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BUILDING RELIABILITY INTO Z BY HP

A workstation is a high-powered PC used by engineers, artists, scientists, doctors and many other creative professionals. They are used to design spacecraft, run medical equipment and communicate information that will be consumed and shared by billions of people. System crashes, component breakdowns, and sluggish performance can bring work to a halt and result in several hours or days of lost productivity. When the user is a professional who must make every minute count, that kind of productivity loss is simply unacceptable.

For workstation users, system reliability is essential. That's why we design our workstations to meet the challenges of the most demanding workloads and duty cycles— an HP focus for the past 30 years. Today, our three decades of workstation engineering innovation has created a level of reliability that is widely recognized in the industry.

Here are some of the things we do to make the Z by HP Workstations name synonymous with rock-solid reliability.

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A STRENUOUS DESIGN STANDARD

We design our Z systems based on workstation application demands, a rigorous customer use model and, a five-year design standard. Our 24x7 design standard drives the types of components we use and the types of testing we employ.

HP Workstations are designed and built for mission-critical workloads and always-on environments. As such, they employ many of the same types of components used in servers. These components include Intel® Xeon® processors, error correcting code (ECC) memory, and enterprise-class storage technologies.

Even the smallest and most common electronic components, like resistors and capacitors, are carefully chosen based on quality, reliability, and top performance. We know that system reliability doesn't happen simply by connecting even the best components together. There must be an iterative test-analyze-fix process. Our current platforms undergo over 120,000 hours of extensive testing and validation for laptops and 360,000 hours for desktops, including functional, electromagnetic, shock, vibration, acoustics, temperature, humidity, environmental compliance, and compatibility and integration.

BRUTAL THREE-AXIS TESTING FOR Z BY HP DESKTOP WORKSTATIONS

In choosing workstation Z by HP desktop components, we don't stop at the specifications in the manufacturer's data sheet. In our workstations test lab in Fort Collins, Colorado, we subject HP desktop components to rigorous testing to verify their performance under extreme conditions. In brutal three-axis testing—where frequency, voltage, and temperature are varied—our engineers push the limits of processors, memory, and other system parts.

This testing goes far beyond the boundaries of typical use models. Inspired by a long history of workstation technologies development, including HP-designed processors and chipset or graphics chips, this three-axis testing uses proprietary tools and techniques, and stresses components in ways that help detect potential design or component weaknesses that would otherwise go unnoticed. Various memory DIMM modules, for example, often fail our three-axis testing, and are disqualified by HP despite being used by other workstation manufacturers. Memory suppliers, in turn, often look to HP to identify design and silicon issues in their products.

Ultimately, this aggressive testing program allows us to design and ship workstations that can easily handle the conditions and workloads of professional environments, from car test tracks to oil fields, manufacturing floors, high humidity environments, construction trailers, etc.

CUSTOMER CENTRIC TESTING ON ZBOOK MOBILE WORKSTATIONS

HP ZBook Mobile Workstations are also developed using advanced test methods in our Fort Collins, Houston, Taiwan and Shanghai test labs. The HP System Validation Test Protocol is an extensive collection of proprietary test methods that are used to push systems to their limits. Some of the SVTP tests use cumulative stresses meant to simulate real world use. Multiple tests are run on the same units so that the cumulative stresses from one test are carried over into following tests, which reveals areas that can be hardened and designed for ultimate reliability.

This testing is based on over 30-years of mobile system design and involves every working aspect of a ZBook Mobile Workstation. Cables are yanked out of systems, laptops are opened and closed tens of thousands of times, screens are subjected to torturous abrasion tests. Entire systems are baked in ovens for long periods of time to simulate years of aging. ZBooks are also subjected to fourteen different military grade durability tests (based on MIL-STD-810G3) including drop, vibration, explosive atmosphere, dust and humidity requirements- the same tests performed on electronics used in satellites, helicopters and aircraft used by the Military and Aerospace industries.

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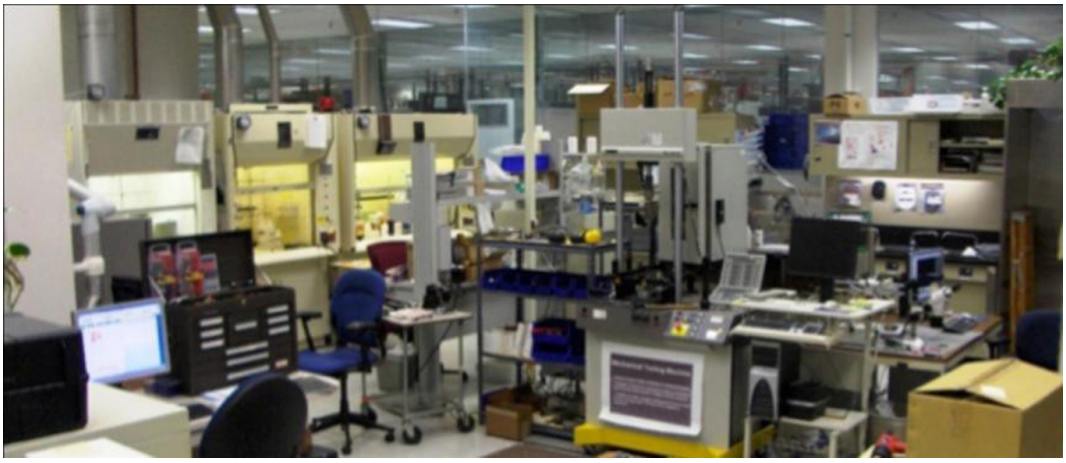
The tests included in the SVTP also include the reliability of pen input systems, touch panels, audio output, microphone operation and other ways that professionals interact with workstation systems. Through these tests, we ensure seamless integration of ZBooks into mission-critical workflows with no jarring interruptions from substandard or malfunctioning interfaces. Your ZBook isn't just a tool, it is an extension of your abilities. It must always seamlessly integrate into professional workflows.

ADVANCED MATERIALS QUALIFICATION

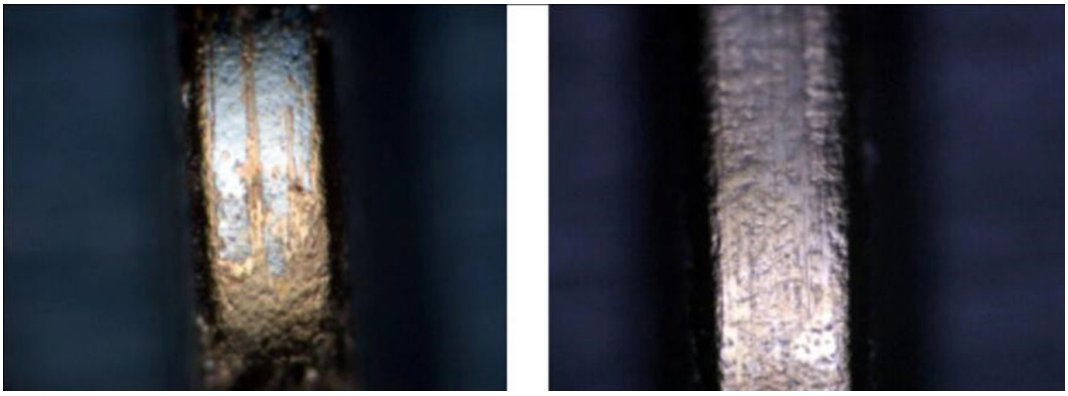
We achieve a high level of I/O, memory, and other component reliability through our adherence to strict standards for materials selection and our tight control of the HP-approved vendor list. And we don't stop there. Working in our state-of-the-art materials analysis lab, our test engineers and materials scientists physically deconstruct workstation components to study the materials and the chemicals used in them, employing advanced scientific equipment such as spectrometers, electron microscopes, and X-ray machines.

Figure 1. The HP Workstations Materials Science Lab, a state of the art facility used to test workstation products beyond standard industry practices.



Poor materials and processes used commonly in the industry will produce designs that are subject to premature failure. Our analysis, specifications, and selection processes drive designs using above-standard quality components. One example of this is memory sockets. Each socket comprises hundreds of contacts whose material interface, if not carefully selected, deposited and controlled, can lead to corrosion. A corroded contact can create a point of failure on a system motherboard in a data-sensitive area. The quality of the materials and the chemicals used in our memory sockets, such as the thickness and quality of the gold plating deposition process are carefully evaluated. If necessary, we work with the manufacturers to drive the parts to the proper quality levels.

Figure 2. A failing (left) and passing (right) result from the standard socket wear testing procedure.



This same level of materials analysis was used during our conversion to BFR (brominated flame retardant) and PVC (polyvinyl chloride) free systems[1]. The Z by HP R&D team did not treat all available unrestricted materials as acceptable options. We engaged in a thorough analysis of the new materials that would need to be used on motherboards, in cases, and in connectors to ensure that the BFR/PVC free materials met our reliability and

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performance expectations. The result of this analysis was materials that exceeded our expectations in almost every category of mechanical and electrical reliability and performance, while producing a product with a reduced environmental impact.[2]

The materials used in our printed circuit boards and board-loadable components are also specified through our rigorous design standards. These materials are tested during all phases of product development. Printed circuit board materials are dissected, chemically analyzed and physically measured to ensure only the best materials are used in Z Workstations. Individual components, like capacitors and inductors, are also cross-sectioned, subjected to materials analysis and tested using advanced proprietary reliability tests to ensure that they can meet the 24X7, full performance specifications of both Z Desktops and Notebooks.

We don't just stop at the industry standard reliability tests. We use the tools of chemistry and physics to look at these materials down to the nanoscale. This gives us the ability to ensure the highest performance and reliability characteristics of the materials used in Z systems.

QUALIFICATION OF COMPONENTS FOR Z BY HP SYSTEMS

We carefully qualify many components that are selected for their enterprise-class reliability and performance, such as ECC memory, SSD, graphics cards, and SAS hard drives. Our qualification processes start with the same industry- standard tests and benchmarks used by other vendors but go above and beyond to also make use of proprietary HP test tools and techniques. These methods have their origins in our long history in the workstation market. These processes comprehensively cover the software, hardware, and firmware interactions of the components with the system and with other components.

In some cases, this rigorous qualification enables us to find issues that have been previously overlooked by our component vendors. Our strong relationships and influence with these partners enables us to obtain and integrate improved components into our systems, many of which are unique to Z Workstation. We routinely identify areas to improve function, performance, and reliability of industry standard components. One recent example of 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. In another example, components in our systems often use firmware or driver versions with Z-specific enhancements or improvements.

We use a suite of applications and hardware that is used to stress the system called HP Meatgrinder. Meatgrinder testing includes local subsystems as well as operability across the system. This software package is a proprietary tool that has been developed over decades. It spans architectures and is continuously updated for new, modern functionality. It is considered one of the best tools for validating full system operability in the industry. For example, a data integrity issue was discovered through the testing and allowed us to patch this security hole in development.

EXACTING STANDARDS

We are unyielding in our adherence to HP quality standards. One example: the power supply unit (PSU), like the rest of the system, undergoes rigorous testing to verify functionality which includes extensive temperature, input voltage and frequency testing. We also give special attention to the choice of aluminum electrolytic capacitors.

Through component evaluation in our materials analysis lab, we know that poorly constructed capacitors can lead to bulging and venting and result in an early failure. We examine capacitors at a molecular level to ensure consistent quality, and also work directly with the suppliers on construction and enhanced reliability testing in order to ensure the highest quality possible. We even require our power supply vendors to justify changes in capacitors by providing evidence of compliance with industry standards and HP designed reliability testing.

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A Z power supply is also designed for a longer life cycle. This often results in our engineers selecting better components to increase our design margins and improve overall reliability. We do not rely only on the PSU vendor for testing. Our testing is completed at three different facilities, which gives us a greater opportunity to find issues during development.

A few other examples of our exacting quality standards:

- We qualify and test every memory type and vendor used in our workstations.
- Compared to common industry practices, we use highly-rated critical electrical components for system stability and long lifetime, as dictated by our design standards.
- We use multi-point thermal sampling to optimize the acoustic and thermal performance of HP Workstations.
- We develop and perform reliability test methods to check every connector in a system for durability and reliability over the lifetime of the product.
- Every workstation motherboard is subjected to strict IPC-A-610 based screening during every phase of development for Class 2 (high reliability) products. Workstation specifications also include many modifications to the IPC standard that are significantly stricter than what is generally required for Class 2 materials.

MEASURING AND CONTINUOUSLY IMPROVING

Workstation users demand solutions that continue to improve throughout their lifecycles. That's why we promote a quality-focused culture here at HP, with incentives to encourage partners who consistently uphold and surpass our high standards for quality. Our extensive product testing and early warning programs detect and address potential concerns before they become problems. All these activities—including customer comments and input —feed back into our design and engineering, helping to ensure that preventive actions are put into place to address any issues discovered across the lifecycle.

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BUILDING RELIABLE SOLUTIONS

At the broader ecosystem level, we work closely with our technology partners to deliver reliable workstation solutions.
A few examples:

- We go beyond just producing hardware and tie it together as a complete solution. We work with component vendors to ensure they are producing good products. Then we holistically test everything together to make sure it is a complete solution. We are a designer and an integrator and are more than the sum of both.
- We work with leading independent software vendors (ISVs) through the HP Application Competency Centers, which are virtual teams that often include an HP engineer residing on site at the ISV. These engineers test and certify our workstations so we are confident in the total solution quality.
- We share our unique graphics qualification tools and processes with our graphics suppliers to ensure that their products meet our requirements for reliability and performance.
- We ship our workstations with HP Performance Advisor (a software application that helps the user identify the proper drivers and settings for specific technical applications to optimize performance), HP Storage Advisor, a free tool to predict and quantify performance improvement for workstation storage solution upgrades, and HP Image Assistant, a software application that helps the user identify the proper drivers and settings for specific technical applications to optimize performance.

A SYSTEM YOU CAN TRUST

Ultimately, our intense focus on reliability gives our users greater peace of mind when running professional applications on an Z by HP Workstations. Our Z by HP Workstation users know they have a system that is designed, tested, and proven for the work they do.

ADDITIONAL RESOURCES

hp.com/go/whitepapers

1. Meeting the industry definition of 'BFR/PVC-free' per the iNEMI Position Statement on "Low Halogen" Electronics. Plastic parts incorporated into the chassis generally contain < 1000 ppm (0.1%) of bromine or chlorine. Printed circuit board and substrate laminates generally contain < 1500 ppm (0.15%) of total bromine and chlorine. Service parts after purchase may not be BFR/PVC-free. External accessories, including power supplies, power cords, and peripherals are not BFR/PVC-free.

LET US HELP YOU CREATE SOME AMAZING BUSINESS SOLUTIONS TODAY

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For more information, visit the HP Workstations home page at http://www.hp.com/go/workstations.

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