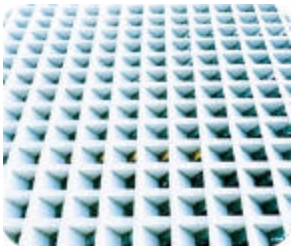

industry standard servers

may 2003

white paper

ProLiant = Reliability

executive summary

ProLiant servers have always been known for their reliability. Engineering expertise combined with extensive testing of software, hardware, and mechanical components results in stable server platforms that limit costly network downtime and conserve valuable IT resources. ProLiant servers undergo rigorous testing to meet demanding data center requirements. Testing includes the following aspects, with details available by clicking on each hyperlinked topic:

- software testing

  The software testing strategy for ProLiant servers consists of four phases; design verification, unit, system, and customer acceptance. The overall goal of this test strategy is to verify quality, "Ease Of Use", and reliability of the ProLiant server.

- thermal testing

  An important component of ProLiant testing consists of thermal tests done on the individual servers as well as the server deployed in a rack. Thermal testing starts during system design to test layout and cooling components, and continues through production to assess the consistency of the manufacturing process.

- reliability testing

  A lot of very cool stuff is used for some very serious and comprehensive reliability tests. ProLiant servers are subjected to wind tunnels, laser and vapor airflow analysis, nitrogen-based thermal imaging, robotics testing and much more. Our reliability labs are so unique we've had to design some of our own test equipment because no other vendor puts their servers through such extensive reliability analysis.

- environmental testing

  ProLiant servers are tested in a wide range of environmental conditions to guarantee reliability and adherence to ISO standards. Testing encompass temperature, altitude, humidity, vibration, and more. Even our shipping boxes are environmentally tested to make sure equipment arrive at the customer location in perfect condition

- environmental regulations and standards

  To legally deliver products into specific countries, ProLiant servers must pass regional and international environmental regulations and standards. Our electromagnetic test laboratories are accredited by both national and international regulatory agencies.

software testing

design verification testing

This test phase consists of reviewing the hardware and software specifications and testing all software functionality with Proto-2 units. This also includes functionality testing of features to verify functionality and consistency across all ProLiant platforms.

unit testing

Unit testing consists of testing all the major server subsystems, for example: server health drivers, embedded NIC subsystem, embedded SCSI/array subsystem, CPU subsystem, video subsystem, and memory subsystem.

system testing

System testing tests the various server-supported options, such as array controllers, SCSI controllers, NICs, hard drives, selected tape drives and remote management. In addition, SmartStart installations, Survey, ACU/ADU, Diagnostics, Erase, and Hewlett-Packard Insight Manager XE will also be utilized during the System phase. In addition, the system is tested in the expected usage model environment on a variety of platform test stations.

customer acceptance test

This testing phase consists of closing outstanding critical issues and assuring final hardware and final software function as designed with all the supported operating systems.

thermal testing	
thermal mock-up	The system is approximated with fans, resistive heaters, and air obstructions representing system features to determine if the system layout and cooling components have merit to warrant proceeding to the next phase of definition and real hardware.
system configuration tests	This series of tests involves real system hardware and typically is operated with the fans at full speed. The goals being to determine what system option configuration is the most difficult to cool; establish what redundant fan failure scenario produces the worst case fan fault scenario; and to verify the system can be cooled under such conditions while also at its maximum warrantee inlet temperature, typically 35 degrees Celsius.
fan speed control	The system is exercised while running at the inlet ambient at which the fans will go from low speed to high speed. While temperatures are monitored, the fans are adjusted to a point where their acoustic impact is lessened while not exceeding the maximum allowable temperature for any system component.
throttling	Running worst-case exercise software, the processors are checked to ensure they will not throttle, even at maximum warrantee inlet temperature.
trip caution and trip deadly	Tests above the maximum warrantee temperature are run to establish the criteria for both an orderly shutdown (Trip Caution) for customers running HP's Healthdriver software, and an abrupt shutdown (Trip Deadly) for those who do not. These shutdown features are intended to provide the customer with hardware investment protection in the event of catastrophic air cooling loss.
rack level verification	Testing is run with the system in a rack full of servers to ensure no interactions on a larger scale, and one that better reflects how the customer will locate and use their system, are encountered. The entire rack of hardware is located within a large temperature chamber and all previous measurements and settings are checked. Through such testing, HP was able to determine when its rack doors needed to be made more open so as not to restrict the airflow on the current generation of processing power and system packaging density.
volumetric airflow measurements	This is a relatively new test that provides the customer with information on how their new system will affect the cooling requirements of the facility in which it will be located. This allows the customer to better size and prepare for their new hardware for minimum impact to their site.
Highly Accelerated Life Testing (HALT)	This is a process which involves thermal step stress of a product, followed by random vibration step stress while the unit is operational. HALT is a destructive process used to stimulate failures in order to help improve the robustness of the design, or to uncover materials or process defects.
Highly Accelerated Stress Audit (HASA)	This is a non-destructive process utilizing concurrent thermal and vibrational stressing while the unit is operating in order to precipitate materials or process defects. HASA is performed on production units to assess the consistency of the manufacturing process.
reliability testing	
wind tunnel testing	System components such as processors, hard drives, chipsets, and related heatsinks are tested in the wind tunnel to determine airflow and system cooling design required to properly cool the individual component.
airflow analysis	Simulation and practical testing using laser and vapor to analyze airflow through the system.

thermal imaging	Nitrogen-based imaging is used to photograph hot spots within the system and on specific components. Thermal 'hot spots' are defined and then thermo-coupled during thermal analysis.
fan testing	System fan designs and their components such as bearings, polymers, and grease are analyzed and tested to determine level of quality and reliability.
power supply testing	Power supplies and resistors are testing for temperature extremes and over/under voltage.
thermal chamber analysis	Units are placed in a thermal chamber that maintains temperature, humidity, and simulates various sea levels. The temperature of individual components is measured over time to determine if additional baffles, heat sinks, fans, etc. are required to maintain proper cooling. Systems are testing individually and within racks to simulate a real-world environment.
robotics testing	HP has custom designed robotics test equipment to test and monitor stability of moving parts through repetitive motion. Robotics testing verifies reliability of any movable component, such as system cables, floppy drive, CDROM, hard drives.
electrostatic discharge	Open air discharge to system ports, seams and vents to guarantee system will continue to run even if it has received a random electrostatic discharge.
shock chamber testing	Systems placed in the shock chamber are subjected to sudden changes in temperature to verify reliability in adverse environmental conditions.
environmental testing	
fan airflow analysis	Fans are tested for RPM vs. airflow. Higher volumes of air at lower fan speeds result in reduced noise emissions and higher system reliability.
noise emissions testing	Measurement of the amount of noise emitted from components and systems result in information to help sell into noise sensitive markets and to meet various international governmental regulations. Testing is in accordance with ISO 7779 and published declared values are in accordance with ISO 9296.
altitude - temperature testing	Systems and components are evaluated across the operating temperature range from sea level to 10,000 ft and beyond in operational mode to ascertain survivability and certify thermal solutions for customers living in higher altitude population centers. Systems are also evaluated across the non-operating temperature range from sea level to 30,000 ft in non-operational mode to ascertain survivability at higher altitudes.
humidity - temperature testing	Systems and components are evaluated in operating and non-operating conditions under environmental extremes cycling across the entire appropriate temperature and humidity ranges. The goal is to evaluate the robustness of hardware design and survivability associated with anticipated end user environments from "pole to pole".
salt fog testing	For those programs evaluating new technology metals, coatings, paints, etc., we have the ability to run an accelerated severe corrosion environment salt fog test. Testing is run in accordance with ASTM B117 and is used to evaluate the integrity of the above-mentioned protective coatings.
vibration testing	Various forms of vibration including random and swept sine is used to evaluate system and component design robustness and survivability in non-operational modes. For operational testing, the goal is to evaluate the system and component's ability to continue to function and survive inputs associated with the anticipated end user environment.

mechanical shock testing	Combinations of ½ sine shock and trapezoidal (square wave) shock are used to evaluate system and component design survivability and robustness in non-operational modes. Occasionally, this may also be referred to as Fragility Testing as the testing continues to total hardware failure. The failure levels are then used by packaging engineers to design adequate protection for the shipping environment. As with Vibration testing, the operational side of shock testing evaluates the system and component's ability to continue to function and survive inputs associated with the anticipated end user environment.
package testing	Pack testing is inclusive of a number of different environmental tests encompassing Temperature, Altitude, Humidity, Salt Fog (occasionally), Vibration (transport), Drops (free fall impact), Inclined impact (pallet loads), and Compression tests. In each instance the focus is to help develop a package that will survive the bumps and bruises of the shipping environment. Indeed, the customer purchased a "NEW" HP product, and when the shipping box is opened at the customer's location our focus is that the product should still be "NEW" after the shipment. Damaged goods are simply not the way we like to do business.
product specifications	The last item of mention for the Environmental Test side of the EMESC is that of Product Specifications. After the development process and subsequent ramp to production, the EMESC reviews the associated test data and results and generates a product specification suitable for customer distribution. This product spec is posted to our web site and is readily available for use by sales and field personnel in support of HP business. Ultimately it is a tool to help make sure our products match our Customer's requirements and expectations.
environmental regulations and standards	
agency approval	To legally deliver products into specific countries, regional and international environmental regulations and standards must be met. Standards and regulations have been established across the globe to protect the consumer from the phenomenon of electromagnetic interference (EMI) and to assure manufacturers keep the interference within specific limits. Some countries require compliance or certification prior to product entry into the country. Some countries back those requirements up with a check for compliance information on every shipment entering the country. Some regulations require ongoing factory or product audits that impact our supply chain, logistics, documentation and record keeping processes. Electromagnetic Compatibility Compliance to electromagnetic compatibility requirements is legally mandated in many geographies, with new legislation covering emissions and immunity being introduced at an increasingly rapid rate. The FCC emissions test requirements, for example, were developed as a way to ensure that electronic products would not interfere with communications signals and equipment (radio, TV, air traffic control, emergency services, etc). Agencies in other countries developed similar standards and then added immunity tests to the list in order to ensure that products would be immune to some level of outside interference.
accreditations	In addition to our ISO 9002 registration, our test laboratories are accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), AUSTEL, VCCI, BCIQ and the FCC. Our EMC facilities include three open area test sites and two anechoic chambers, with the capability to perform emission and susceptibility measurements to meet European Directive requirements. In addition, we are listed in the Interference Technology International laboratory network as an approved laboratory capable of performing emissions and immunity measurements in accordance with the EU Directives.

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for more information

Details about ProLiant servers are available at:

http://h18004.www1.hp.com/products/servers/platforms/

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