

# Testing the business ruggedness and reliability of HP Business PCs



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# Commitment to Quality

A product is only as great as its quality. And quality built into the overall product design requires more than just a mix of technologies, best practices, and high standards; it requires a mindset that understands that each design detail is as important as the next, each potentially a spark of quality innovation.

At HP, we make a quality commitment and stand by it. We follow through with our promises. We believe that we can always do it better—and then we do. And that belief pushes our quality standards ever higher.

Quality delivers a higher return on investment to our customers. We want them to be happy with their product throughout its lifecycle.

## We care about quality—it's in our DNA

At HP, we believe quality matters. Quality is core to HP's legacy. HP's strong focus on quality design and engineering innovations dates back to its early beginnings with Bill Hewlett and Dave Packard.

Quality is foremost at every stage of HP's product development process. From the earliest design stage through product testing, manufacturing, service and support, and eventual end-of-life, we remain alert for new opportunities to improve our products, services, and customer relationships.

## Striking a perfect balance

Our goal is to make our products the highest possible quality with the lowest total cost of ownership. We are focused on enhancing our customers' experience with products that deliver the best price, features set, and value proposition. The HP Business PC portfolio gives customers that perfect balance of cost efficiency, reliability, durability, and innovative design.

Quality is built into every product as a design requirement. HP Business PCs are designed to meet the demands of leading businesses. Built from high-quality materials and backed by legendary HP reliability, these stylish and sturdy devices are powerful yet simple to use.

## Performance you can trust

As part of the design process, all HP Elite and Pro Business PCs undergo the HP Total Test Process (TTP)<sup>1</sup> — an exhaustive series of rigorous tests and validation procedures that demonstrate superior quality and reliability in a wide range of applications and operating environments. To help make our business PCs more robust and a more dependable tool for our customers' evolving business needs, our testing process is constantly reviewed and enhanced.

The HP Total Test Process is an outgrowth of the longstanding HP commitment to quality. That's why we go to extreme measures to build high reliability into every HP Business Desktop and Notebook PC.

Our comprehensive and proven testing program consists of a minimum of 120,000 hours of rigorous multi-tiered testing and validation procedures per computing platform. The program, driven by rigid quality specifications and standards, includes 50,000 test steps, with 240 industry-standard hardware and software products tested for compatibility.

Pre-launch HP Business PCs are exposed to rigorous conditions including harsh drops and vibration, high temperatures, and enduring mechanical and functional tests that simulate rough handling over the life of the product. Strong reliability can mean less downtime and a lower cost of ownership.

Knowledge gained through the HP Total Test Process leads to many innovations that allow HP Business Desktop and Notebook PCs to deliver an enhanced computing experience. Customers can rely on HP Business PCs to help them perform at their very best when their most demanding work is on the line.

## World-class design

First impressions are important, as they set the expectations for the rest of the user experience. HP design engineers excel at designing that very important first experience. Clean implementation of innovative PC technologies starts with a holistic design approach to quality. Design engineers work in conjunction with the manufacturing engineers to optimize the design for production in a way that upholds extremely high quality.

Any given HP Business PC design will go through multiple small builds to fine-tune the design for optimal quality and manufacturability before the design is finalized. HP Business PCs are subject to multiple design enhancements prior to our first-production build, resulting in a final design that is as elegantly built as was originally envisioned by the design engineer.

HP's attractive enterprise-class industrial designs, which combine innovation with style, use high-quality materials and flawless finishes. HP's leading-edge chassis construction, component accessibility, electrical and air flow designs elevate the customer experience with product quality and reliability.

## Going above and beyond

After careful material selection and precision-engineered construction, HP Business PCs are put to the test. Our MIL-STD-810G testing<sup>2</sup> procedures go above and beyond what a PC may endure on a typical day in business and enterprise environments. This testing helps to demonstrate overall HP product quality and reliability.

# HP Business PC models tested

All HP Elite notebooks, tablets, and desktop PCs undergo multiple MIL-STD-810G test procedures as a way to help demonstrate product quality and reliability. This standard, though created specifically for the U.S. Department of Defense (DoD), is widely used as a benchmark for quality for commercial products in multiple industries. It outlines a broad range of tests that can be tailored to measure the reliability of specific pieces of equipment and includes multi-tiered climatic and environmental test methods.<sup>2</sup>

The products identified below have all undergone multiple MIL-STD-810G testing procedures.

## 2-in-1 Detachable Notebook PCs

### High-performance tablet

- HP Pro x2 612 G1
- HP Elite x2 1011 G1
- HP Elite x2 1012 G1
- HP Elite x2 1012 G1 Travel Keyboard
- HP Elite x2 1012 G1 Advanced Keyboard

### 3-in-1 Device

- HP Elite x3 G1

## Convertible Notebook PCs

### Ultra-slim convertible laptop with 360° hinge

- HP x360 310 G2
- HP Spectre Pro x360 G2

### Ultra-thin EliteBook that converts to a tablet

- HP EliteBook Revolve 810 G2
- HP EliteBook Revolve 810 G3

## HP ElitePad Tablets

### The true tablet for business

- HP ElitePad 1000 G2
- HP ElitePad 1000 G2 Healthcare Jacket
- HP ElitePad 1000 G2 Rugged Tablet

## HP EliteBook Notebook PCs

### Thin and light enterprise-class design

- HP EliteBook 725/745/755 G2
- HP EliteBook 725/745/755 G3
- HP EliteBook 820/840/850 G1
- HP EliteBook 820/840/850 G2
- HP EliteBook 820/840/850 G3
- HP EliteBook Folio G1
- HP EliteBook Folio 1020 G1 and 1020 G1 SE
- HP EliteBook Folio 1020 G2
- HP EliteBook Folio 1030 G1
- HP EliteBook Folio 1040 G1, G2
- HP EliteBook 1040 G3
- HP EliteBook Folio 9480m

## HP ProBook Notebook PCs

### Thin, light and packed with productivity features

HP ProBook 430/440/450/455/470 G4  
HP ProBook 430/440/450/455/470 G3  
HP ProBook 640/645/650/655 G1  
HP ProBook 640/650/645/655 G2  
HP ProBook 11 G2 EE

## HP ChromeBooks

HP ChromeBook 11 G4 EE

## HP Mobile Workstations

### HP's thinnest and lightest mobile workstations

HP ZBook 14 G2  
HP ZBook 15u G2, G3  
HP ZBook 15 G2, G3  
HP ZBook 17 G2, G3  
HP ZBook Studio G3

## HP EliteDesk Business PCs

### Performance, flexibility and security desired by business PC users

HP EliteDesk 800 G2 TWR  
HP EliteDesk 800 G2 SFF  
HP EliteDesk 800 G2 DM  
HP EliteDesk 705 G2 MT  
HP EliteDesk 705 G2 SFF  
HP EliteDesk 705 G2 DM

## HP EliteOne All-in-One Business PCs

### Enterprise-class space-saving performers that are as reliable as they are stylish

HP EliteOne 800 G2 AiO  
HP EliteOne 705 G2 AiO

# Test results

The following tables summarize independent third-party test of HP Business PC models based on MIL-STD-810G test methods.<sup>2</sup>

The conditions or specifications outlined in each of the MIL-STD-810G test methods are not covered under the HP Limited Warranty.

## 2-in-1 Detachable Notebook PCs

## 3-in-1 Device

| Test                       | Pro x2<br>612 G1 | Elite x2<br>1011 G1 | Elite x2<br>1012 G1 | Elite x2<br>1012 G1 Travel KB | Elite x2<br>1012 G1 Adv KB | Elite x3 |
|----------------------------|------------------|---------------------|---------------------|-------------------------------|----------------------------|----------|
| Drop                       | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Functional Shock           | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Vibration<br>(Category 4)  | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Vibration<br>(Category 24) | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Dust                       | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Humidity                   | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Altitude                   | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| High Temperature           | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Low Temperature            | PASSED           | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Temperature Shock          | NO               | PASSED              | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Sand                       | NO               | NO                  | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Explosive Atmosphere       | NOT TESTED       | NOT TESTED          | PASSED              | PASSED                        | PASSED                     | PASSED   |
| Freeze/Thaw                | NO               | NO                  | PASSED              | PASSED                        | PASSED                     | PASSED   |

## Convertible Notebook PCs

| Test                    | Spectre Pro x360 G2 | x360 310 G2 | EliteBook Revolve 810 G2/ G3 |
|-------------------------|---------------------|-------------|------------------------------|
| Drop                    | PASSED              | PASSED      | PASSED                       |
| Functional Shock        | PASSED              | PASSED      | PASSED                       |
| Vibration (Category 4)  | PASSED              | PASSED      | PASSED                       |
| Vibration (Category 24) | PASSED              | PASSED      | PASSED                       |
| Dust                    | PASSED              | PASSED      | PASSED                       |
| Humidity                | PASSED              | PASSED      | PASSED                       |
| Altitude                | PASSED              | PASSED      | PASSED                       |
| High Temperature        | PASSED              | PASSED      | PASSED                       |
| Low Temperature         | PASSED              | PASSED      | PASSED                       |
| Temperature Shock       | PASSED              | PASSED      | PASSED                       |

## HP ElitePad Tablets

| Test                    | ElitePad 1000 G2 | ElitePad 1000 G2 Healthcare Jacket       | ElitePad 1000 G2 Rugged Tablet          |
|-------------------------|------------------|--|---|
| Drop                    | PASSED           | PASSED<br>Also passed 36" (91.4 cm) drop | PASSED<br>Also passed 72" (183 cm) drop |
| Functional Shock        | PASSED           | PASSED                                   | PASSED                                  |
| Vibration (Category 4)  | PASSED           | PASSED                                   | PASSED                                  |
| Vibration (Category 24) | PASSED           | PASSED                                   | PASSED                                  |
| Dust                    | PASSED           | PASSED                                   | PASSED                                  |
| Humidity                | PASSED           | PASSED                                   | PASSED                                  |
| Altitude                | PASSED           | PASSED                                   | PASSED                                  |
| High Temperature        | PASSED           | PASSED                                   | PASSED                                  |
| Low Temperature         | PASSED           | PASSED                                   | PASSED                                  |
| Temperature Shock       | PASSED           | PASSED                                   | PASSED                                  |

## HP EliteBook Notebook PCs

| Test                    | EliteBook 725/745/755 G2 | EliteBook 725/745/755 G3 | EliteBook 820/840/850 G1                    | EliteBook 820/840/850 G2 | EliteBook 820/840/850 G3 |
|-------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|
| Drop                    | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Functional Shock        | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Vibration (Category 4)  | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Vibration (Category 24) | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Dust                    | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Humidity                | PASSED                   | PASSED                   | 820 G1 PASSED<br>840 G1 PASSED<br>850 G1 NO | PASSED                   | PASSED                   |
| Altitude                | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| High Temperature        | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Low Temperature         | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Temperature Shock       | PASSED                   | PASSED                   | PASSED                                      | PASSED                   | PASSED                   |
| Sand                    |                          | PASSED                   |   |                          | PASSED                   |
| Explosive Atmosphere    |                          | PASSED                   |   |                          | PASSED                   |
| Freeze/Thaw             |                          | PASSED                   |   |                          | PASSED                   |

| Test                    | EliteBook Folio G1 | EliteBook 1020 G1 and 1020 G1 LE | EliteBook 1030 G1 | EliteBook 1040 G2 | EliteBook 1040 G3 | EliteBook Revolve 810 G3 |
|-------------------------|--------------------|----------------------------------|-------------------|-------------------|-------------------|--------------------------|
| Drop                    | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Functional Shock        | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Vibration (Category 4)  | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Vibration (Category 24) | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Dust                    | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Humidity                | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Altitude                | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| High Temperature        | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Low Temperature         | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Temperature Shock       | PASSED             | PASSED                           | PASSED            | PASSED            | PASSED            | PASSED                   |
| Sand                    | PASSED             | NO                               | PASSED            | PASSED            | PASSED            | NO                       |
| Explosive Atmosphere    | PASSED             | PASSED                           | PASSED            |                   |                   |                          |
| Freeze/Thaw             | PASSED             | NO                               | PASSED            | PASSED            | PASSED            | NO                       |



## HP ProBook Notebook PCs

| Test                       | ProBook<br>430/440/450/<br>455/470 G4 | ProBook<br>430/440/450/<br>455/470 G3 | ProBook<br>640/645/650/<br>655 G1 | ProBook<br>640/645/650/<br>655 G2 | ProBook<br>11 G2 EE |
|----------------------------|---------------------------------------|---------------------------------------|-----------------------------------|-----------------------------------|---------------------|
| Drop                       | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Functional Shock           | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Vibration (Category 4)     | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Vibration<br>(Category 24) | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Dust                       | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Humidity                   | PASSED                                | PASSED                                | 655 NO<br>ALL OTHERS<br>PASSED    | PASSED                            | PASSED              |
| Altitude                   | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| High Temperature           | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |
| Low Temperature            | PASSED                                | PASSED                                | 655 NO<br>ALL OTHERS<br>PASSED    | PASSED                            | PASSED              |
| Temperature Shock          | PASSED                                | PASSED                                | PASSED                            | PASSED                            | PASSED              |

## HP ChromeBooks

| Chromebook<br>11 G4 EE |
|------------------------|
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |
| PASSED                 |

## HP Mobile Workstations

| Test                    | ZBook 14 G2 | ZBook 15u G2 | ZBook 15 G2 | ZBook 17 G2 |
|-------------------------|-------------|--------------|-------------|-------------|
| Drop                    | PASSED      | PASSED       | PASSED      | PASSED      |
| Functional Shock        | PASSED      | PASSED       | PASSED      | PASSED      |
| Vibration (Category 4)  | PASSED      | PASSED       | PASSED      | PASSED      |
| Vibration (Category 24) | PASSED      | PASSED       | PASSED      | PASSED      |
| Dust                    | PASSED      | PASSED       | PASSED      | PASSED      |
| Humidity                | PASSED      | PASSED       | PASSED      | PASSED      |
| Altitude                | PASSED      | PASSED       | PASSED      | PASSED      |
| High Temperature        | PASSED      | PASSED       | PASSED      | PASSED      |
| Low Temperature         | PASSED      | PASSED       | PASSED      | PASSED      |
| Temperature Shock       | PASSED      | PASSED       | PASSED      | PASSED      |

| Test                    | ZBook 15u G3 | ZBook 15 G3 | ZBook 17 G3 | ZBook Studio G3 |
|-------------------------|--------------|-------------|-------------|-----------------|
| Drop                    | PASSED       | PASSED      | PASSED      | PASSED          |
| Functional Shock        | PASSED       | PASSED      | PASSED      | PASSED          |
| Vibration (Category 4)  | PASSED       | PASSED      | PASSED      | PASSED          |
| Vibration (Category 24) | PASSED       | PASSED      | PASSED      | PASSED          |
| Dust                    | PASSED       | PASSED      | PASSED      | PASSED          |
| Humidity                | PASSED       | PASSED      | PASSED      | PASSED          |
| Altitude                | PASSED       | PASSED      | PASSED      | PASSED          |
| High Temperature        | PASSED       | PASSED      | PASSED      | PASSED          |
| Low Temperature         | PASSED       | PASSED      | PASSED      | PASSED          |
| Temperature Shock       | PASSED       | PASSED      | PASSED      | PASSED          |
| Sand                    | PASSED       | PASSED      | PASSED      | PASSED          |
| Explosive Atmosphere    | PASSED       | PASSED      | PASSED      | PASSED          |
| Freeze/Thaw             | PASSED       | PASSED      | PASSED      | PASSED          |
| Crash Hazard Shock      | PASSED       | PASSED      | PASSED      | PASSED          |
| Bench Handling          | PASSED       | PASSED      | PASSED      | PASSED          |

## HP EliteDesk Business PCs

| Test              | EliteDesk 800 G2 TWR | EliteDesk 800 G2 SFF | EliteDesk 800 G2 DM | EliteDesk 705 G2 DM | EliteDesk 705 G2 MT | EliteDesk 705 G2 SFF |
|-------------------|----------------------|----------------------|---------------------|---------------------|---------------------|----------------------|
| Blowing Dust      | PASSED               | PASSED               | PASSED              | PASSED              | PASSED              | PASSED               |
| Altitude          | PASSED               | PASSED               | PASSED              | PASSED              | PASSED              | PASSED               |
| High Temperature  | PASSED               | PASSED               | PASSED              | PASSED              | PASSED              | PASSED               |
| Low Temperature   | PASSED               | PASSED               | PASSED              | PASSED              | PASSED              | PASSED               |
| Temperature Shock | PASSED               | PASSED               | PASSED              | PASSED              | PASSED              | PASSED               |

## HP EliteOne All-in-One Business PCs

| Test              | EliteOne 800 G2 AiO | EliteOne 705 G2 AiO |
|-------------------|---------------------|---------------------|
| Blowing Dust      | PASSED              | PASSED              |
| Altitude          | PASSED              | PASSED              |
| High Temperature  | PASSED              | PASSED              |
| Low Temperature   | PASSED              | PASSED              |
| Temperature Shock | PASSED              | PASSED              |

# MIL-STD-810G test 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 can perform 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 PC 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 business PC; Procedure II evaluates the effects of high temperature while the PC is running.

## Test scenarios

A third-party facility tested the durability of the HP Business PC 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 professionals.

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### Note

MIL-STD-810G testing is conducted on select HP products. Testing is not intended to demonstrate fitness for U.S. Department of Defense (DoD) contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage or damage under these test conditions requires an optional HP Accidental Damage Protection Care Pack.

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The following sections describe the grueling test scenarios to which these business-rugged PCs were subjected. All testing was performed by a third-party testing facility.

### Drop test<sup>2</sup>

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 unit could be safely operated after being dropped from desk height. For this test, 26 drops were performed from 30 in. onto every side, angle and edge onto 2 in. of plywood over steel over concrete. Unit is powered down and checked for operation.

### Functional Shock test<sup>2</sup>

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 unit could be safely operated after being exposed to sudden physical shock events while operational. For this test, 3 shocks were performed across each axis and direction for a total of 18 shocks.

## Vibration test<sup>2</sup>

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 unit during a 1000-mile simulation of vibrations created by a truck driving on a U.S. highway.
- Operate the unit 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<sup>2</sup>

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 unit was dusted with Arizona Road Dust for six hours while being operated.

## Humidity test<sup>2</sup>

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%.

## Altitude test<sup>2</sup>

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<sup>2</sup>

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 units' performance while it was being exposed to high temperature conditions: 60°C (140°F) operational and 71°C (160°F) non-operational.

## Low Temperature test<sup>2</sup>

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 unit's performance while it was being exposed to low temperature conditions: -29°C (-20°F) operational and -51°C (-60°F) non-operational.

## Temperature Shock test<sup>2</sup>

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 unit 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.

## Sand test<sup>2</sup>

The Sand test was performed in accordance with MIL-STD-810G, Method 510.4 Procedure II. The objective of this test was to determine whether the unit could be safely operated after being exposed to blowing sand of up to 20M/S at a temperature of 60°C (140°F) for 4.5 hours (every 90 minutes, the unit is rotated 90°).

## Explosive Atmosphere test<sup>2</sup>

The Shock test was performed in accordance with MIL-STD-810G, Method 511.5 Procedure I. The objective of this test was to determine whether the notebook could be safely operated in fuel-air explosive atmospheres without causing ignition.

## Freeze/Thaw test<sup>2</sup>

The Freeze/Thaw test was performed in accordance with MIL-STD-810G, Method 524.54 Procedure III. The objective of this test was to determine whether the unit could be safely operated after being exposed to a temperature drop of -10°C (14°F) for two hours. Unit is removed and checked for operation.

## Bench Handling test<sup>2</sup>

The bench handling test was performed in accordance to the MIL-STD-810G, Method 516.6 Procedure VI. This test was designed to test whether the unit can withstand levels of shock resulting from bench handling, bench maintenance, and/or packaging.

## Crash Hazard test<sup>2</sup>

The crash hazard test was performed in accordance to the MIL-STD-810G, Method 516.5 Procedure V. The purpose of this test was to ensure that the ZBook does not eject sub-elements and that its restraining devices will not fail during crash situations.

### ESD (Electrostatic Discharge) test<sup>2</sup>

The ESD test was performed in accordance with IEC 61000-4-2. The objective of this test was to determine whether the unit could be safely operated after being exposed to sudden electrostatic discharge events of up to 8,000 volts. Electrostatic discharge points were performed at horizontal and vertical ground planes, chassis screw, serial port ground, screen, finger pad, power cable, power button, keyboard, speaker button, and trackball for a total of 11 discharge points.

### Pass/fail criterion

The third-party verified that the tested unit was operational after each environmental exposure by booting the Microsoft® Windows® operating environment.

### Test descriptions

The following table includes the 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)<br>Procedure I, Category 4 (Ground Vehicle) | Non-operational 0.04 g <sup>2</sup> /Hz at 20-1000 Hz, -6 dB/octave at 1000-2000 Hz; One hour/axis duration<br>Operational U.S. highway truck exposure 1000 mile Simulation<br>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<br>Six hours duration  |
| Humidity             | Method 507.5           | Procedure II  | Relative humidity 95%; Temperature cycled between 30°C and 60°C (86°F and 140°F); Test cycle 24 hours; test consisted of ten cycles   |
| Altitude             | Method 500.5           | Procedure I (Storage/air transport)<br>Procedure II (Operation/air carriage)                  | Non-operational 15,000 feet at 57 kPa<br>One hour duration<br>Operational 15,000 feet at 57 kPa<br>One hour duration  |
| High Temperature     | Method 501.5           | Procedure I (Storage)<br><br>Procedure II (Operation)   | Non-operational<br>Temperature cycled between 35°C and 71°C (95°F and 160°F)<br>Test cycle 24 hours; test consisted of seven cycles<br>Operational 60°C (140°F)<br>Four hours duration                |
| Low Temperature      | Method 502.5           | Procedure I (Storage)<br><br>Procedure II (Operation)   | Non-operational -51°C (-60°F)<br>Four hours duration<br>Operational -29°C (-20°F)<br>Four hours duration  |
| Temperature Shock    | Method 503.5           | Procedure I (Steady State)  | Non-operational<br>High temperature -132°C (-205°F)<br>Low temperature -51°C (-60°F); Three cycles (a cycle consists of a dwell low, low to high, dwell high, high to low)<br>One hour dwell time     |
| Shock                | Method 516.6           | Procedure V   | Operational<br>3 shocks/axis/direction for a total of 18 shocks; 40 Gs peak, 11 ms  |
| Drop                 | Method 516.6           | Procedure IV  | 26 drops from 30 in. onto every side, angle and edge onto 2 in. of plywood over steel over concrete.<br>Unit is powered down and checked for operation.   |
| Explosive Atmosphere | Method 511.5           | Procedure I   | Unit could be safely operated in fuel-air explosive atmospheres without causing ignition  |
| Freeze/Thaw          | Method 524.54          | Procedure III   | Non-operational<br>Exposed to a temperature drop of -10°C (14°F) for two hours.<br>Unit is removed and checked for operation.   |

| Test           | MIL-STD-810G Reference | Key Test Parameters |  |
|----------------|------------------------|---------------------|--|
| Crash Hazard   | Method 516.5           | Procedure V         | Non Operational 2 shocks in each axis/direction for a total of 12 shocks; 75 Gs peak 6 ms  |
| Bench Handling | Method 516.6           | Procedure IV        | 16 drops from 4 inches on a wooden bench top on all sides, edges and corners that could be impacted during normal handling or during maintenance |

## ESD test descriptions

The following table includes the specific test parameters for the Electrostatic Discharge test.

| Test                          | Reference   | Key Test Parameter  |
|-------------------------------|-------------|---|
| ESD (Electrostatic Discharge) | IEC 6100-42 | Temperature: 23°C (73°F)<br>Humidity 39%<br>Between 6 to 8,000 Volts applied to: <ul style="list-style-type: none"> <li>• Horizontal Ground Plane</li> <li>• Vertical Ground Plane</li> <li>• Chassis Screw</li> <li>• Serial Port Ground</li> <li>• Screen</li> <li>• Fingerprint</li> <li>• Power Cable</li> <li>• Power Button</li> <li>• Keyboard</li> <li>• Speaker B</li> </ul> |

The MIL-STD-810G test specification can be accessed at [at.ec.army.mil/publications/Mil-Std-810G/Mil-Std-810G.pdf](http://at.ec.army.mil/publications/Mil-Std-810G/Mil-Std-810G.pdf).

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<sup>1</sup> HP's Total Test Process is not a guarantee of future performance under these test conditions. Accidental Damage or damage under these test conditions requires an optional HP Accidental Damage Protection Care Pack.  
<sup>2</sup> MIL STD 810G testing is conducted on select HP products. Testing is not intended to demonstrate fitness for U.S. Department of Defense (DoD) contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage or damage under these test conditions requires an optional HP Accidental Damage Protection Care Pack.

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