

ITRONIX' WHITE PAPER

PC Ruggedization Standards: A Practical Analysis

What was once a single "battle-tank" approach to ruggedized mobile computing has evolved today into a sophisticated array of products to match any organization's needs or budget. Microcomputing, new wireless technologies, specific user environments, and industry competition are just a few of the factors that have driven recent developments in ruggedized computer design.

In one way, these developments have made it easier than ever for organizations to choose the right PC for their particular mobile deployment requirements, as the price/feature continuum is now much broader and better defined. Yet the new smorgasbord of choices has also made the selection process somewhat bewildering, especially because so many ratings organizations, specifications, and testing methods are used to establish suitability of individual computers for various applications.



The Itronix GoBook MAX is totally sealed.

Classes of Ruggedized PCs

A good way to begin understanding the differences in ruggedized mobile computing devices is to recognize the four distinct types of notebook PCs:

- **Commercial** – the common grade of portable computer, possessing little or no protection against rough use.
- **Enhanced Commercial** – generally defined as "semi-rugged" or rugged "by packaging," this category features units encased in various metals such as magnesium and titanium for dent and scratch resistance and to protect the display. Enhanced commercial models often have a wide range of conventional PC features with no internal microprocessor protection offered.
- **Rugged** – devices carrying this classification are rugged "by design," meaning they offer internal components and cases engineered from the ground up for computing in harsh conditions. Rugged computers offer magnesium alloy on structural components; they also resist vibration, dust, water and extreme temperatures, and can take repeated drops onto hard surfaces without failure.
- **Ultra-Rugged** – this durable class of notebook offers the maximum protection "by design." Ultra-rugged computers offer incredible performance for use in the most hostile environments, and often include enhancements designed to address specific industries or user requirements.

While the delineation between "commercial" and "ruggedized" mobile computing products is comparatively easy to grasp, many people are not aware that critical category differences exist within the world of rugged computers. Not understanding the differences can cause problems when evaluating performance and value as a prelude to purchase.

Rugged, Semi-Rugged, and Ultra-Rugged models, for example, are often lumped together for consideration, when in fact these models are manufactured for very different markets and applications. Pricing can vary widely, as can performance under standardized testing. Unfortunately, when apples and oranges get thrown into the same barrel, the result can be selection of the wrong computer choice for the intended application.

In order for buyers to get a fair reading on the quality of a specific model, it is vital for evaluations to be conducted against models that not only are in the same category of ruggedization, but that also carry similar industrial ratings and specifications. Even these benchmarks should be supplemented by additional information (as we will see later).

Major Rating Organizations and Standards

Beyond the broad description of toughness and protection provided by the four classes of ruggedization, a number of objective ratings and standards exist. These ratings, set by various government agencies, industry groups, and/or independent laboratories, are typically cited by manufacturers in order to establish a more exact degree of environmental protection and reliability. Some of the more common standards include:

- **MIL STD (Military Standard) or MIL SPEC (Military Specification)**

A series of performance and manufacturing guidelines set by the U.S. Department of Defense. MIL-STD 810E (superseded by MIL-STD 810F on January 1, 2000) is generally accepted as the “gold standard” for ruggedization testing by mobile computer manufacturers.

MIL-STD 810E and 810F actually define a series of complex testing protocols for rain, humidity, salt fog, sand/dust, vibration, shock, and temperature, among others. Many public safety forces also use MIL-STD 810E or 810F when writing specs for their mobile computers. An on-line copy of the MIL-STD 810F specification can be downloaded from the United States Army Developmental Test Command at <http://www.dtc.army.mil/pdf/810.pdf>.

- **IP (Ingress Protection)** A set of enclosure protection standards established by the International Electrotechnical Commission. Expressed as a two-digit number, the IP rating describes the ability of an electrical enclosure to withstand penetration from solids and liquids according to the following table:

	FIRST NUMBER (SOLIDS)	SECOND NUMBER (LIQUIDS)
0	No protection	No protection
1	Protected against objects > 50 mm (hands)	Protected against dripping water or condensation
2	Protected against objects > 12 mm (fingers)	Protected against sprays of water 15° from vertical
3	Protected against objects > 2.5 mm (tools/wires)	Protected against sprays of water 60° from vertical
4	Protected against objects > 1 mm (small tools)	Protected against water sprayed from all directions
5	Protected against dust, limited ingress	Protected against low pressure jets of water
6	Totally protected against dust	Protected against heavy seas (shipdeck)
7	N/A	Protected against the effects of immersion
8	N/A	Protected against submersion

A rating of IP 68, therefore, would indicate a dusttight device that can withstand total submersion in water.

- **IS (Intrinsic Safety)** IS is a term representing the Hazardous Location classifications as described in the National Fire Protection Association's (NFPA) National Electrical Code (Article 500). The National Electrical Code (NEC) defines Hazardous Locations as those areas "where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings."

An Intrinsic Safety rating details the specific Hazardous Location in which an electrical device can be used without fear of electrostatic discharge that may cause an explosion.

SUMMARY OF CLASS I, II, III HAZARDOUS LOCATIONS			
CLASSES	GROUPS	DIVISION 1	DIVISION 2
I. Gases, vapors, and liquids	A: Acetylene B: Hydrogen, etc. C: Ether, etc. D: Hydrocarbons, fuels, solvents, etc.	Normally explosive and hazardous	Not normally present in explosive concentrations (but may accidentally exist)
II. Dusts	E: Metal dusts F: Carbon dusts G: Flour, starch, grain, plastic, chemical dust	Ignitable quantities normally or possibly in suspension	Dust not normally suspended in an ignitable concentration (but may exist)
III. Fibers and flyings	Textiles, wood-working, etc.	Handled or used in manufacturing	Stored or handled in storage

- **ASTM (American Society for Testing and Materials)** The ASTM is a non-profit organization that develops standards in hundreds of product categories. Of particular use to ruggedized computer manufacturers are the ASTM's standards for truck or vehicle transport, since many mobile computers are used by field repair/maintenance workforces and as such are subjected to severe jostling and vibration.
- **Other testing bodies** Depending on the product or application, standards may also be cited from NEMA (National Electrical Manufacturers Association), UL (Underwriters Laboratories), the CSA (Canadian Standards Association, a Canadian equivalent of UL), CENELEC (European Committee for Electrotechnical Standardization, keepers of the CE certification mark), and SAE (Society of Automotive Engineers), among others.

In order to determine what real-world situations are covered by the various certifications, it's advisable to become familiar with the definitions. Unfortunately, some ratings organizations charge for the reports; you may be able to obtain relevant information from a qualified ruggedized computer reseller or manufacturer. International Product Safety News also maintains a Web site, www.safetylink.com, containing links to scores of product safety testing resources.

How Much Ruggedization Do You Need?

A critical step in determining the level of ruggedization needed for a specific deployment is to do some first-hand research. It's vital that you be aware of every field condition that will affect the performance of your computer.

Reports and user interviews are helpful; however, nothing can replace the knowledge gained by experiencing the user environment for yourself. By riding along with field users for a few days and listening to their "war stories," you can gain an understanding of ruggedization needs from both a technical and an environmental viewpoint.



The Itronix GoBook MAX is ideally suited for computing in ultra-rugged field environments, including telco and utility repair.

Do your workers remain outside when it rains? For how long? How much vibration is their equipment subjected to? What are the temperature extremes? By generating a full list of statistics-average number of drops per week, volumes of water, temperature shock, amounts of sand or dust, you will quickly determine what practical challenges your computers will have to meet, and which class of notebook PC will best suit that particular need.

Manufacturer sales representatives and resellers can also be helpful in setting specifications. One Midwestern U.S. police department, for example, needed a crime scene computer for its detectives who confiscate, catalog, and dismantle illegal methamphetamine labs. The lieutenant in charge of PC acquisition knew that his department's notebook computers would have to be water-resistant, since the crime scene personnel are required to wipe down equipment with a diluted bleach solution to prevent drug and chemical contamination. It took a conversation with an Itronix authorized computer reseller, however, to discover that an Intrinsically Safe (IS) device was needed as well.

"These types of labs are filled with volatile chemicals and caustic vapors," said the lieutenant. "Our sales rep pointed out that ordinary notebook computers can generate an electrostatic discharge that might cause an explosion."



Another way to determine suitability of a ruggedized PC for a given application is to stage an in-house test. At one U.S. Air Force base in Nevada, military personnel compared several mobile computers to see which could take the intense heat of the base's outdoor aircraft maintenance area.

On tables near the air base's flightline, workers placed notebook computers from several different manufacturers. There, in +60° C (+140° F) temperatures so intense they actually delaminated the tabletops holding the equipment, one computer screen after another failed. The winning computer, an Itronix X-C 6250 Pro unit, was eventually issued to dozens of maintenance personnel who service the Air Force's powerful J-STAR surveillance and battlefield management aircraft.

A real-world beta test over an extended period can give you information not attainable through staged experiments. After a one-year trial with several different makes of computers on open 21-foot buoy boats, the U.S. Coast Guard chose an Itronix model that could withstand the rigors of both Coast Guard personnel and Mother Nature.

"Although we knew our mobile computers might be dropped on a deck or kicked around, our main concern was the salt environment," said the ensign in charge. "Our analysis proved that a computer could be exposed to the elements as well and still function."

Finally, for large-scale deployments (ranging from several hundred to several thousand units) pilot tests employing five to fifty computers can prove invaluable. Such tests provide the only day-in/day-out routine feedback that can tell you with certainty whether a particular ruggedized computer can meet your specific, long-term needs.



One GoBook MAX can withstand 54 repeated drops from 3 feet onto plywood over concrete without failure.

Going Beyond the Spec Sheet

To get the real story of how rugged a mobile PC is, it's not enough to note the ratings in the manufacturer's sales literature; you must ask for a copy of the company's test reports. Such information can tell you exactly how and how well a particular product fares relative to its competitors.

Remarkably, two different computers, each meeting the same standard and priced similarly in the marketplace, can vary widely in their individual test performance. The MIL-STD 810E specification for mechanical shock, for instance, calls for notebook computers to withstand 26 drops (one drop on each face/edge/corner with display screen closed, and unit powered OFF) onto 2" plywood over solid concrete without failure. Any computer successfully completing such a test is certified as MIL-STD 810E compliant.

Often left out of the discussion, however, is a provision that allows up to five computers to be used in the test. In other words, as long as 26 drops are successfully completed without failure by the fifth unit, the product meets the standard.

Other potential differences exist as well. MIL-STD 810E permits units to be tested while OFF or in "Sleep" mode (powered up with operating system and hard drive suspended), and with onboard communication antennas tucked away. In the real world, however, most units are often dropped during use, when systems are on and antennas and screens are exposed. What's more, 810E mandates testing at common operational temperatures, whereas ruggedized computers are often subjected to subzero or +38° C (+100° F) operating conditions that can aggravate accidental damage.

These variables, among others, underscore the need to compare each manufacturers' test results. By doing so buyers can uncover substantial differences among computers of similar class, all of which meet MIL-STD specs. As an example, Itronix Corporation's ultra rugged unit, the GoBook MAX, withstands 54 drops (all faces/edges/corners, display closed, open, and powered ON) using a single unit. Most similar competitor models require five units to pass the test.



The GoBook MAX can withstand 4 inches of rain per hour.

All drop testing on the GoBook MAX is conducted with units powered up and wireless antennas fully deployed. Of the 54 drops on the GoBook MAX test, 42 are done at room temperature, while six (all unit faces) are administered at maximum specified operating temperature of +60° C (+140° F) and another six at minimum operating temperature of -23° C (-10° F). Such test procedures give customers a more accurate idea of a particular unit's true capabilities, and can provide the critical information needed to make a wise purchase decision.

Ultimate Choice: The Ultra-Rugged GoBook MAX

As a best-of-breed, fully rugged PC, Itronix' GoBook MAX provides the ultimate example of brains and brawn. Combining best-in-class Intel Pentium 700 MHz processor speed, exclusive CRMA™ (Common Radio Module Architecture) field-upgradable wireless technology, plus a light, ergonomic design, the GoBook MAX meets the needs of any field-deployed workforce requiring uncompromising RF performance, ruggedness, and durability in demanding conditions.



The GoBook MAX features an ergonomic "Bat Handle" making computing convenient even in tight spaces.

GoBook MAX meets or exceeds all MIL STD 810E specifications for shock, vibration, dust, and water protection. The die-cast magnesium unit has been subjected to 40 psi water spray for four hours (40 minutes on each face) at a rate of four inches per hour-conditions similar to those found in typhoons-and with all port doors open, resulting in no damage.

Operating temperatures for GoBook MAX have been broadened compared to its predecessor unit, the Itronix X-C 6250 Pro. GoBook MAX provides reliable operating service from -23° C to +60° C (-10° F to +140° F), and storage temperatures ranging from -55° C to +75° C (-67° F to +167° F). The unit also withstands vibration levels from 20 to 1,000 HZ. Strong enough for use in military helicopters.

GoBook MAX carries an Intrinsic Safety rating of Class I, Group D, Division 2, making it suitable for aerospace flightline and/or HazMat duty where JP-5 jetfuels or other explosive gasses may be present. The unit is UV stable, immune to particulate matter, and resists humidity up to 95% (fully condensing).

Itronix' premier ultra-rugged notebook PC is ideal for field utility, telecommunications, public safety, aerospace, military, commercial field service and HazMat use. It supports BellSouth Wireless Data, Cisco Wireless LAN, Motient, CDPD and GSM wireless networks. Also providing exceptional wireless flexibility is the unit's CRMA™ architecture which enables users to swap radio modems or switch networks in the field, thereby avoiding costly service bureau returns. In addition, with CRMA™, your computer doesn't become outdated as networks evolve and change.

In total, the Itronix GoBook MAX is not only the number one choice in ultra-rugged mobile computing, but also a valuable reference point for anyone seeking to understand the essential underpinnings of notebook PC ruggedization. Demanding PC users will find the GoBook MAX a wise and cost-efficient alternative for their harshest deployment requirements. The GoBook MAX is simply the fastest, light, ultra-rugged, intrinsically safe notebook PC on the planet.