HP drives industry standards for rugged computing

Executive summary

Hewlett-Packard Company has introduced a rugged line of notebooks and tablets built for performance, mobility, and versatility to survive the most demanding needs in tough environments. With the introduction of the HP nr3600 Rugged Notebook and the HP tr3000 Rugged Tablet PC, HP offers excellent computing capabilities to highly mobile users in extreme conditions.

These mobile PCs are ideal tools for users who often work in remote and demanding environments where computers must be able to withstand long-term vibration, rain, dust, and extreme operating temperatures.

Universal compliance testing standards do not yet exist for this class of product in the industry today. Therefore, in order to best meet the needs of customers seeking this more rugged solution for portable computing, HP performs extremely rigorous compliance testing. In fact, the qualification procedures for the HP Rugged Notebook and the HP Rugged Tablet PC are setting the industry standard.

HP follows test specifications from several industries, including the trucking industry and the U.S. military. The standard frame of reference for rugged products in general is the U.S. Military Specification for ruggedness, also referred to as MIL-STD 810F specification (or MIL spec 810F). The MIL spec 810F is not a specification for computing devices only; it covers a broad range of devices procured by the U.S. military. For this reason, HP computing devices are typically tested to applicable specifications only. These specifications include Vibration, Temperature, Sealing, Humidity, Low Pressure, ESD, and Drop (Shock).

Both the HP Rugged Notebook and the HP Rugged Tablet PC devices comply with MIL-STD-810F and offer an Ingress Protection rating of IP54, which specifies the level of environmental protection a device provides against liquids and solid objects, like rain and dust. Only the most durable systems survive this series of tests, which simulate real-life situations in the field.

This white paper lists the standard tests and technical specifications to which the HP Rugged Computing products conform.

Test descriptions

Both the HP Rugged Notebook and HP Rugged Tablet PC are intended for the most demanding environments and as such undergo the following tests. Because of its different usage model, the HP nr3600 Rugged Notebook undergoes four additional tests: 2 Vehicle Vibration tests, the Vehicle Shock test, and the Vehicle Crash test. The post-test pass and survival criteria are as follows:

- No program data is lost
- Unit meets Water Resistance specification
- Unit functions (user can run applications)

Table 1. HP Rugged Notebook and HP Rugged Tablet PC environmental test criteria

Test name	Standard	Test description
Standalone unit		
Shock (Drop)	MIL-STD 810F, Method 516.5, Procedure IV, Modified	Unit is dropped from a height of 3 feet to 2 inches of plywood over concrete onto each face, edge, and corner (26 contact points). Unit is nonoperating; display is closed; media bay contains CD-ROM disk; up to 2 units may be used; room temperature is about 20°C (68°F). Unit is powered on after each drop to check functionality. Unit passes if there is no loss of program data, the unit meets the Water Resistance specifications, and the user can run applications.
Vibration I (nonoperating)	MIL-STD 810F, Method 514.5, Procedure I, Category 24	Unit is placed on a vibration table with display facing up and then is subjected to a series of 3 tests for each of 3 orientations (axes) for 60 minutes each: front to back, side to side, and up and down. Unit is nonoperating; room temperature is about 20°C (68°F). Unit is powered on after testing. Random profile is studied.
Vibration II (nonoperating)	MIL-STD 810F, Method 514.5, Procedure I, Category 24	Unit is placed on a vibration table with display facing up and then is subjected to a series of three tests for each of three orientations (axes). The random vibration test lasts for 60 minutes and the sinusoidal vibration test lasts for 30 minutes each per axis: front to back, side to side, and up and down. Unit is nonoperating; room temperature is about 20°C (68°F). Unit is powered on after testing. Sine profile is studied.
Vibration III (operating)	ASTM 4169-99 Truck Assurance Level II, Schedule E	Unit is subjected to vibration for a duration of 90 minutes. Unit is operating.
Humidity	MIL-STD 810F, Method 506.4, Procedure II, Time modified	Unit is placed in a humidity chamber for ten 24-hour cycles at 30°C at 85% relative humidity (RH) noncondensing and 60°C at 95% RH noncondensing. Unit is operating, accessing hard disk drive.
Water resistance	MIL-STD 810F, Method 506.4, Procedure II, Time modified	Unit is placed in a rain chamber that supplies simulated rain at a rate of no less than 4 inches per hour. Unit is tested for 10 minutes on each of 6 specific contact points with the display open. Unit is nonoperating.

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Test name	Standard	Test description
Dust and water	IEC 60529 IP-54	Unit is subjected to dust and then to water splashing. An IP number is assigned, specifying the environmental protection afforded by enclosures around electronic equipment. These ratings refer to specific tests. The IP number is made up of 2 digits, each signifying a separate component. For example, in the rating IP44 the first digit refers to the protection against solid objects such as dust, and the second digit refers to the protection against liquids. The higher the number, the better the protection. 1st digit: 5—Protected against dust, limited ingress (no harmful deposit) 2nd digit: 4—Protected against splashing water from all directions
High operating temperature	MIL-STD 810F, Method 501.4, Procedure II	Unit is placed in a thermal chamber to operate at +60°C for five 24-hour cycles. Unit is operating, running a script file from a DOS window to keep resources running at 100% load.
Low operating temperature	MIL-STD 810F, Method 502.4, Procedure II, Modified	Unit is placed in a thermal chamber at less than –23°C for one 24-hour cycle. Unit is operating, running a script file from a DOS window to keep resources running at 100% load.
Low start temperature	Twinhead PA STD Appendix 13	Unit is placed in a thermal chamber for 1 hour at 0°C, then powered up and the display checked for visibility and unit functionality, and then powered down, for a series of 5 power-up tests.
High storage temperature	MIL-STD 810F, Method 510.4, Procedure I	Unit is placed in a thermal chamber at 75°C for seven 24-hour cycles. Unit is nonoperating.
Low storage temperature	MIL-STD 810F, Method 502.4, Procedure 1	Unit is placed in a thermal chamber at –55°C for one 24-hour cycle. Unit is nonoperating.
Temperature shock	MIL-STD 810F, Method 503.4, Procedure 1	Unit is alternately placed in 2 thermal chambers, one at –55°C and the other at +75°C, for 4-hour periods with no more than 5 minutes taken to change to the other chamber. Unit is nonoperating.
Low pressure	MIL-STD 810F, Method 500.4, Procedure I, Procedure II modified	Procedure I: First, unit is placed in a vacuum chamber at room temperature and held at PSIG of 10,000 feet for 1 hour. Unit is nonoperating. Procedure II: Unit is then placed in a vacuum chamber at room temperature and brought to PSIG of 30,000 feet at a rate of up to 2,000 feet per minute. Unit is operating, accessing disk.

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Test name	Standard	Test description	
Mechanical life (for HP nr3600 Rugged Notebook)	HP internal	Unit mechanical components are moved (cycled) the number of times they are expected to perform in the 5-year life of a rugged product.	
		Display hinges	5,200 (times) per year
		Power	1,300 per year
		Battery pack	1,000 per year
		Hard drive connector	750 per year
		RJ-11 jack:	1,300 per year
		RJ-45 jack:	1,040 per year
		"D" connectors	1,040 per year
		USB port	1,040 per year
		Keyboard keys	100,000 per year
		Vehicle cradle	2,600 per year
		Antennae	5,200 per year
		Display harness	5,200 per year
		CTO connectors	2 per year
		EL keyboard panel	Maintain at least 2 units for 7,000 hours of use
		Touchscreen	Repeated writing of 100,000 characters at a specific pressure and stylus type
Mechanical life (for HP tr3000 Rugged Tablet PC)	HP internal	Unit mechanical components are moved (cycled) the number of times they are expected to perform in the five-year life of a rugged product.	
		Power	1,300 per year
		Battery pack	4 per year
		2nd battery pack	520 per year
		RJ-11 jack	1,300 per year
		USB port	1,040 per year
		Keys	500,000 per year
		Antenna	5,200 per year
		LCD with touchscreen	Repeated writing of 100,000 characters at a specific pressure and stylus type

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Test name	Standard	Test description
Bench handling	HP internal	Unit is dropped on each of the 4 edges of the base of the product on a typically used bench surface. Operating mode: Each edge is dropped 25 times at 10-second intervals, from a height of 7 cm. Nonoperating mode: Each edge is dropped 50 times at 10-second intervals, from a height of 10 cm.
Electrostatic discharge (ESD)	IEC 801-2, Contact discharge; 4kV and 8kV; air discharge: 15kV	Unit external contacts, connectors, and screws are subjected to 5 discharges per polarity per kV, first with no external power and second with external power, and then with peripherals. At ± 4kV: No noticeable effects At ± 8kV: No data or program loss; unit reboots, resets At ± 15kV: No component failure (hard error) Unit is operating, accessing disk.
Removable hard drive		
Handling while outside unit	Bench handling specification	Removable hard drive is checked after the drive is dropped onto a typical bench surface from a height of 5 cm, 25 times, with a time interval of 5 seconds between drops. Drive is tested while removed from unit and therefore is nonoperating.

Table 2. Additional HP nr3600 Rugged Notebook tests (unit in vehicle cradle)

Test name	Standard	Test description
Vehicle vibration (operating)	ASTM 4169-99 Truck Assurance Level II, Schedule E	Unit is subjected to vibration for 90 minutes across each of the 3 axes described in the earlier Vibration test. Unit is operating, accessing disk.
Vehicle vibration (contact continuity)	MIL-STD 810F, Method 514.5, Procedure I, Category 24	Unit is subjected to 2 tests across 3 axes: 1 hour per axis and 30 minutes per axis. Unit is nonoperating.
Vehicle shock (contact continuity)	SAE J1455 Pothole Shock (4.10.3.4)	Unit is mounted in a vehicle and subjected to a total of 18 shocks of a 20-millisecond duration, such as might be encountered by sudden acceleration, braking, or turning.
Vehicle crash	SAEJ1455, Crash Shock (4.10.2.4)	Unit is subjected to 4 lengthwise 30-mph vehicle crash simulations in each of 4 orientations for a force of 20G and duration of 120 milliseconds with one rebound.

Summary

As can be seen in the detailed test descriptions, HP testing standards provide for outstanding ruggedness verification. By conducting such rigorous qualification tests for its rugged systems, HP is driving industry standards to best ensure that the needs of this special class of customers are met.

For more information

http://www.hp.com

5982-5747EN, August 2004