

When is a Notebook Tough Enough?

The definition of “fully rugged” extends beyond MIL Spec standards

Requirements for rugged notebooks have expanded well beyond surviving extreme environmental conditions like drops, dust, humidity and spills. IT managers expect rugged systems to provide additional hardening for anything that’s a “weak link” in commercial versions. To meet a fully rugged designation, notebooks must also overcome non-physical conditions that could impair field operations, which means ensuring robust communications, security and usability features, just to name a few.

As materials and computer technologies evolve, so does the definition of fully rugged. New technologies are enabling faster and more capable systems that military personnel, field service workers and first responders can count on. This white paper explores some of the new technologies that are extending the capabilities of fully rugged notebooks.

Rugged Specifications

For many people, rugged means a device can take a beating and still work. Going well beyond this operational definition, two U.S. government standards offer detailed test specifications:

- MIL STD 810 (or MIL-SPEC)
- IPXX (ingress protection) for dust and water protection

Supplemented with other standards, they represent a comprehensive set of tests, some of which are listed in Table 1. For a given test method, like watertight, there can be multiple specifications, as shown in Table 2. These specifications define different test conditions that govern how equipment under test is subjected to water with respect to volume, duration and water velocity. There are even two different procedures within the same subcategory MIL STD 506.4, which illustrates why it's neither practical nor economical for a vendor to evaluate each and every test condition.

Rugged Technologies

Fully rugged notebooks are designed to handle much more punishment than consumer notebooks, using special materials and sealants that mitigate the impact of extreme environmental conditions. For example, designing a notebook that can withstand huge spikes of energy (drop) as well as subtle energies (vibration) usually requires two distinct materials technologies: a super spongy material that prevents damage from a 10-meter drop and a rigid material to protect against vibration.

Fully rugged systems have lower failure rates than commercial versions because they employ advanced materials and higher reliability components, including:

- **Shock Protection:** Special shock-absorption materials, such as ISODAMP* from E-A-R Specialty Composites, provides shock protection for displays and hard disk drives (HDDs).
- **Reliable Storage:** The trend is to replace HDDs with solid-state drives, which have lower power dissipation, higher reliability and no moving parts.
- **Robust Case:** Magnesium alloy cases are exceptionally impact-resistant and about 20 times stronger than commercial laptop cases made from ABS (acrylonitrile butadiene styrene) plastic.
- **Lighter Frame Materials:** "Various companies are experimenting with carbon fiber, which is used these days for high-end racing bicycles and other applications where both weight and strength are critical," says Roger Kay, president of Endpoint Technologies Associates and rugged subject matter expert.¹

Table 1. Rugged test examples

Test	Conditions
MIL STD 810 Temperature	<ul style="list-style-type: none"> • Operating: -4° to 140°F (-23° to 60°C) • Non-Operating: -67° to 167°F (-55° to 75°C)
MIL STD 810 Vibration	<ul style="list-style-type: none"> • Random and sinusoidal
MIL STD 810 Drop	<ul style="list-style-type: none"> • 26 drops from 3 feet (91.4 centimeters)
MIL STD 810 Humidity	<ul style="list-style-type: none"> • Operating: 60° C @ 95% relative humidity (RH) non-condensing • Non-Operating: 75° C @ 5% to 90% RH
MIL STD 810 Altitude	<ul style="list-style-type: none"> • Operating: 0 to 10,000 ft (3,048 m) • Non-Operating: 0 to 30,000 ft (9,144 m)
MIL STD 810 Water Resistance	<ul style="list-style-type: none"> • Procedure II watertightness
ANSI/IEC 529 Ingress Protection	<ul style="list-style-type: none"> • IP5x Dust • IPx4 Water
UL1604 Hazardous Location	<ul style="list-style-type: none"> • Class 1, Division 2, Group A, B, C
SAE J1455 Crash Test	<ul style="list-style-type: none"> • 30 mph sled shock (20G/120ms)
ASTM Operational Vibration	<ul style="list-style-type: none"> • 1 to 200 Hz @ 90 minutes per axis (270 minutes total)

Table 2. Examples of watertight tests

Specification	Water Volume (gallons)	Duration (minutes)	Velocity (miles per hour)
MIL STD 810 4 Procedure III	1.75	15	drip, no continuous stream
MIL STD 5.08 4 Procedure II	7.5	60	7.5
IBC IPx4	15	8	continuous stream

Communications Technologies

"Since these notebooks spend a disproportionate amount of time in the field, they need robust multifarious communications," says Roger Kay. Multimodal wireless capabilities are crucial for enabling communications with different partner agencies and network systems, and notebook vendors are responding by packing three or more radios into one unit, such as:

- Bluetooth* for personal devices
- 802.11 for local area connections
- CDMA and GSM for wide area connections
- GPS (global positioning system) for location services via satellite

The need for reliable and flexible wireless communication is evident during large-scale emergencies, where first responders require seamless radio communications among multiple agencies to stay informed and coordinate activities.

Security Technologies

Absent brick and mortar protection, field-based computers are more vulnerable to theft or compromise. There's a wide range of advanced security features designed to protect users, information and networks, which are particularly relevant to the mobile workforce, including:

- **Integrated Fingerprint Reader:** With a simple finger swipe, users can easily and securely log on to notebooks and networks.
- **Trusted Platform Module (TPM 1.2):** Complementing software security, TPM creates another layer of security developed to protect information assets (data, passwords, keys, etc.) from compromise due to external software attack and physical theft.
- **High Security BIOS:** Thwarting hackers capitalizing on operating system security holes, a high security BIOS requires users to enter a pre-boot password, an additional layer of security, which is relatively tamper-proof.
- **Computer Tracing Agent:** As soon as a stolen notebook accesses the Internet, a service provider sends a message to lockdown the system; the BIOS responds by shutting down the system, preventing any future system reboots and rendering the system inoperable.

Usability Technologies

The mobile workforce faces some different operating challenges than office dwellers. For example, some mobile workers have to carry their notebooks all day long, so the use of lightweight materials is especially important. Outside of the office, direct sunlight on a commercial display makes it almost impossible to read, therefore fully rugged notebooks require display technologies that prevent display wash out.

A key challenge for the military is that field missions may last 18 hours, which means extended battery runtime is critical. The use of low-power Intel® processors and easy-to-use battery management tools can increase battery run time, as seen by two generations of General Dynamics Itronix rugged notebooks in Figure 1. The GD8000,* equipped with the Intel® Core™2 Duo processor SL9400,† has battery run of 8 to 12 hours, double that of its predecessor, the GoBook* XR-1.

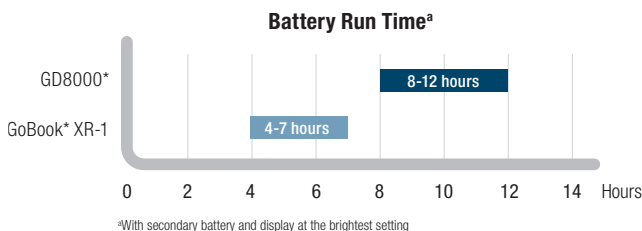


Figure 1. Battery run time comparison²

Going Beyond MIL Spec Standards

Fully rugged notebooks are integrating the latest technologies and reaching higher levels of rugged, communications, security and usability, as demonstrated by the GD8000 from General Dynamics Itronix (Figure 2). Ready for anything, the GD8000 notebook computer boots cold, runs fast and hits the dirt without losing performance or data. The GD8000 is designed for military personnel, field service workers and first responders who require high-performance computing while working in extreme temperatures, humidity, dust and rain-soaked environments.

Rugged

GD8000 has a range of rugged features, in some instances exceeding MIL-SPEC, including a watertight IP64-compliant case, a shock mounted display, the capability to withstand 48-inch (1.22 meters) drops onto a hard surface and resilience against the following harsh conditions:

Ingress protection (IP) tests

- Protect against dust with limited ingress
- Resist 15 gallons (57 liters) of water for 10 minutes

Drop tests

- MIL STD 810-F drop using only one unit
- 26 drops from 42 inches (1.07 meters); unit operating with standard hard disk drive
- All surface edges and corners
- 6 additional drops onto all surfaces from 48 inches (1.22 meters) while the system is off

Temperature tests

- Operating: -22°F (-30°C) to +145°F (63°C)
- Non-Operating: -67°F (-55°C) to +167°F (75°C)



Figure 2. The General Dynamics Itronix GD8000* Rugged Notebook

Communications

Providing complete wireless connectivity across the spectrum, the GD8000 integrates up to three RF modems and a GPS receiver at one time, delivering mission-critical connectivity – anytime, everywhere.

GPS

The GD8000 features a quadra-helix antenna with SiRFXTrac high-sensitivity GPS software for increased acquisition and tracking.

RF Modems

- Class 1 Bluetooth with 100 meters line-of-sight
- Wireless LAN supporting 802.11a/b/g/n with optional 300mW for greater coverage
- Wireless WAN with choice of EV-DO/1xRTT/CDMA or HSDPA/UMTS/EDGE/GSM and Common Radio Module Architecture supports field replaceable WWAN radio modules

Security

The GD8000 has security features designed to protect sensitive data and files from unauthorized access. It includes TPM 1.2 Network Security Standard, integrated fingerprint reader, integrated CAC (Smart Card) reader, a removable hard drive, a security lock slot and super password startup configurations.

Usability

Not just tough, the GD8000 is a lightweight high-performance computer with an advanced display. Equipped with the Intel Core2 Duo processor, the GD8000 outperforms many office-level computers and is still one half pound lighter than other 13.3-inch fully rugged notebooks. Power-efficient Intel Core 2 Duo processors integrate two complete execution cores that can execute multiple applications simultaneously and significantly improve system response.



Figure 3. Visibility comparison: DynaVue* on the right-hand side

The GD8000 incorporates industry-leading touchscreen display technology, called DynaVue,* which optimizes viewability in all lighting conditions, including direct sunlight, as shown in Figure 3. DynaVue is based on filtering technology that achieves a dramatically improved contrast ratio to provide rich color and sharp images. Since DynaVue does not rely on adding light to improve visibility, it consumes less power than standard displays, which extends battery runtime. To further reduce power consumption and increase reliability, the GD8000 may be configured with an optional 64 GB solid-state drive.

For more information on the General Dynamics Itronix GD8000 vehicle-rugged notebook, please visit www.gd-itronix.com/GD8000.

Additional information about Intel® embedded products can be found at www.intel.com/products/embedded/index.htm.

GENERAL DYNAMICS
Itronix



⁴Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.

¹Roger Kay, "Is There a 'Business-Rugged' Market in the United States?" Technology Pundits Website, www.technologypundits.com/index.php?article_id=460.

²Performance tests and ratings are measured using specific computer systems and/or components and reflect approximate performance of Intel® products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information on performance tests and on the performance of Intel products, visit www.intel.com/performance/resources/benchmark_limitations.htm.

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