



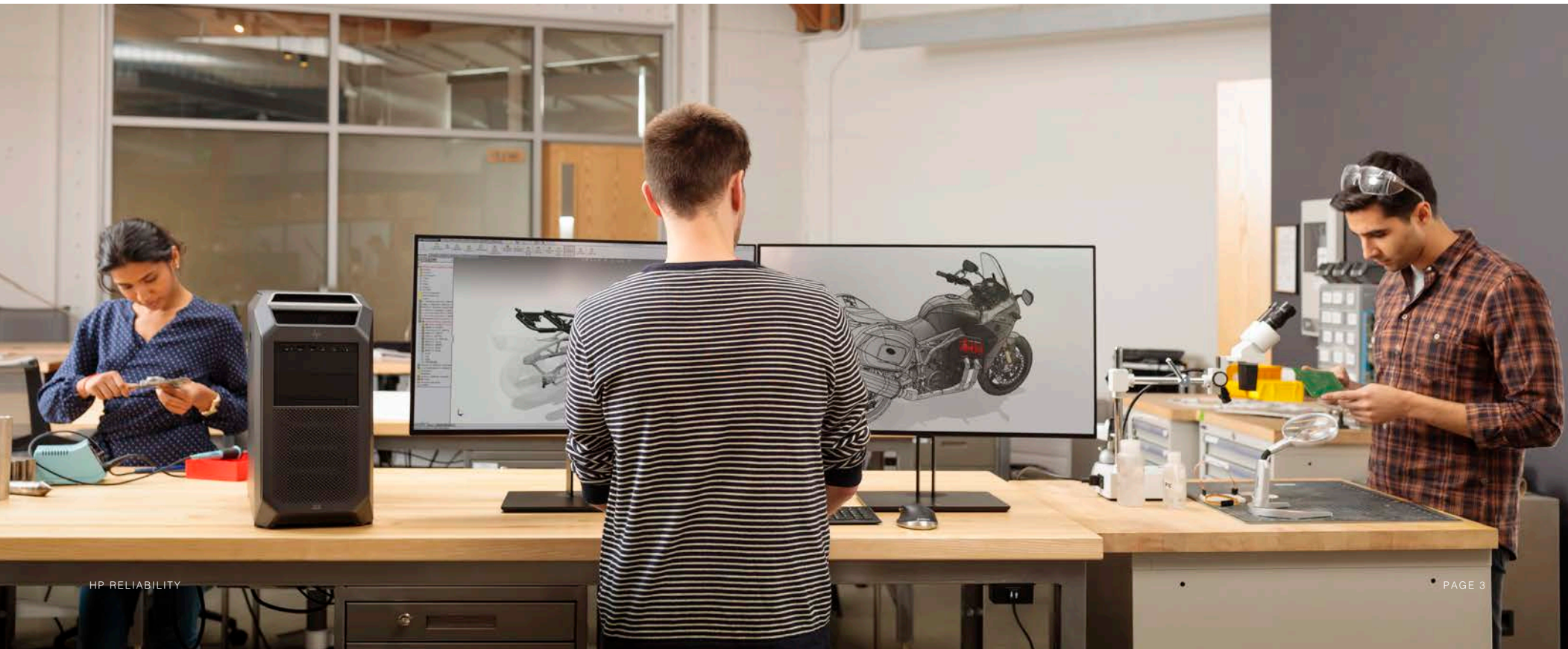
WORKSTATION Z
HP RELIABILITY



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For workstation users, system reliability is essential. That is why an HP focus for the past 30 years has been to design our workstations to meet the challenges of the most demanding workloads and duty cycles. Today, our three decades of workstation engineering innovation has created a level of reliability that is widely recognized in the industry. This document will provide insight on some of the many things we do to ensure our PC reliability including strenuous testing and design standards while also highlighting how these things benefit the end-user.





MIL-STD TESTING

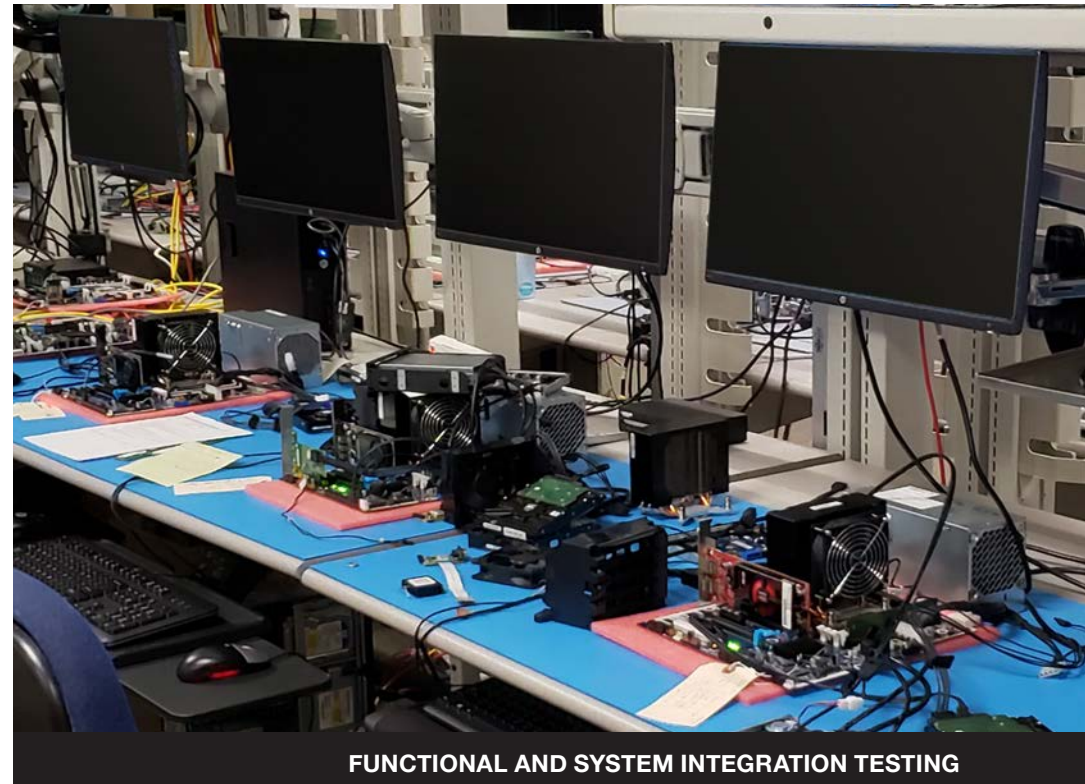
We put our mobile workstations through hours of brutal testing¹ involving drop, shock, heat, etc. to ensure that all of our mobiles can withstand the multitude of different workflow environments ranging across all of our vertical segments. This military grade testing allows our customers to take our products safely into the field with them to increase productivity, and decrease downtime. For more detailed information on what specific platforms have passed which specific tests, please view our [MIL-STD whitepaper](#).



HP SPECIFIC

FUNCTIONAL AND SYSTEM INTEGRATION TESTING

Through rigorous qualification, we identify areas to improve function, performance, and reliability of industry standard components such as graphics cards, memory, and hard drives. Genuine Z by HP components are guaranteed to integrate into any configuration with no loss in productivity due to downtime or slow performance. If we didn't do this testing, then components such as hard drives and memory may fail early or corrupt data, resulting in potential data loss. Some poor components can even permanently damage the system, causing complete loss. In order to avoid these issues, we ensure all of our components are tested and made specifically for our Z by HP products. As an example, our qualification findings resulted in joint development with NVIDIA® to obtain a Z by HP specific version of their Quadro® graphics and machine learning card, achieving improved thermal and acoustic performance. This HP-specific testing also ensures operation at the highest levels of performance and speed for mission critical workloads.



FUNCTIONAL AND SYSTEM INTEGRATION TESTING

FAILURE MODES AND EFFECTS ANALYSIS (FMEA)



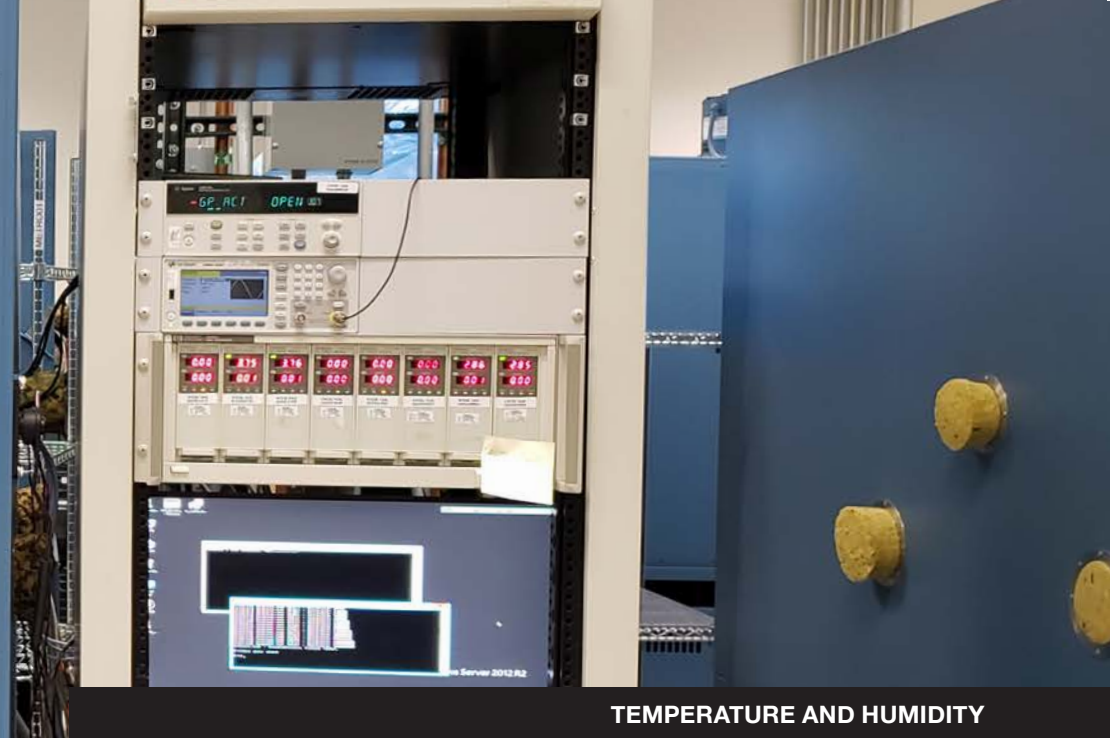
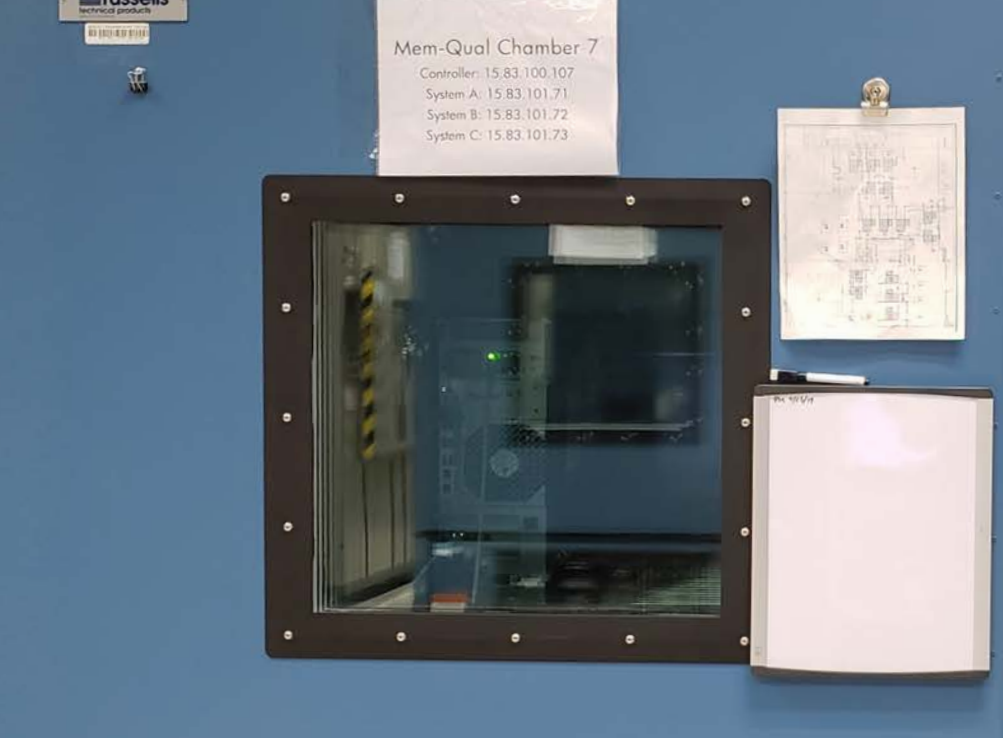
FMEA is a tool used in high-reliability industries like automotive, medical, and aerospace. It is also used on Z Workstation designs. Not all reliability issues are the same. The use of FMEA on Z system designs allows us to catch the most critical reliability issues very efficiently at the earliest stages of development. A system designed with FMEA methods has a very low likelihood of exhibiting problems relative to the reliable operation of a product. This systematic method allows us to find issues, rate the severity and assign corrective action even before a single system is constructed. A system not designed with systematic quality assurance methodologies, like FMEA and many other HP proprietary tests may exhibit failure modes that are extremely severe.

SHOCK AND VIBRATION

Notebook and desktop workstations are frequently used in mobile applications, and must be able to withstand dynamic events over their useful lives. For example, a TV crew may use a desktop or notebook to process video in a moving van in real-time. In some cases, scientific exploration involving Workstation systems frequently involves probes and vehicles that explore terrestrial and space environments. A system that is not designed to withstand the rigors of shipping, handling, and general movement during end use will fail very quickly. Many of the components in our system are attached via connectors. If the mechanical systems that hold them down are not adequately designed, then these parts could move around, and cause damage to the connectors and even complete system failure. In order to avoid this, HP tests systems on special tables that apply shock and vibrational energy into functioning and packed products.



SHOCK AND VIBRATION



TEMPERATURE AND HUMIDITY

ACOUSTICS



HP Z Workstations are designed to stay quiet during even the heaviest operational loads. When a creative professional is “in the zone”, the sound of a Z system will not interrupt the creative flow. A Z Workstation can be used in a recording studio, game development company, or engineering firm without distracting the user. A noisy computer can do more than just distract a user that is engaged in a mission-critical workflow. High levels of noise can have negative physical effects on the human body, even at levels below hearing damage. It is for these reasons that HP uses special acoustic ranges, microphones, and in-house standard methods to ensure that systems stay quiet during operation.

TEMPERATURE AND HUMIDITY



A system that has not been designed to operate in global customer environments will fail when placed in outdoor areas. Corrosion of components can occur, which causes the metals used in the products to degrade and eventually fail. Electronic components can also malfunction if not properly designed and protected for intense temperatures and humidity conditions. Z Workstations are designed for the most demanding workloads. Proprietary HP standards require the use of large ovens, in which the systems are placed while operating long periods of time at elevated temperatures and humidities. This testing allows us to not only ensure that systems can operate in different extreme environments, but also gives us insight as to how long a system will last in these environments.



ENVIRONMENTAL COMPLIANCE



HP SPECIFIC

ENVIRONMENTAL COMPLIANCE

HP is committed to being a leader in the area of sustainable personal computing. A system that is not designed with materials sustainability in mind may have long term negative and environmental health effects. These issues can occur during manufacture, use, and final disposal. In short term, a system not designed for energy efficiency may drive user power costs up considerably. HP Z Workstation materials are tested for materials that are restricted by entities around the world, required to be eliminated by ecolabels (EPEAT®, TCO), and are voluntarily restricted by HP. The goal of making systems free of substances of concern potentially benefits every single person on Earth. In addition to reducing targeted materials, HP also offers high efficiency power supplies, uses recycled content in systems, and is introducing Ocean Bound recycled plastics into many products within our portfolio. Systems are also rigorously tested to ensure that power efficiency meets the standards to which we develop (ENERGY STAR®, EPEAT, etc.).



HP SPECIFIC

THREE AXIS TESTING

In mission critical applications, where variation in power quality and environmental conditions are likely, it's important to have known system performance metrics. Z systems go through brutal 3 axis testing, where frequency, voltage, and temperature are varied. Our engineers use a "test to fail" mentality to push the limits of processors, memory, and other system parts. Z systems are not just copies of reference designs. Three axis testing allows us to understand where the limits to our designs are, so that we can refine our systems to expand our operating margin; and ensure our systems are as robust as possible. In addition, we can confidentially discuss our products performance in non-standard environments with our customers using this data.





HP SPECIFIC

SYSTEM VALIDATION TEST PROTOCOL (NOTEBOOKS)

Our Z Notebooks go through a large collection of quality focused tests that ensure their systems operate as intended throughout their life cycle. These protocols include tearing cables out of systems at different angles, display quality checks, thermal tests, and battery safety tests. Notebooks that are not validated during development may exhibit unexpected behavior during use such as, permanent defects that appear on the screen, hinge damage, keys popping off the keyboard, etc. HP's collection of customer centric tests ensures that hinges will not fail, screens will remain bright, keyboards can be used for millions of cycles, and many other things. This battery of tests ensure that customers experience with our Z Notebooks will be high quality and consistent over the life of the product.



HP SPECIFIC

THERMAL TESTING

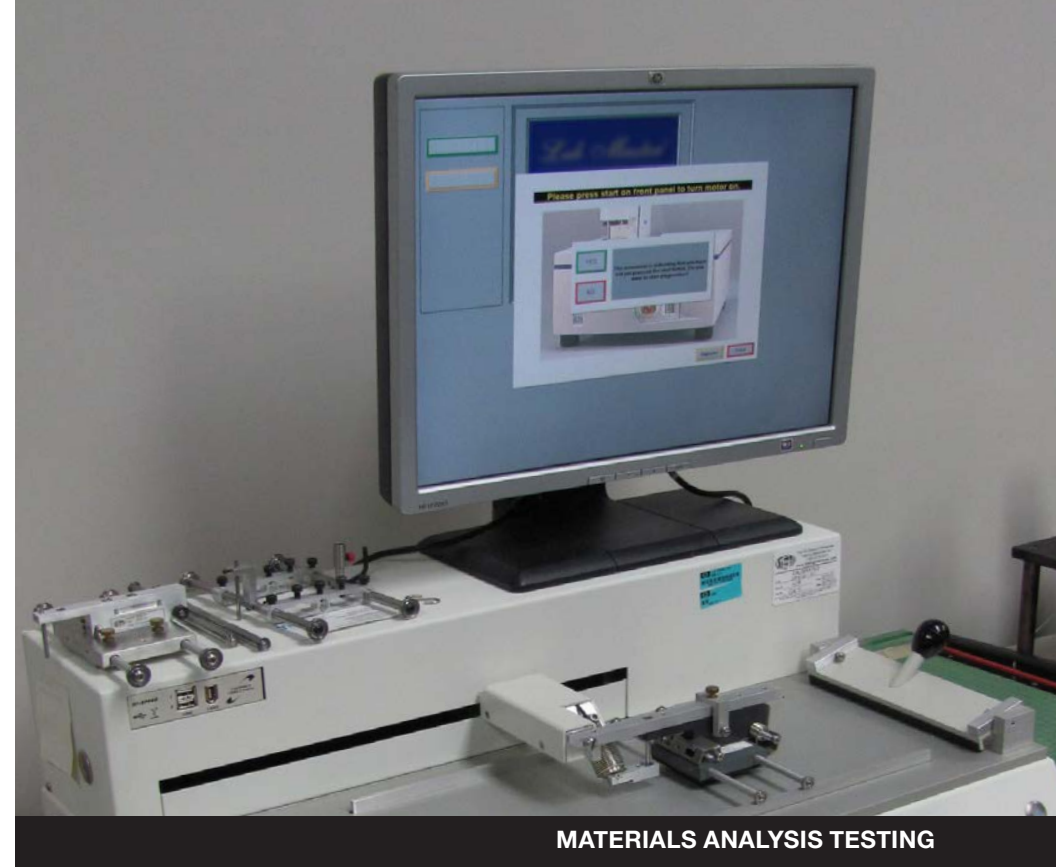
Generally, hot temperatures damage electronic components. Cooler parts typically run faster which translates into measurable performance gains. A system that has not been optimized for thermals will likely fail earlier than expected. In addition, most modern components will throttle performance when not cooled sufficiently. A system can appear to function normally, but can be restricted to very slow performance and early failure due to inadequate cooling design. In serious cases, poor thermal design can result in hazardous conditions in and around the computing system during failure. The mechanical engineers at HP use modern tools like thermocouples and IR cameras to fully characterize the thermal characteristics of Z systems. Both notebook and desktops are rigorously studied and modified to ensure a balance between performance, reliability, and thermals. Even the smallest parts on a Z system mainboard are carefully studied to ensure that they are operating as cool as possible. This is one of the main reasons that some customers use Z Workstations long after competitive systems have failed. We have a reputation for long-life and high reliability, and extensive thermal studies are one of the prime reasons for this.



HP SPECIFIC

SYSTEM QUALITY TEST MANUAL (DESKTOPS)

The SQTM includes a series of quality focused tests that ensure consistent and strong performance throughout the lifetime of a desktop product. These tests include acoustic, thermal, drop and shock, serviceability, etc. A system that is not validated during development may exhibit unexpected behavior during use, such as graphics card failure after shipping, damage during servicing, etc. Our collection of customer centric tests ensures that parts can be removed and inserted easily, that systems can operate correctly during temperature changes, and that systems can be shipped with no damage amongst many other things. Quality includes more than just reliable operation. It also includes a consistent and positive experience for the user throughout the use period. The battery of tests ensures that customers will have a high quality and consistent experience with our Z Desktops over the life of the product.



MATERIALS ANALYSIS TESTING



HP SPECIFIC

MATERIALS ANALYSIS TESTING

If the materials used in a product are not checked during the life cycle checkpoints of development, major reliability issues can be shipped to customers. For example, cables manufactured incorrectly can emit or pick up signals that cause data corruption or system failure. Industry standard methods such as the IPC methods for printed circuit boards, printed circuit assemblies (motherboards) and cables are used to scrutinize HP materials during development and production. HP proprietary tests are

also used to look at specific components that are known to require attention during the reliability planning process. HP's materials testing ensures that every solder joint on an electronic board is made in a way that will last for years. It ensures that the boards are free of conductive contamination, which can short out boards and cause failure and data loss. It also ensures that only the best materials are used, which can also help boost overall system performance.



ELECTROMAGNETIC TESTING



Electromagnetic emissions are the “pollution” that humans cannot see. These emissions can cause glitches in electronic systems, and sometimes can cause the system to fail completely. A system that is not properly tuned to eliminate and resist electromagnetic emissions not only can fail, but can also cause malfunctions in other electronic devices nearby. For example, a poorly designed workstation could cause a nearby cell phone or printer to malfunction. HP goes beyond regulatory requirements and ensures there is an adequate margin in both emitted and received electromagnetic radiation levels to ensure flawless operation in customer environments. We do this by using in-house and manufacturing partner EMI test facilities to measure radiated emissions from our systems. We also test the resistance of our systems to emissions from other electronic products.



ELECTROMAGNETIC TESTING



HP SPECIFIC

HEALTHCARE TESTING



Healthcare chemicals are extremely corrosive by nature, and can easily damage electronics that are not specifically designed to resist their use. HP customers that use products marketed to be healthcare editions can rest easy knowing that sanitation requirements in medical care facilities can be met without damaging or adversely affecting system operation. HP uses a suite of in-house developed tests

to ensure that common healthcare chemicals can be used on specific HP systems in support of the healthcare industry. These tests involve direct exposure of the chemicals to our systems in ways that simulate a full lifetime of use. Without this qualification for healthcare chemicals, a system will likely experience severe damage to the display, outer casing, and even the circuit board.





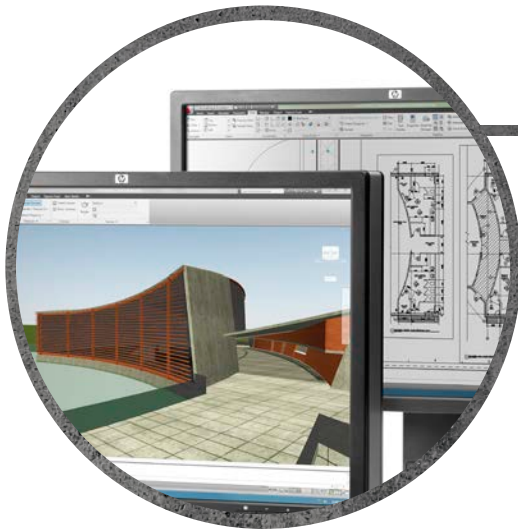
HP SPECIFIC

GRAPHICS QUALIFICATION

At HP, we understand that our customers demand maximum stability and performance from our workstations, and the graphics subsystem is a major pillar within. Every graphics card and driver that we release has gone through thousands of hours of graphics and compute centric testing, using a combination of internal proprietary tools and industry standard benchmarks/apps to ensure stability, functionality, and performance under a wide range of operating modes and scenarios — including extended 24/7 runs. If it doesn't meet our stringent testing, it doesn't release. This comprehensive testing ensures that every professional graphics card we offer is ready for 24/7 professional use. By working closely with our graphics partners, we relentlessly drive hardware and software improvements, even before release, directly benefiting the end user. Without the HP-qualified driver and hardware, and the rigorous testing that enabled its release, customers may be exposed to delays in their workflows due to unexpected behaviors which would otherwise be resolved during our qualification process.



GRAPHICS QUALIFICATION



SOFTWARE TESTING WITH ISVs



We provide hardware and support to key ISV partners to validate and support hundreds of software solutions on Z Workstations (or specific graphics testing). When there are problems during testing or support for a customer, ISV partnerships allow for fast resolution. Hardware support also enables our partners to enable new technologies such as VR, Real Time Ray Tracing, Data Science, etc. ISV testing often translates to support from the ISV. It allows the ISV to reproduce customer problems on like configs to enable faster resolution and test new technologies with HP Z Workstations. Through our partnerships we maintain application expertise to provide performance analysis and config recommendations. If ISVs don't have access to test workstations then quality for our customers may be poor. Some ISVs won't support HP products if they can't validate their solution. Others may only test graphics but still resolution of problems for customers could be poor. Partners are not able to reproduce problems on like configs.



CONTACT US

¹MIL - STD - 810G testing is conducted on select HP products. Testing is not intended to demonstrate fitness for U.S. Department of Defense (DoD) contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage or damage under these test conditions requires an optional HP Accidental Damage Protection Care Pack.

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