White Paper

Rugged Computer MIL-STD Ratings and IP Ratings

U.S Military Standard (MIL-STD)

The U.S. Military Standard (MIL-STD) gives a guideline for devices that is said to be "rugged" or "ruggedized". It was introduced to provide a series of tests to simulate how material would hold up to environmental stress during operational lifetime. It has been revised several times over the years, the most recent being Revision G. It details 28 different testing methods that cover everything from temperature to fungal infestation or gunfire. The eight tests used to determine a computing device is rugged: high temperature, low temperature, rain, humidity, sand and dust, immersion, vibration, and shock.

Method 501.5 – High Temperature

This testing is broken down into three procedures. Procedure I (storage) exposes the device to high temperatures while it is turn off, and its purpose is to test the durability of the physical materials that make up the device. Procedure II (operation) is concerned with how the device puts up with heat while having it turned on and used. Procedure III (tactical-standby to operational) gauges how it works under operational temperatures after having been exposed to higher storage temperatures.

Method 502.5 – Low Temperature

This testing also has three procedures to determine how the device will behave In low temperature. Procedure I (storage) is much the same as the high temperature test. Procedure II (operation) testing involves slowly cooling the device to the low temperature in the appropriate range and leaving it at that temperature for at least two hours, checking visually to see that it is still functioning during that time. Procedure III (manipulation) investigates the ease with which the device can be set up and disassembled while wearing heavy winter clothing.

Method 506.5 – Rain

This test is for water resistant, and the results help determine what Ingress Protection (IP) rating the device should get for liquid protection. Procedure I (rain and blowing rain) is for devices that will be used outdoors. Procedure II (exaggerated) is for large material that can't fit inside a rain chamber that isn't used for computing devices generally. Procedure III (drip) is for devices that would be protected from rain, but may still be exposed to some falling water.

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Method 507.5 – Humidity

This method determines how well the device can hold up to warm, humid air. Procedure I (induced and natural and cycles) involves three 24-hour cycles representing conditions that may occur during storage and transit, and three more that simulate natural environments cycles. Procedure II (aggravated) exposes the device to more extreme temperature and humidity levels than those found in nature, but for shorter durations.

Method 510.5 – Sand and Dust

This method checks how good the device is at keeping out particles. Procedure I (blowing dust) tests ingress of dust particles that are smaller than 150 micrometers (μm). Procedure II (blowing sand) tests ingress with particles that are between 150 μm and 850 μm.

Method 512.5 – Immersion

This method determines if a device can withstand being submerged or partially submerged in water, or just splashed a lot, and be able to function after or even during the process. Procedure I (immersion) covers putting any part of the device underwater.

Method 514.6 – Vibration

This method is one of the most complicated tests in the entire MIL-STD. Generally is it designed to determine if a device can withstand the vibrations it would be exposed to during its lifecycle. Most of the tests involve using laboratory shakers set to different levels to simulate being on a vehicle or carried by a person. Variations in the vibrations' wave form, frequency and intensity will change depending on the type of device and the environment being simulated, as will the actual duration of the testing.

Method 516.6 – Shock

This test gauges how well a device holds up to impacts while falling from certain heights. The tests are designed to determine how well a device can put up with general physical abuse while in operation, but not from factors such as nearby explosions.

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IP Rating "Ingress Protection"

IP ratings are a set of standards published by International Electrotechnical Commission, and focus on a mechanical casing and/or electrical enclosure's ability to resist intrusion from solids, water, and in the case of dangerous objects, people. It classifies how well electrical enclosures are protected against intrusion of solid objects, dust, and water. When used to indicate sealing of rugged computers, the IP rating tells you whether dust or water can get into your computer. IP ratings are actually two ratings in one – the first digit represents solid ingress resistance, and the latter represents water. The higher the numbers in the rating, the more resistant a device is to a particular kind of ingress.

IP Rating Chart

First Number	Definition	Second Number	Definition
Protection against solid objects		Protection against liquids	
0	No protection	0	No protection
1	Protected against solid objects over 50mm (e.g. accidental touch by hands)	1	Protected against vertically falling drops of water
2	Protected against solid objects over 12mm (e.g. fingers)	2	Protected against direct sprays up to 15° from the vertical
3	Protected against solid objects over 2.5mm (e.g. tools and wires)	3	Protected against direct sprays up to 60° from vertical
4	Protected against solid objects over 1mm (e.g. tools, wires and small wires)	4	Protected against sprays from all directions - limited ingress permitted
5	Protected against dust - limited ingress (no harmful deposit)	5	Protected against low pressure jets if water from all directions - limited ingress permitted
6	Totally protected against dust	6	Protected against strong jets of water (e.g. for use on shipdecks - limited ingress permitted)
		7	Protected against the effects of temporary immersion between 15cm and 1m. Duration of test 30 min.
		8	Protected against long periods of immersion under pressure

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