

# Testing the business ruggedness and reliability of HP EliteBook Notebook PCs

2012 Business Notebook PC Models

Technical white paper

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## Executive summary

HP business notebooks are designed with reliability in mind, which is why all HP business notebooks undergo the HP Total Test Process consisting of over 115,000 hours of testing. Our comprehensive and proven testing program delivers superior quality and reliability and includes 50,000 test steps with 240 industry-standard hardware and software products tested for compatibility. The basic premise under the program lies in building a solid, more reliable business notebook; a better tool for your business. For instance, mechanical tests simulate opening and closing the notebook 10 times every day for 6 years (25,000 cycles), and 7 years of keyboard usage (10 million keystrokes). Functional testing ensures that our notebooks can stand up to rigorous work environments. Better reliability means less downtime and a lower cost of ownership.

HP EliteBook p-series Notebook PCs and w-series Mobile Workstations are designed to deliver even higher levels of quality and durability. These notebooks feature the following standard reliability features:

- Magnesium construction
- Precision aluminum-alloy hinges
- Cast titanium-alloy latches
- Spill-resistant keyboard with bottom-case drain
- HP 3D DriveGuard
- Optional Solid State Drives (SSDs)
- HP DuraFinish and HP DuraKeys
- DisplaySafe Frame
- Chemically strengthened glass touchpad

HP tests 2012 EliteBook p-series Notebook PC and w-series Mobile Workstation models to demonstrate that these notebooks can meet the same stringent military standards as many semi-rugged and even some fully-rugged notebooks. The HP notebooks were subjected to drop, shock, vibration, dust, humidity, altitude, high and low temperatures, and temperature shock.

The testing was based on MIL-STD-810G, the Department of Defense (DoD) Test Method Standard for Environmental Engineering Considerations and Laboratory Tests. This standard, though created specifically for DoD, is widely used for commercial applications. It outlines a broad range of tests that can be tailored to measure the reliability of specific pieces of equipment.

## Tested models

- 2012 HP EliteBook p series
  - HP EliteBook 8470p Notebook PC
  - HP EliteBook 8570p Notebook PC
- 2012 HP EliteBook w series
  - HP EliteBook 8470w Mobile Workstation

## Test Results

Table 1 summarizes the 3<sup>rd</sup> party test results<sup>1</sup> of testing that used MIL-STD-810G test methods to evaluate the reliability of HP EliteBook Notebook PC models under a specific set of environmental conditions.

**Table 1.** Results Summary

Test	EliteBook 8470p	EliteBook 8570p	EliteBook 8470w
Vibration	Pass	Pass	Pass
High Temp	Pass	Pass	Pass
Low Temp	Pass	Pass	Pass
Temperature Shock	Pass	Pass	Pass
Dust	Pass	Pass	Pass
Altitude	Pass	Pass	Pass
Drop	Pass	Pass	Pass
Shock	Pass	Pass	Pass
Humidity	Pass	Pass	Pass

## Background

Created by the U.S. government, the MIL-STD-810G test method standard is intended to help organizations prepare environmental tests to evaluate how well a particular piece of equipment will survive in the field. The standard outlines **dozens** of test methods, each associated with a source of environment stress, such as vibration, moisture, dust, extreme temperatures, or humidity; for example, Method 500.5 describes Low Pressure (Altitude) testing, while Method 501.5 describes High Temperature testing. While there is not a recommended or required list of tests for device categories, most major notebook vendors generally perform between 5 and 8 test methods.

Each test method outlines multiple test procedures; for example, Method 501.5 describes Procedure I (Storage) and Procedure II (Operation). Thus, Procedure I can be used to evaluate the effects of high temperature storage on the subsequent performance of a notebook PC; Procedure II evaluates the effects of high temperature while the notebook is running.

To tailor MIL-STD-810G so that you can assess the durability of a notebook PC, you must first identify the environmental challenges faced by notebook users in the field. For example, the notebook may be dropped from a desk; it may be used in a moving vehicle or a harsh outdoor work environment; or it may be stored in an unheated building or in a car trunk during seasonal temperature extremes.

Based on these environmental stressors, you can select appropriate test methods from the menu provided by MIL-STD-810G. You then choose which of the procedures described by each test method you wish to run. Finally, using requirements and guidelines provided by MIL-STD-810G, you complete

the tailoring process by identifying appropriate parameter levels along with applicable test conditions and techniques for each selected procedure. <sup>1</sup>

## Test Scenarios

A third party facility tested the durability of the HP EliteBook p-series Notebook PC and w-series Mobile Workstation models using procedures tailored from MIL-STD-810G. HP used the MIL-STD-810G test menu to select tests that most closely reflect the challenges faced by today's mobile professionals. The grueling tests passed by the business-rugged EliteBook models are listed below.

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### Note

This testing was not intended to demonstrate the fitness of EliteBook p-series Notebook PC and w-series Mobile Workstation models for military use. Test results are not a guarantee of future performance under these environmental conditions.

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The following sections describe the grueling test scenarios to which these business-rugged notebooks were subjected. All testing was performed by a 3<sup>rd</sup> party testing facility.

### Vibration test

The Vibration Resistance test was performed in accordance with MIL-STD-810G Test Method 514.6, Procedure I (Non-operational) and Procedure II (Operational). Test parameters were set to simulate the following:

- Operate the notebook during a 1000-mile simulation of vibrations created by a truck driving on a U.S. highway.
- Operate the notebook after it has been subjected to higher levels of vibration while in storage.

Terrain, road and surface discontinuities, vehicle speed, loading, structural characteristics, and suspension system are all reflected in this simulation.

### Dust test

The Dust Resistance test was performed in accordance with MIL-STD-810G, Method 510.5, Procedure I (Dust). Test parameters were set so that the notebook was dusted with Arizona Road Dust for six (6) hours while being operated.

### Humidity test

The Humidity test was performed in accordance with MIL-STD-810G, Method 507.5, Procedure II with the aggravated temperature-humidity cycle. Each cycle was one day (24 hours); ten cycles with the temperature being cycled between 30°C (86°F) and 60°C (140°F); and relative humidity was a constant 95%.

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<sup>1</sup> Testing was performed by National Technical Systems in March of 2012. This testing was not intended to demonstrate the fitness of EliteBook p-series Notebook PC and w-series Mobile Workstation models for military use. Test results are not a guarantee of future performance under these environmental conditions.

## Altitude test

The Altitude test was performed in accordance with MIL-STD-810G, Method 500.5, Procedure I (Storage) and II (Operation). The altitude level simulated for both procedures was 15,000 feet (the highest equivalent altitude given within MIL-STD-810G for cargo pressures within military aircraft).

## High Temperature test

The High Temperature test was performed in accordance with MIL-STD-810G, Method 501.5, Procedure I (Storage) and II (Operation). This test evaluated the notebook's performance while it was being exposed to high temperature conditions: 60°C (140°F) operational and 71°C (160°F) nonoperational.

## Low Temperature test

The Low Temperature test was performed in accordance with MIL-STD-810G, Method 502.5, Procedure I (Storage) and II (Operation). This test evaluated the notebook's performance while it was being exposed to low temperature conditions: -29°C (-20°F) operational and -51°C (-60°F) nonoperational.

## Thermal Shock test

The Thermal Shock test was performed in accordance with MIL-STD-810G, Method 503.5 procedure I. The objective of this test was to determine whether the notebook could be safely operated after being exposed to sudden changes in ambient temperature while non-operational. The high temperature was set to be 96°C (205°F) and the low temperature to be -51°C (-60°F); three high-to-low cycles were performed.

## Drop test

The Drop test was performed in accordance with MIL-STD-810G, Method 516.6 Procedure IV. The objective of this test was to determine whether the notebook could be safely operated after being dropped from desk height. 26 drops were performed from 30" onto every side, angle and edge onto 2" of plywood over steel over concrete.

## Shock test

The Shock test was performed in accordance with MIL-STD-810G, Method 516.6 Procedure I. The objective of this test was to determine whether the notebook could be safely operated after being exposed to sudden physical shock events while operational. 3 shocks were performed across each axis and direction for a total of 18 shocks.

## Pass/fail criterion

The 3<sup>rd</sup> party verified that the tested notebook was operational after each environmental exposure by booting the Microsoft® Windows® operating environment.

# Test Descriptions

Table 2 provides more information on the tests performed.

**Table 2.** Tests performed with specific MIL-STD-810G method references and key test parameters

Test	MIL-STD-810G Reference	Key Test Parameters	
Vibration	Method 514.6	Procedure I, Category 24 (Minimum Integrity Test)	Non-operational 0.04 g <sub>2</sub> /Hz at 20-1000 Hz, -6 dB/octave at 1000-2000 Hz One hour/axis duration
		Procedure I, Category 4 (Ground Vehicle)	Operational U.S. highway truck exposure -- 1000 mile Simulation One hour/axis duration
Dust Resistance	Method 510.5	Procedure I (Blowing dust)	Particles of Arizona Road Dust, 10.6 +/-7 grams per cubic foot Six hours duration
Humidity	Method 507.5	Procedure II Aggravated temperature-humidity cycle	Relative humidity 95% Temperature cycled between 86oF and 140oF Test cycle 24 hours; test consisted of ten cycles
Altitude	Method 500.5	Procedure I (Storage/air transport)	Non-operational 15,000 feet at 57 kPa One hour duration
		Procedure II (Operation/air carriage)	Operational 15,000 feet at 57 kPa One hour duration
High Temperature	Method 501.5	Procedure I (Storage)	Non-operational Temperature cycled between 95o and 160oF. Test cycle 24 hours; test consisted of seven cycles
		Procedure II (Operation)	Operational 140oF Four hours duration
Low Temperature	Method 502.5	Procedure I (Storage)	Non-operational -60oF - Four hours duration
		Procedure II (Operation)	Operational -20oF - Four hours duration
Temperature Shock	Method 503.5	Procedure I (Steady State)	High non-op temperature 205oF Low non-op temperature -60oF 3 cycles (a cycle consists of a dwell low, low to high, dwell high, high to low) 60 minutes dwell time
Drop	Method 516.6	Procedure IV	26 drops from 30" onto every side, angle and edge onto 2" of plywood over steel over concrete
Shock	Method 516.6	Procedure V	3 shocks/axis/direction for a total of 18 shocks – 40 Gs peak, 11 ms, 3 pulses

## For more information

To learn more about HP business notebooks and desktops, contact your local HP sales representative or visit [www.hp.com](http://www.hp.com).

The MIL-STD-810G test specification can be accessed at <http://www.dtc.army.mil/publications/MIL-STD-810G.pdf>.



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4AA2-xxxxENW, Created April 2012

