# Building Reliability into HP Workstations

For workstation users, system reliability is essential. System crashes, component breakdowns, and sluggish performance can bring work to a halt and result in hours or days of lost productivity. When the user is a professional who must make every minute count, that kind of lost productivity is simply unacceptable.

At HP, we recognize that professionals can't settle for anything less than the highest levels of reliability. That's why we design our workstations to meet the challenges of the most demanding application workloads and duty cycles—an HP focus for the past 30 years. Today, our three decades of workstation engineering innovation have paid off in a level of reliability that is widely recognized in the industry.

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

## A strenuous design standard

We design our systems based on workstation application demands, a full-time customer use model, and a five-year design life standard. This model assumes the system is used around the clock. 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 hard-drive technologies, such as 15K Serial-Attached SCSI (SAS) and solid-state disk (SSD).

Even the smallest and most common electronic components, like resistors and capacitors, are carefully chosen based on quality, reliability and top performance.

## Brutal three-axis testing

In choosing workstation 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 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 3-axis testing uses proprietary tools and techniques, and stresses components in ways that help detect potential design or component weaknesses that would otherwise go un-noticed. 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 vendors, in turn, often look to HP to identify design and silicon issues in their products.

Ultimately, this aggressive testing program yields more reliable end products. It allows us to design and ship workstations with robust functional margins and components 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.

## Materials and chemical testing

We achieve high reliability in I/O, memory, and other components 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 equipment such as, spectrometers, electron microscopes, and X-ray machines.

Figure 1 - The 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 DIMM 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 DIMM 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 Workstation R&D team did not treat all available unrestricted materials as acceptable options. We engaged in a rigorous and thorough analysis of the new materials that would need to be used on motherboards, in workstation cases, and in connectors to ensure that the BFR/PVC free materials met our reliability and 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.

## One system, multiple tests

Rather than running different tests on different systems, we take a single system and put it through a series of physical tests, such as shaking tests and drop tests, to see how well it holds up under a combination of stresses. We then correct any issues and repeat the cycle. We repeat the test cycle until we achieve the high level of quality our customers expect.

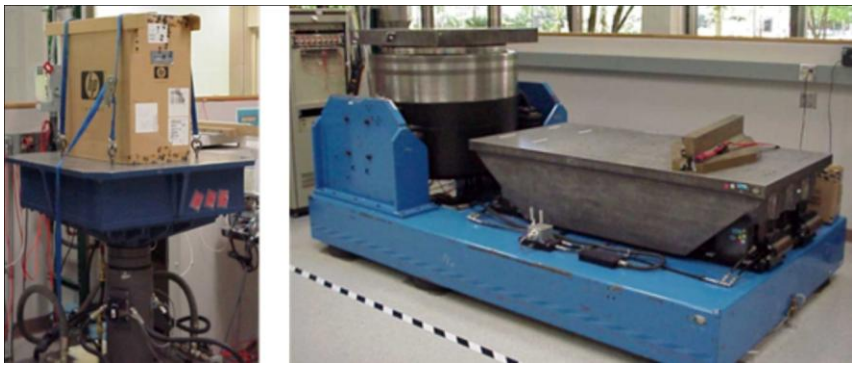


Figure 3 – examples of the tools used to shake and drop our products, simulating real world shipping and usage events

We know that system reliability doesn't happen simply by connecting even the best components together. While high quality components are an essential piece of the reliability puzzle, there must be an iterative test-analyze-fix process. Our current platforms undergo over 95,000 hours of extensive testing and validation, including functional, electromagnetic, shock, vibration, acoustics, temperature, humidity, environmental compliance, and compatibility and integration. This iterative concept has been an integral factor in the development of HP Workstations for 30 years.

## Enterprise-class qualification

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 that 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 HP Workstations. 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 an HP-specific version of the Quadro FX 3800 graphics card, achieving improved thermal and acoustic performance. In another example, components in our systems often use firmware or driver versions with HP-specific enhancements or improvements.

## Exacting standards

We're 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 and 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, and test results for, industry standards and HP-designed reliability testing.

A workstation power supply is also designed for a longer life cycle. This often results in our workstation engineers selecting better components in order 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.

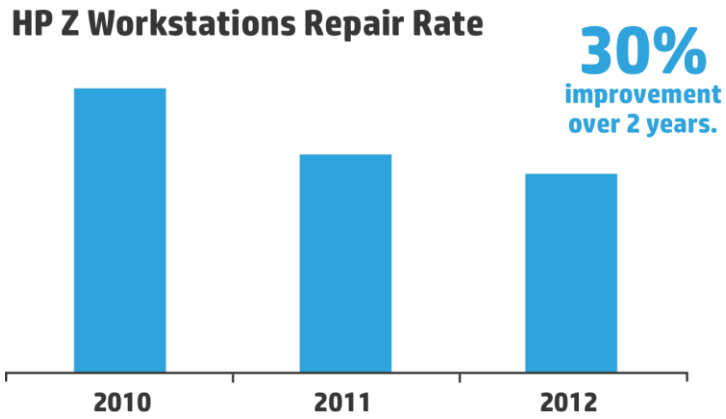
A few other examples of our exacting quality standards:

- We qualify and test every DIMM type and vendor used in our workstations
- Compared to common industry practices, we use higher-rated critical electrical components for system stability and longer lifetime, as dictated by our design standards
- We use multi-point thermal sampling to optimize the acoustic and thermal performance of HP Workstations
- We developed and perform reliability test methods to check every connector in a system for durability and reliability over the lifetime of the product.

## 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. We monitor and measure the quality of components and platforms to ensure we are delivering reliable solutions. All of 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.

Our efforts have helped us achieve the best performance level in HP workstation history[2]:




## Building reliable solutions

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

- 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 vendors 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.

This kind of behind-the-scenes work helps us ensure that the HP Workstation is ready for the rigors of any work environment and the steep demands of professional applications.

## A system you can trust

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

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### 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.

2 Based on a worldwide average of in-warranty HP workstations from 1Q10 through 3Q12, as of July 2012.



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