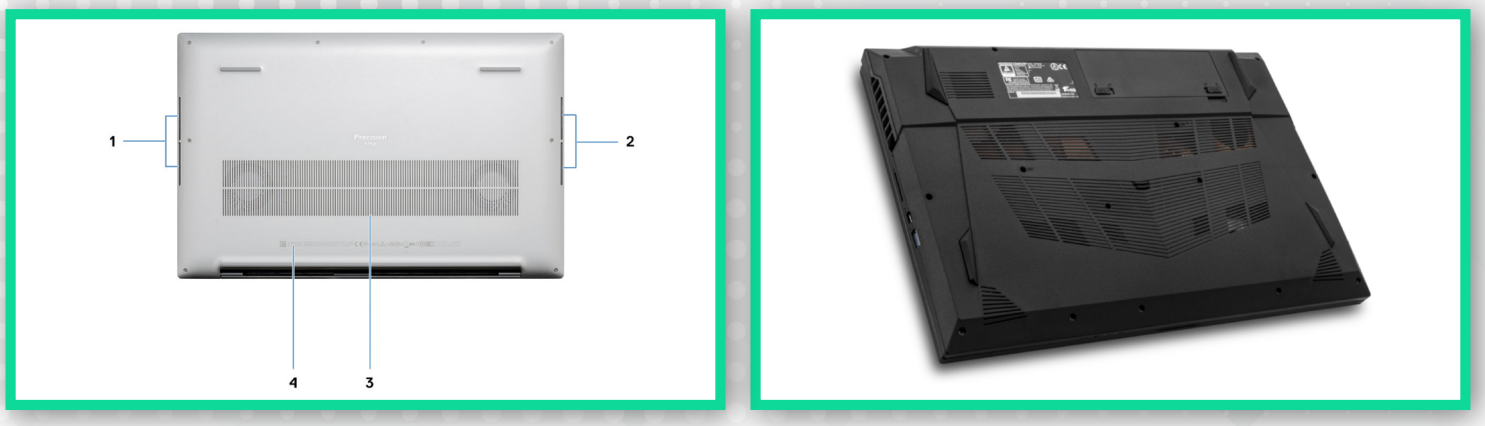
LAPTOPS AND COOLING

Perhaps one of the most overlooked aspects of designing a laptop chassis is airflow. More often than not, laptop designs are focused primarily on packing all of the components into as small of a chassis as possible, leaving minimal room for air to pass through to cool things down. As we continue to tax our systems throughout the day, sometimes as long as 8-12 hours, these systems build up heat and have no choice but to undergo thermal throttling.

So if your laptop starts to feel like an oven ready to cook your thighs, it is most likely one of the many models plagued by poor airflow design. BIMBOX has carefully selected their laptop chassis to be some of the best on the market when it comes to proper airflow. Large fans paired with air intake and exhaust ports significantly bigger than competitors, BIMBOX makes cooling a top priority for their laptops. Below is a series of images comparing the laptop chassis of competitors to those of BIMBOX's Slim Series and Mobile Workstation laptops.

Take note of the differences in air intake and exhaust ports on each of the models. You can clearly see how BIMBOX is able to outperform its competitors in keeping systems properly cooled to limit thermal throttling throughout the day. The air ports on the competition's models are significantly smaller, with some of the laptops even having fewer ports for air to flow through. This disparity in airflow design coupled with the use of high performance thermal paste are some of the key elements to BIMBOX's success at providing mobile solutions that outperform the competition.

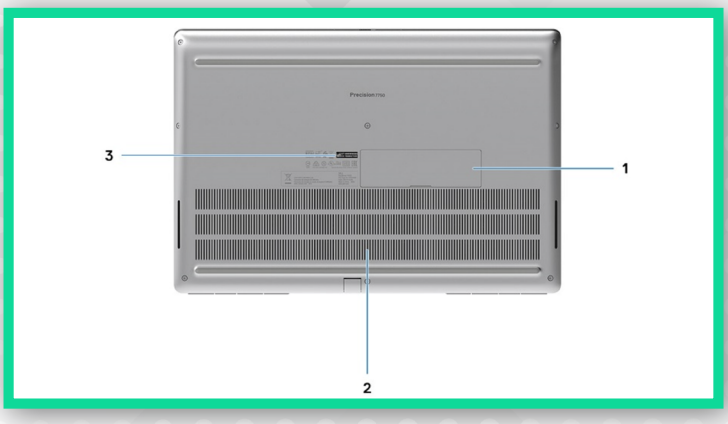
SLIM LAPTOP CHASSIS AIRFLOW DESIGN COMPARISON



Bottom of competitor’s laptop chassis vs BIMBOX Slim

Back of competitor’s laptop chassis vs BIMBOX Slim

MOBILE WORKSTATION LAPTOP CHASSIS AIRFLOW DESIGN COMPARISON

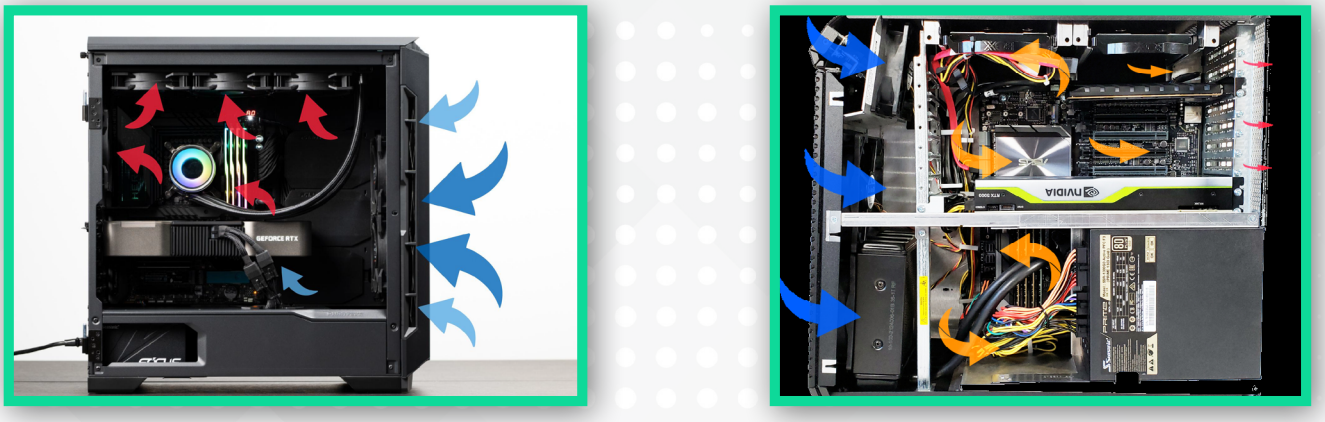


Bottom of competitor’s Mobile Workstation chassis vs BIMBOX Mobile Workstation

Back of competitor’s Mobile Workstation chassis vs BIMBOX Mobile Workstation

DESKTOP COOLING

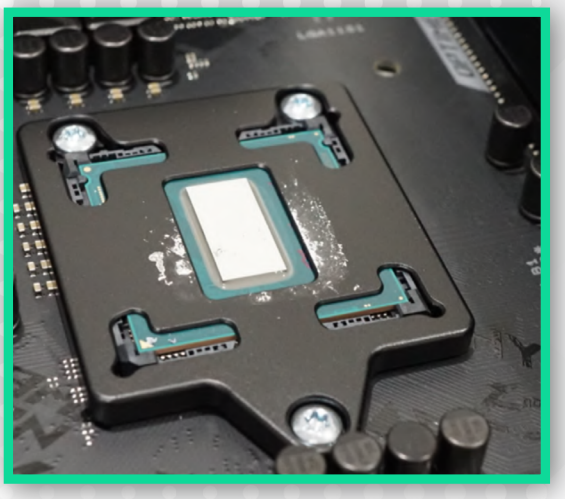
How a system is cooled is extremely important when it comes to desktops. Think of the case as an oven: there are many components inside that get hot and the heat has to go somewhere, otherwise the it's just sitting in there and the components get hot and start to throttle. Here is an example of a BIMBOX case vs a traditional case you would see in AEC firms.

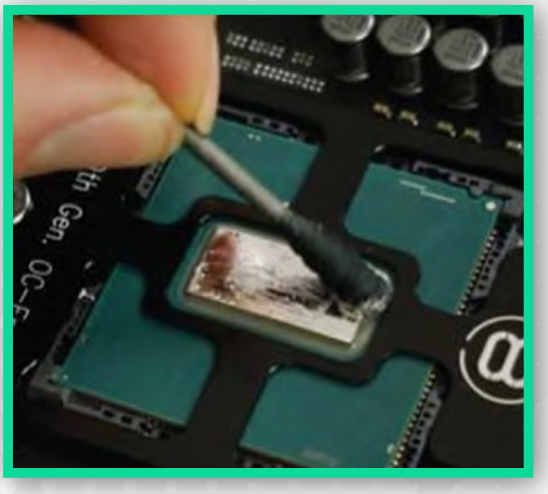


Example of airflow in BIMBOX versus a typical computer in an AEC firm

The BIMBOX Stryker IV and Osprey cases are specifically designed for Near-Neutral Pressure Airflow and are paired with a massive 360mm liquid cooling system. In comparison, many other desktops used in the AEC industry opt for a Positive Pressure Airflow and a significantly smaller liquid cooling solution or even worse, a fully air-cooled solution. This approach often creates heat pockets inside the case that ultimately result in decreased performance. BIMBOX's combination enables our systems to run fully-unconstrained at extreme clock speeds.

DIRECT DIE COOLING





Example of Direct Die delidding process

To achieve and maintain a **5.7GHz all Pcores** speed on our i9-14900k CPU, BIMBOX modifies the Intel CPU by removing the heat spreader (silver cap that has the info of the processor on it), carefully cleaning off any residual solder, applying liquid metal to the CPU die, and mounting a water cooler directly on to it. By doing this, we see a +20°C temperature drop. This extensive process allows us to overclock all of the CPU's cores without ever reaching the thermal barrier. Any process or application that is driven by the CPU will be able to perform at significantly higher speeds than a standard desktop. This process is called Direct Die Cooling and is offered exclusively in the AEC industry by BIMBOX.

The major benefit of this direct die process comes by way of extreme performance for multi-tasking AEC workflows. Instead of receiving an extremely short boost on a single core, which happens in most systems, a BIMBOX Stryker IV with direct die cooling has all of its cores and threads running at boost-level speeds 24/7, bringing massive efficiencies to the end user.

CONCLUSION

With our employees spending more than a decade in the AEC industry, we at BIMBOX know first-hand just how demanding our industry's workflows are on computers. From taking on tasks that take hours to process to being housed in less than optimal environments, our computers are more than capable of handling the daily stress that our competitors fall short on.

Understanding the importance and complexity of cooling laptops and desktops is a core value at BIMBOX. Many hardware companies fail to address these concepts in the design of their products, providing tools that underperform and leave you waiting to perform your work. As computer components continue to improve their performance, the issues of thermal throttling and finding a hardware solution capable of providing sufficient cooling will become increasingly significant. As you select hardware moving forward it is important to be mindful of the pitfalls poor cooling can have on their consistency of performance.