Dell Rugged devices technical overview

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Introduction

Dell Rugged devices are designed, built and tested from the inside out—so interior components get the same close scrutiny as the exterior ones do. They deliver productivity anywhere for real-world users and provide business-class control to the IT teams supporting them. Dell Rugged devices also have three distinct advantages over other rugged choices:

Familiarity: You benefit from the existing Dell business laptop infrastructure and the ecosystem behind one of the biggest technology solutions providers in the world.

Service: Dell is the only Tier 1 Technology Solutions provider with the global supply chain necessary for delivering rugged PCs at scale and speed.

Manageability: Only Dell provides powerful endpoint management solutions for on-premises or remote fleet device management.

All Dell Rugged devices are MIL-STD-810G/H certified, which means they'll survive in extreme environmental conditions. However, Dell Rugged engineers don't stop testing once a device meets this military certification. All devices are "tested to fail" in the Dell Rugged Lab, enduring conditions that go beyond the military standard. This means you can count on them to keep working at peak performance in situations where standard devices would stop functioning properly. For more information on the methods Dell Rugged engineers employ to test these devices, read the "Testing for the real world" section.

In this document, we will introduce each Dell Rugged device, explore why and how the Dell Rugged family of devices perform well under extreme conditions and show how "testing for the real world" translates into real benefits across many verticals.

Dell Rugged devices

Dell Rugged devices are built on a foundation of automotive-grade, magnesium alloy chassis with rubber corner bumpers for maximum impact protection; upgraded components purpose-built for harsh environments; optional full RGB color gamut backlit keyboards sealed against hurricane-driven rain and vibration-proof components for travel across rough terrain.

Rugged devices deliver tangible benefits to users in the field, in part because Dell has incorporated real-world user feedback into the design. All Dell Rugged devices can include:
* 1,000-nit direct-sunlight viewable screens that are gloved multi-touch-capable
* Outdoor readable displays built with extensive Anti-Reflective (AR) treatments
* Touchscreens that are optically bonded with the LCD display to reduce reflective layers
* Anti-glare coating applied to touchscreens to reduce glare and soften specular reflections
* Durable, backwards-compatible pogo-pin docking interfaces that withstand rough use and are natively sealed from the elements without needing a door
* A wide variety of port options, from modern USB-C® ports to legacy serial RS-232 ports, to ensure compatibility and connections to your critical equipment
* A fan-based QuadCool™ thermal management system, which combines conductive cooling and forced convection to critical system components—keeping them running reliably and internally sealed from the elements
* Optional dual hot-swap batteries to deliver continuous power for multi-shift, 24/7 operations
* Next-gen Intel® Core™ processors

Dell Rugged devices are also FirstNet Ready™, which provides first responders with fast, reliable and priority access to the LTE network core.

Universal docking options
Current, previous and future generation Dell Rugged devices can be installed anywhere and upgraded in place without having to replace every accessory.

Dell Rugged devices work with a wide variety of secure mounting and docking options for laptops and tablets. These rugged accessories ensure Dell Rugged devices can be easily mounted and/or charged on everything from police or service vehicles to warehouse forklifts or office desks. The Dell Rugged universal docking solution—an industry first—means you can assign different rugged devices to various roles without having to invest in multiple docking solutions. A single dock in a work truck or utility van can accommodate old, new and future Dell Rugged laptops.

Semi-rugged device use cases
Dell Latitude Rugged 5000-Series devices are classified as semi-rugged and engineered to transition from the desk to the field without a problem. They have large screens with crystal-clear displays that are easily viewable in bright sunlight. They can also pack many convenience-oriented features, such as DVD-RW or Blu-ray drives, additional storage bays and PCMCIA or ExpressCard customizations. Dell Rugged 5000-Series devices are ideal for rough, but not extreme, handling and environments.

Use case example #1: An insurance adjuster who spends more time in the field dealing with claims and inspections than they do at a desk could benefit from using a Dell Rugged 5000-Series device instead of a standard commercial laptop in three key ways:
* The outdoor-friendly, 1,000-nit, anti-glare touch screen delivers relief from the eye strain and fatigue that comes from trying to use a consumer device in full sunlight.
* The semi-rugged device hinge is designed to handle over 60,000 opens and closures through its lifetime. This translates to longer device functionality in harsh conditions.
* Dell Rugged 5000-Series devices provide peak performance in adverse weather conditions.

Use case example #2: A structural engineer who frequently oversees construction sites could benefit from using a Dell Rugged 5000-Series device instead of a standard commercial device in three key ways:

- Intel Core processors and hot-swappable dual batteries means structural engineers can run heavy workloads on the job without worry.
- Consumer devices don't go through the same level of environmental testing or drop testing that Dell semi-rugged devices go through, which puts them at a disadvantage in the field.
- Dell Rugged 5000-Series devices are designed for rough handling on construction worksites, which reduces repair costs and lost productivity associated with consumer device usage. You can calculate the TCO benefits your organization might see by going to https://dell.valuestoryapp.com/rugged/.

Fully rugged device use cases

Dell Rugged Extreme 7000-Series devices are classified as fully rugged and have higher military-grade certifications and ingress protection (IP) ratings than semi-rugged devices. Engineered for use in extreme environments, these devices simply have to be tougher to survive—typical notebooks and tablets don't stand a chance.

Use case example #1: A firefighter who needs to use their device at the station, in their truck, and at the scene of a fire could benefit from using a Dell Rugged Extreme 7000-Series device instead of a consumer device in three key ways:

- A Dell Rugged Extreme 7000-Series device will continue to function well in the heavily vibrating environment of a fire truck.
- Consumer devices don't typically have sealed cooling, which regulates temperature without exposing the internal components to dust and water—and which is standard on Dell Rugged devices. Not all consumer devices could handle the high heat of an active blaze, but Dell Rugged Extreme 7000-Series devices can.
- If their Dell Rugged Extreme 7000-Series device is hit with water from a fire hose or sits outside in an environment heavy with dust and ash, it'll still work well when it gets back to the station.

Use case example #2: A transmission tower climber who can't easily grab another device if anything happens to the one they're using could benefit from using a Dell Rugged Extreme 7000-Series device instead of a consumer device in three key ways:

- Hot-swappable dual batteries allow them to work all day without worry.
- The 1,000-nit outdoor-viewable display lets them work in the brightest sunlight.
- Dell Rugged Extreme 7000-Series devices won't fail prematurely from repeated heat/cold exposure. How do you know? They are MIL-STD-810G/H certified, remaining operational after both 24 hours of exposure to -20°F and five days of exposure (five 24-hour cycles) at 145°F. Dell Rugged labs also performed thermal shock testing on the devices—cycling them though three cycles consisting of four hours of exposure at 160°F followed by four hours of exposure at -60°F (24 total hours of sequential testing). This ensures the devices don't become brittle or break apart under extreme temperature changes.

Dell Rugged tablets

7220 Rugged Extreme Tablet

This is the lightest and most powerful fully rugged 12-inch tablet on the market. It maintains peak performance while offering military-grade durability. It comes with a Corning® Gorilla® Glass touchscreen and is IP-65 rated for maximum protection against dirt, dust and water ingress. It includes multiple connections for vehicle deployment with RF pass-through ports so you can maintain mission-critical connectivity at all times. Additionally, 802.11ax Wi-Fi® connectivity reduces interference and increases network throughput for faster video streaming and file transfers.

7220EX Rugged Extreme Tablet

This version of the 7220 Rugged Extreme Tablet is designed for use in potentially explosive environments and designated as intrinsically safe, which means it is incapable of producing enough heat or spark to ignite an explosive atmosphere. In addition to the features mentioned above, it comes with the ATEX, IECEx Zone 2 and Zone 22 locations certification. These certifications are required for use in gas and dust environments where explosive atmosphere may occur for short periods, but is unlikely to occur under normal conditions.

Latitude 7220 Rugged Extreme Tablet

Latitude 7220EX Rugged Extreme Tablet

Dell Rugged tablet accessories

Mobility accessories: Improve portability with rigid handles, hand and shoulder straps.

Keyboard cover with kickstand: Add an IP-65 keyboard for productivity on the go.

Kickstand: Keep your tablet upright for easy viewing at the desk.

Modular expansion: Expand functionality with an Extended I/O Module (2x USB 3.0 ports + Ethernet) as well as barcode and magnetic stripe reader options.

Rugged vehicle dock: Mount securely and ergonomically with docking.

Rugged desk dock: Maximize productivity by adding connectivity and battery-charging at the office.

Activity stylus: Get the most input responsiveness with an available active stylus.

Multi-bay battery charging dock: Charge up to 16 batteries at a time.

Dell Rugged laptops

5420 Rugged Laptop
This durable and reliable semi-rugged 14-inch laptop is IP-53 rated. It's designed to be as thin and light as possible with integrated Intel HD high-performance graphics, which deliver a crystal-clear viewing experience. It could be used to support scientists collecting agricultural samples or service personnel in the field.

5424 Rugged Laptop
This semi-rugged 14-inch laptop is IP-53 rated and engineered to increase productivity in the field with integrated Intel HD high-performance graphics, which deliver a crystal-clear viewing experience. You can also opt for a DVD-RW or Blu-ray drive, multiple storage bays and PCMCIA or ExpressCard customizations. It is an ideal choice for employees working in inclement weather conditions, such as insurance claim adjusters in disaster zones, who may require more robust storage and/or access to other storage media.

7424 Rugged Extreme Laptop
This fully rugged 14-inch laptop is IP-65 rated and built to withstand anything the world throws at it. It's designed to support soldiers in remote regions or oil and gas engineers, with MIL-STD-810G certification for vibration, salt fog, and drop testing. It comes with enhanced graphics performance and up to 4 TB of storage.

Latitude 5420 Rugged Laptop   Latitude 5424 Rugged Laptop   Latitude 7424 Rugged
                                                                                                       Extreme Laptop

Dell Rugged laptop accessories

Mobility accessories: Go hands-free with shoulder straps.

Dell Auto-Air DC Adapter: Plugs into any standard auto or air outlet so you can work virtually anywhere.

Rugged vehicle dock: Mount securely and ergonomically with docking.

Rugged desk dock: Maximize productivity by adding connectivity and battery charging at the office.

Multi-bay battery charging dock: Charge up to 16 batteries at a time.

Testing for the real world

When you purchase a Dell Rugged device, you can be confident that it'll handle real-world field conditions. Dell Rugged devices have earned their certifications by passing 29 environmental durability tests conducted at the [Dell Rugged Lab](#). All testing is targeted toward replicating real-world user experiences.

To ensure products won't fall apart in the field, Dell Rugged engineers perform "testing to fail," testing 12 products per product iteration up to the release model. This includes a combination of both single and sequential tests: Each device must be able to pass not just any one single test, but also a combination of multiple tests in various sequences to determine whether one set of conditions influences the results or durability of a material in other tests. For example, a Dell Rugged engineer might increase the temperature in the thermal chamber, then do drop testing to ensure that a device performs well when dropped under more extreme temperature conditions. Dell Rugged devices are also certified independently by accredited third parties who perform their own testing and report the results.

For performance testing, Dell Rugged engineers measure baseline performance, which includes observable changes beyond performance (changes to screen brightness, battery life, etc.). Dell does this during and after environmental testing to determine the impact real-world conditions have on overall system performance.

Below, we review a sampling of the kinds of mechanical and environmental tests performed on Dell Rugged devices before their release. Note that not all Dell Rugged devices go through all tests; because semi-rugged and fully rugged devices serve different purposes, they are tested to different standards, both by independent third parties and by Dell.

Hinge testing

Dell Rugged engineers perform this test on every hinged device. The semi-rugged laptops go through 60,000 cycles and the fully rugged laptops go through 150,000 cycles before they hit the market. Dell Rugged engineers do this to guarantee the torque value stays the same over the life of the device. This is especially critical for military personnel who use their devices while vehicles are in motion over rough terrain, as the constant jarring can put a strain on the hinge. It's also important for police officers who open and close their devices 40 times a day on average.

Drop testing

Drop testing is critical for devices that will be carried, transported and/or placed on a variety of surfaces, some of which might not be stable. For example, imagine you're using a device on the back of an inclined truck. What happens if the airbrake is released and it slides off? In Dell Rugged engineers know that Dell Rugged devices can handle it. To pass Dell Rugged Lab drop tests, all devices must power on and perform normally after each test.

Dropping devices onto a 2-inch-thick piece of plywood over concrete is the MIL-STD-810G standard. Dell goes further. To meet the MIL-STD-810H standard on select devices, Dell engineers drop devices onto a 1-inch-thick steel plate over concrete, because that's more likely to reflect the hardness of the surfaces out in the field.

Transit drop

For this test, the device is turned off. Dell Rugged engineers drop the device a total of 26 times from the specified height: once for each face, edge and corner of the device. This test simulates a user dropping their device while it's turned off, perhaps before their workday starts or after they've powered off their device at the end of the day.

Operating drop

For this test, the device is turned on and open. Dell Rugged engineers drop the device 26 times from the specified height: once for each face, edge and corner of the device. This test replicates an experience many workers dread: their device unexpectedly falling to the ground while they're using it.

Micro-drop
Micro-drop testing mimics the day-to-day abuse that devices endure that we don't think about. For example, what happens to the device when a user slips it into a backpack or duffel bag every day? What about tossing it onto a passenger seat of a vehicle on a regular basis? The standard micro-drop distance for rugged devices is 6 inches. We drop each device 10,000 times in 8 orientations. This alerts us to any components that are loosening or breaking over time.

Environmental testing
Dell Rugged engineers don't test to meet just military-grade environmental conditions—they test beyond those standards to the limits of the devices themselves. This guarantees Dell Rugged devices keep working at peak performance in situations where standard devices stop functioning properly. In addition to the MIL-STD-810G/H tests mentioned below, Dell Rugged engineers also test dust and moisture ingress to the IEC IP ratings. To learn more about these standards, read the "Certifications" section of this report.

Blowing sand and dust
In environments with a lot of airborne particulates, such as the desert or in a sawmill, non-rugged devices can pull in particulates through their air intakes and suffer electrical shorts as these particles build up in their delicate electronics. Ports can get filled with particulates and block connections or cause errors. Anyone who has tried to charge their phone through a lint-filled charging port knows this problem well. Dell Rugged devices use sealed ports and chassis to keep particulates out.

The Dell Rugged Lab dust chamber determines each devices' resistance to different weights of particulate matter. Before starting testing, the Dell Rugged engineers drill a hole into the sealed space within the test device and attach a vacuum to the hole to create negative pressure within the system. Then, the engineers blow pulverized talcum powder that could fit through a 0.75 micron screen at the test device at a speed of 20mph. Sand is harder to keep airborne because it is bigger and heavier, so they crank up the wind to between 40 and 65mph for the mini sandstorm.

Dell Rugged engineers blow the dust and sand onto each system for nine hours, looking at how particulate matter affects the outside of the system. They also check to see how well the system keeps the dust/sand out of the inner electronics.

Damp conditions
Blowing rain, humidity and salt fog tests are critical for determining how a device will perform in damp conditions. Moisture can cause short circuits and eventual corrosion, while salt fog—common in coastal environments and on ships—can cause corrosion very quickly. The Dell Rugged Lab can simulate these environments in its humidity chamber, creating controlled conditions that are similar to, or worse than, conditions in the real world. For any outdoor usage, or even indoor usage in damp environments such as a greenhouse, moisture protection is critical.

Blowing rain
Dell Rugged engineers test devices with 70mph wind-driven rain, at a rate of 5.8 inches of rain per hour, for 30 minutes on each surface.
70mph wind speed is just under Category 1 hurricane levels and 5.8 inches per hour of rainfall is considered an extreme level of rainfall.

Aggravated humidity
This is an accelerated test, meaning the parameters (10 days at 0-95 percent non-condensing humidity in temperatures ranging from 86°F to 140°F) aren't something you're going to find in the real world. It simulates a device operating consistently under hot and humid outdoor conditions you might find in tropical environments or the southern US in summertime. Dell Rugged engineers are looking for any corrosive effects of all that warm moist air on the system.

Salt fog

For this accelerated test, Dell Rugged engineers spray devices with a mist containing five percent salt over the course of four days. Any device components not resistant to salt fog would rapidly corrode during the test. This allows Dell engineers to address any design weaknesses that users might encounter in corrosive coastal areas or at sea. The devices with rubberized keyboards are exposed to two cycles of 24 hours wet, 24 hours dry.

Vibration

Vibration and shock tests are performed by clamping the device to a vibrational pad and putting the device through a series of frequencies.

The frequencies are designed to test basic vibrations (e.g., from loud noises or running equipment in a manufacturing plant) as well as vehicle-like vibrations to simulate transport in various vehicle types.

Shock tests are performed using the same vibrational pad to apply a measured g-force impact. For example, imagine a device in the back of truck that has just hit a deep pothole.

Vibration and shock tests are most useful for equipment that is being transported often, especially off road. Many environments include vibrations as the norm, such as machine shops where a device might share a desktop with a bench-grinder. Environments with loud noises, such as racetracks, could also induce vibrations that would cause a non-rugged device to suffer from negative effects, such as loosening adhesives, connectors falling out or severed electrical connections or circuits inside the device.

For these vibration tests, Dell Rugged engineers check device performance as well as durability.

Composite wheeled vehicle

Dell Rugged engineers measure vibration data on 14 different styles of vehicle, running the gamut from U.S. Heavy Tactical Truck to US light 2½-ton trailer to German 15-ton trucks. Each test simulates a 500-mile run on these vehicles, 35 percent on paved road and 65 percent off road. This test assumes the device and other objects that might bump into it are secured to the truck.

Ground vehicle

This test simulates a 1,000-mile trip over U.S. interstate highways based on input data from seven different configurations of semi-truck/trailer. This test assumes the device and any loose cargo that might bounce around is secured to the truck.

Loose cargo

This test simulates an unsecured device being transported in military vehicles driving across rough terrain.

Minimum integrity

Minimum integrity testing is supplemental vibrational testing that is useful when the exact vibration patterns of the user's intended environment are unknown. This test provides a baseline understanding of a device's capacity to withstand vibrations, but it is not a substitute for the more tailored tests such as vehicle simulations. If you're purchasing devices for a large number of users working in varying conditions, some of which may have vibrating elements, you should look at this test.

Thermal extremes

Thermal tests are performed with heating and freezing chambers at the Dell Rugged Lab. The expansion and contraction of components under extreme temperature swings, as well as protection against condensation resulting from these extreme changes, are important to consider for devices used in very high or very low temperatures. It's critical that everything on the Dell Rugged devices, from rubber to magnesium alloys to glass and polymers, expands and shrinks at the same rates.

High temperature
Dell Rugged engineers perform three high-temperature tests: storage, operational and tactical stand-by to operational. Low-temperature tests also use storage and operational testing, but at different temperatures.

The *storage test* checks to see if the product degrades when stored at a non-operational temperature of 160°F for seven days. This is important in situations where devices are left in vehicles for extended periods of time.

The *operational test* is a five-day test at an operational temperature of 145°F. The MIL-STD-810G/H requirements for passing are that the system is still operational, with no concern for performance, after five days. While this is a helpful metric, it's not good enough for customers working in environments where the ground is hot enough to fry an egg. You might think that only happens in desert conditions, but concrete sidewalks can get up to 145°F, and the hood of a car is even hotter than that. So, we also look at how much performance degradation occurs.

The *tactical stand-by to operational test* determines whether the device will boot up at operational temperature (145°F) after being unused for a couple of hours at non-operational temperature (160°F). It is the equivalent of pulling a device out of a hot vehicle and getting to work during a heatwave.

Low temperature
Dell Rugged engineers repeat both operational and storage testing using an operational temperature of -20 F and a non-operational temperature of -60 F. The intent of these tests is identical to the high temperature reasons mentioned above.

Temperature shock
All materials expand and contract when they change temperature. This test is to make sure that there are no materials in Dell Rugged devices that are intimately mated to each other and expand/contract at very different rates. Those different rates of change could cause cracks, breaks, tears or premature failure of moving components in a device.

Dell Rugged engineers gauge the effects of *thermal shock* by cycling the devices through three cycles where the temperature alternates between -60°F for four hours and then jumps to 160°F for four hours.

The *freeze/thaw test* has the device stabilized at 77°F and then placed into a freezing chamber at 14°F. Dell Rugged engineers leave the device there for one hour after reaching the chamber temperature. Then they move the device back to the 77°F chamber and perform an operational test.

Atmospheric pressure
Altitude and solar radiation tests are useful for showing how devices will perform at high altitudes, where the atmospheric pressure is lower and thinner, allowing for more UV radiation to impact the device. Examples would be working on top of a mountain or in a plane.

Altitude
Dell Rugged engineers do non-operational (non-op) and operational testing in a vacuum chamber that simulates the low-pressure environment of 15,000- and 30,000-feet elevations.

The non-op test makes sure that the platform components don't degrade when exposed to high altitude (anywhere from 30,000 to 40,000 feet). Components most likely to see issues at high altitude are LCD displays and batteries.

The operational test makes sure that the degradation of thermal performance due to thinner air doesn't drastically affect the performance of the system.

Solar radiation
In the MIL-STD-810 manual, solar radiation testing comes in two flavors. The first is testing the actinic effects of the radiation (think UV damage to plastics out in the sun). Dell Rugged engineers no longer perform this test, because the materials Dell uses for rugged devices have improved and are not readily susceptible to this type of UV damage. The second type of test—which the engineers do perform—measures the effect of additional thermal load on a system out in the sun. Radiation can have a significant effect on the thermal performance of electronics by heating the housing, making it harder to dissipate heat generated by critical components such as the processor and graphics.

Dell Rugged engineers perform the solar radiation testing by beaming electromagnetic energy at frequencies in the solar radiation range at the device for 12 hours at 120°F and for another 12 hours at 110°F. After the cycle is finished, they inspect the device according to a checklist in MIL-STD-810. They assess the device for damage such as jammed or loose parts, weakened solder joints, electrical component damage, housing adhesive failure and other problems caused by extreme heat.

Explosive atmosphere
This test is important for devices that will be used in potentially explosive environments, such as fuel storage areas or gas leak investigations.

For this test, Dell Rugged engineers place the device in a chamber with a fuel and air mixture that could ignite from low-level electrical currents the device emits. They then cycle the device on/off, with various functionality checks, such as swiping a card for a card reader.

Dell Rugged devices passed these tests:

	Transit drop	Operating drop	Blowing dust, vibration, functional shock, humidity, altitude and thermal extremes	Blowing rain, blowing sand, salt fog, solar radiation, thermal shock, freeze/thaw and temperature extremes
7220/ 7220EX	48"	36"	Yes	Yes (The 7220EX also passes the explosive atmosphere test)
7424	72"/60"/48"	36"	Yes	Yes
5420/ 5424	36"	36"	Yes	No

Certifications

The MIL-STD-810G/H Standard provides 29 different methods (categories), each of which offer assurance that a product meeting this standard can handle a specific element of the environment for which it is designed. For example, moisture ingress tests are useful in knowing how a device might perform on an oil rig. It is important to note that MIL-STD-810G/H certification does not mean the device is rated for use in all of these categories—each category has individual pass/fail requirements. See the "Testing for the real world" section for detailed information on the tests Dell Rugged engineers conduct.

		Rugged Extreme	Rugged
Transit Drop	MIL-STD-810G/H (78 total drops, one test unit)	NB: 72", 60" and 48" Tablet: 48" and 36"	36"
Thermals	MIL-STD-810G/H (-20°F/24hr to 145°F/5-day operating)	✓	✓
Rain	MIL-STD-810G/H – Blowing rain	✓	
Dust	MIL-STD-810G/H – Blowing dust	✓	✓
Sand	MIL-STD-810G/H	✓	✓
Vibration	MIL-STD-810G/H	✓	✓
Humidity	MIL-STD-810G/H	✓	✓
Salt fog	MIL-STD-810G/H (optional with rubber keyboard)	✓	
Altitude	MIL-STD-810G/H	✓	✓
Explosive environment	MIL-STD-810G/H	✓	
Functional shock	MIL-STD-810G/H	✓	✓
Ingress protection	IP-65 certified	IP-65	IP-53
EMI certification	MIL-STD-461F certified	✓	
Hazardous locations	ANSI/ISA.12.12.01 certification capable (Class I, Division 2, Groups A, B, C,D) CAN/CSA C22.2 No. 213-M1987 CI D2	✓	

ATEX and IECEx certifications

ATEX and IECEx certifications are international safety standards for devices that will be used in potentially explosive atmospheres. Workspaces with combustible materials such as fuel (gaseous) or particles (dust) in the atmosphere can be dangerous because an electrical spark or other heat source can ignite them. The ATEX and IECEx certifications give some guidelines on how safe a device will be in these environments.

The only Dell Rugged device with the ATEX and IECEx certifications is the Dell Rugged Extreme 7220EX Tablet.

The gas certification code for the 7220EX is II 3G Ex ic IIC T4 Gc.
Gas code breakdown:
II: Surface industry equipment group (designed for use anywhere except in underground mines)
3G: Gas category 3 (certified for use in flammable gases in a category 3 atmosphere. This is an area where an explosive atmosphere is unlikely to occur in normal operation)
Ex: Explosion-proof electrical equipment
ic: Intrinsic safety protection type
IIC: Hydrogen gas group C
T4: Self-ignition temperature of gases and vapors: 200-300°C
Gc: Gas zone 2 (protection from abnormal explosions)

The dust certification code for the 7220EX is II 3D Ex ic IIIB T130°C Dc.
Dust code breakdown:
II: Surface industry equipment group (designed for use anywhere except in underground mines)
3D: Dust category 3
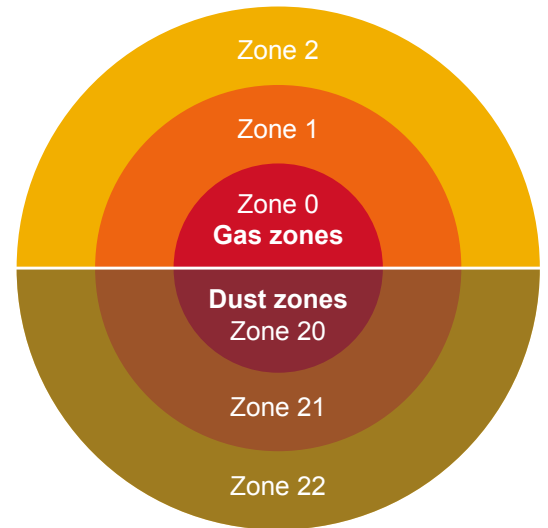Ex: Explosion-proof electrical equipment
ic: Intrinsic safety protection type
IIIB: Non-conductive dust size smaller or equal to 500 micrometers and resistance greater than 1,000 Ohm-meters
T130°C: Maximum device surface temperature
Dc: Dust zone 22 (protection from abnormal explosions)

Explosive atmosphere zones

With these certifications, you can be confident that you can use the Dell Rugged Extreme 7220EX Tablet almost anywhere—except underground mines—with protection from dust, heat and abnormal explosions.

Gas zone	Description	Dust zone
0 ATEX group and category: II 1G IECEx equipment protection level: Ga	This explosive atmosphere occurs frequently, for long periods of time, or is present continuously	20 ATEX group and category: II 1D IECEx equipment protection level: Da
1 ATEX group and category: II 2G IECEx equipment protection level: Gb	This explosive atmosphere is likely to occur occasionally or on a predictable schedule	21 ATEX group and category: II 2D IECEx equipment protection level: Db
2 ATEX group and category: II 3G IECEx equipment protection level: Gc	This explosive atmosphere is unlikely to occur for short periods or on a predictable schedule	22 ATEX group and category: II 3D IECEx equipment protection level: Dc

Dell Rugged devices are rated according to the IEC ingress protection standard, or IP rating. These two-digit ratings define the different levels of effective sealing of electrical enclosures against intrusion.

The **first digit** indicates the level of protection against ingress of "solids" (i.e., protection against dirt and dust ingress).

The **second digit** indicates the level of protection against ingress of "liquids" (i.e., protection against water ingress).

First digit: Solids	Object size protected against	Examples
0	Not protected	No protection against contact and ingress of objects
1	>50mm	Larger body parts
2	>12.5mm	Fingers or tools
3	>2.5mm	Smaller tools, thick wires
4	>1mm	Most wires, screws, etc.
5	Dust protected	Dust is not fully blocked, but cannot enter enough to affect device operation
6	Dust tight	Device is fully sealed against dust

Second digit: Liquids	Object size protected against	Examples
0	Not protected	No protection against ingress of liquids
1	Dripping water	Vertically falling droplets have no effect
2	Dripping water when tilted at 15 deg	Vertically falling droplets still have no effect, even when the device is tilted at an angle of up to 15°
3	Spraying water	Water falling as a spray at any angle up to 60° from the vertical
4	Splashing water	Water splashing against the enclosure from any direction
5	Water jets	Water projected by a 6.3mm nozzle from any direction
6	Powerful water jets	Water projected by powerful jets (12.5mm nozzle) from any direction
7	Immersion up to 1m	Ingress of water in harmful quantity is not possible under specific conditions of pressure and time
8	Immersion beyond 1m	Equipment is suitable for continuous immersion in water

For users who need a device that can withstand hurricanes, dust storms, potentially explosive environments, and missions that take them over rough terrain, Dell Rugged Extreme 7000-Series devices are ready for anything you throw at them.

For warehouse workers or users in field service industries who seek shelter in inclement weather, the Dell Rugged 5000-Series laptops are tough enough to get the job done without worrying that an errant hose or pollen season is going to take their devices out of commission.

Device	IP rating
Rugged Extreme 7220 and 7220EX Tablets Rugged Extreme 7424 Laptop	65
Rugged 5420 and 5424 Laptops	53

Verticals

Different businesses and roles have different needs. In the industries we mention here, using standard business or consumer laptops can lead to device failure, which can sideline users and create massive headaches for the often-distant IT team. What's needed instead are Dell Rugged devices, which are mobile, resilient and available and can stand up to the most extreme conditions on Earth.

First responders

Police officers, firefighters and emergency medical technicians need mobile, reliable GPS solutions that can be easily mounted in vehicles and accessed on the road. Dell Rugged 5000-Series and Dell Rugged Extreme 7000-Series devices are ready for action. They also deliver the tightest security settings available, in-vehicle charging options, and are FirstNet Ready, which provides first responders with fast, reliable and priority access to the LTE network core.

Government

For military personnel on the front lines and civilian agency professionals in disaster zones, tech failure can put lives in danger. They require Dell Rugged Extreme 7000-Series devices that maintain constant mobile connectivity, transfer large amounts of data quickly and securely, are easy to read in bright sunshine, contain long-life batteries and remain operational in harsh and challenging environments.

Oil and gas

Field workers in these potentially explosive environments need a Dell Rugged Extreme 7220EX Tablet, which is deemed intrinsically safe from explosive gasses and protected from drops, liquid ingress and excessive vibrations. The 7220EX also comes with an outdoor-readable touch screen, which is critical for enabling engineers to create data and consume it for analysis.

Field services

Not only do TV/internet installers, insurance adjusters and field technicians typically work outside, they cover a lot of ground during the course of a day. With onboard GPS and mobile broadband in their Dell Rugged 5000-Series laptops and Dell Rugged Extreme 7000-Series tablets, these teams can get from one job site to another efficiently, delivering maximum output for customer satisfaction and profitability. These personnel, like others in the field, need to be able to perform tasks in any environment. Their devices must be usable and functional in both bright sunlight and heavy rain.

Transportation and logistics

Supply-chain administrators, transportation managers and logistics analysts need Dell Rugged Extreme 7000-Series devices that operate well in dusty warehouses and transportation terminals open to the elements. Dell Rugged Extreme devices provide reliable connectivity and real-time updates so users can track stock and shipments in weather that's hot enough to boil an egg or cold enough to make ice cubes—sometimes within the same day.

Manufacturing and warehousing

These Dell Rugged 5000-Series laptops and Dell Rugged Extreme 7000-Series tablets are often used in noisy and potentially dusty environments, attached to forklifts and other heavy machinery that may produce heavy vibrations. Dell Rugged devices are able to withstand extreme weather conditions, whether this means a hot warehouse in the summer, or a cold storage facility where freezing temperatures prevail. These adverse conditions can drastically shorten the lifespan of any device not specifically rated for them.

Healthcare

In order to provide the best patient care possible, nurses and other healthcare professionals need Dell Rugged 5000-Series laptops or Dell Rugged Extreme 7000-Series tablets that are immune to repeated bumps, drops, liquid splashes and can withstand frequent disinfection.

Retail

Whether they're helping customers find what they want, ringing up sales, receiving payments or arranging for delivery, salesclerks need dependable Dell Rugged Extreme 7000-Series tablets can survive regular drops and routine disinfection before they're handed to the next shift worker.

Construction

For on-site construction workers, drops, dirt, dust and extreme weather conditions are a daily occurrence. A cracked commercial device screen from flying debris or a dunk in a muddy puddle can result in lost productivity, time spent getting repairs or replacement and a loss in revenue. Dell Rugged 5000-Series laptops and Dell Rugged Extreme 7000-Series tablets can take the abuse that commercial devices can't.

Laboratory

Gloved multi-touch capable Dell Rugged 5000-Series laptops and 7000-Series tablets make it easier for research technicians to keep detailed experiment logs while wearing protective gear and conduct routine device wipe downs to avoid cross-contamination in the lab environment.

Outdoor adventures

Whether you're working in the agriculture field or in a maritime industry—and even if you're living dangerously as a tornado chaser, pit crew member on a stock-car racing team, or circumnavigating the world on a yacht—a reliable and durable Rugged Extreme 7000-Series device can mean the difference between keeping ahead of or falling behind the competition.

Total cost of ownership

Deploying Dell Rugged devices instead of standard business or consumer devices improves your team's chances of success. The Dell world-class supply chain, coupled with imaging and provisioning services, Next Business Day On-Site Service and global support, means that you can deploy devices in weeks instead of months.

You might think that buying a couple of inexpensive consumer devices is cheaper than investing in a Dell Rugged device. But the price tag's not the whole story. You must also factor in the cost to reimage and re-deploy another device every time someone drops it, or when dust gums up the works. Compare that to the 3-to-5-year lifespan of a Dell Rugged device. Plus, with Dell Rugged devices, you get the benefits of easy management and Dell support for times when you do run into trouble. This translates to more time-savings and less downtime, which results in long-term cost-savings.

Business-class control: Dell Technologies Unified Workspace enables your IT team to deploy devices with great speed, transfer data securely and leverage ProSupport Plus for predictive, proactive and automated maintenance and 24/7 access to ProSupport Engineers for optimal fleet support.

Calculate your TCO and learn more about what devices will work best for you at https://dell.valuestoryapp.com/rugged/.

Dell Rugged by design

The Dell Rugged team consists of people dedicated to usability and ergonomics as well as construction. Their goal is to achieve the necessary ruggedized specifications and deliver something that is very easy and naturally intuitive to learn and use.

Chassis

Dell Rugged devices begin with a sturdy magnesium alloy core that supplies needed rigidity and strength to take on extreme environments while remaining lightweight and portable. Custom polymers complement the alloy core to help absorb shock from vibrations as well as deflect force resulting from accidental impacts or drops to keep devices operational even under duress. Finally, the rubber bumpers protect the most frequent impact points on the device without adding excessive bulkiness that would make the device cumbersome or impractical.

Screens

All Dell Rugged devices are designed for outdoor use. Several factors go into a good outdoor-readable display:
- High-quality LCD panels which adhere to the highest-spec panels available
- Great color differentiation and acuity
- Good off-angle display for when multiple people are looking at the screen
- 1.7-nit minimum to 1,000-nit maximum brightness for optimal brightness under a variety of conditions with longer battery life
- Anti-glare (AG) treatment

The 1,000-nit direct-sunlight viewable screens—the brightest in this class—are gloved multi-touch capable.

Dell Rugged anti-glare measures contribute to the best viewing experience possible: Dell Rugged devices offer a vibrant image in direct sun without offensive levels of reflection. Balance in AG measures is key. When there's too much AG, you can't see anything outdoors; if there's not enough, you get too much reflection.

Dell Rugged devices have:
- Reduced reflectivity instead of an ultra-high backlight for better readability with less drain on battery life
- Bright LCD displays built with extensive Anti-Reflective (AR) treatments
- Touchscreens that are optically bonded with the LCD display to reduce reflective layers
- Anti-Glare applied to the touchscreen to reduce glare and soften specular reflections

Dell Rugged Extreme Tablets also have Gorilla Glass touchscreens for maximum durability.

Keyboards and touchpads

Dell Rugged keyboards feel just like a regular Dell keyboard, but the design is very different. Dell Rugged devices use hydrophobic glue that keeps the membrane together so water doesn't seep in and render the device useless. Ultimately, Dell Rugged keyboards provide users with the same experience they're used to, but feature extra protections from the elements that you won't find in regular keyboards. Dell Rugged devices also feature large touchpads and large buttons for improved usability.

Dell Rugged devices are designed to help you type accurately in the dark with color customizable, backlit keys. LEDs behind the keyboard illuminate the keys for visibility in low-light or dusty conditions. The backlight color toggles between white, red, green and blue presets, or you can select your own custom color from the complete RGB color gamut.

Doors, latches, hinges and covers

Dell Rugged 5420, 5424 and Rugged Extreme 7424 laptops have mechanical latches and hinged doors. The Rugged Extreme 7424 Laptop includes additional ingress protection with laser-cut rubber gaskets to keep the elements out. The Rugged Extreme 7220 Tablet uses tight-fitting rubber covers and retains its IP-65 rating even if the covers are open. The Rugged Extreme 7220EX Tablet doors are made of the same armor covering as the system—you close and secure them with thumb screws.

Doors: Dell engineers designs the rugged device doors to open and close in one direction so you get a consistent experience. Competitor doors sometimes have multiple ways to open each of the doors within the device, creating additional frustration to a user who needs to quickly access doors to connect peripherals.

Latches: All mechanical latches on doors open, close and lock in the same direction on the device, making for an easy and consistent user experience.

Hinges: Dell uses steel door hinges that lay flat when opened, and all doors are of the same high quality. Competitors' doors sometimes use live hinges that don't lay flat on their own, so you would have to hold the door open.

Covers: To help protect against dust and moisture, as well as damage from larger objects, Dell Rugged devices have covers for all IO ports, such as USB, power adapter, serial port, etc. When in transport, you can securely close the Dell Rugged device port covers to protect the vulnerable ports from all type of ingress—whether it's dust, moisture or damage from something larger. Port covers are essential because the ports expose sensitive electronics, are the main ingress point and often require a hardware replacement to fix. With port covers, users can stop dust and moisture from getting inside the device, and therefore are less likely to need to replace components.

Ports and docking pogo connectors: All Dell Rugged ports and docking connectors take into account the need for physical connections to Ethernet and peripherals and are designed with convenience in mind. Depending on the use case, this may be for security reasons or simply because the users are beyond the reach of wireless connectivity.

| Dell Rugged & Rugged Extreme laptops	Dell Rugged Extreme tablets
• USB-A and USB-C ports • Native RS-232 serial port • Universal audio jack • RJ-45 gigabit Ethernet • HDMI® • Docking pogo connector • Optional second RJ-45 gigabit Ethernet with VGA, DisplayPort™, or second RS-232 port	• USB-A and USB-C ports • Micro SIM/SD card reader • Combo mic/headphone jack • Docking pogo connector • Optional mini RS-232 serial port • Optional RJ-45 gigabit Ethernet & additional USB connectors (via backpack pogo connector).

The docking pogo connectors offer a durable, fast, reliable and dust and water-resistant path to peripherals without the hassle of an additional door. (More sensitive connectors, like the traditional tongue in groove port, would require a door.) They also offer a one-stop-shop approach by supplying all power and I/O to the docked device. Best of all, the connectors are cross and backwards compatible, allowing the Latitude 5420, 5424, 7424, and legacy Rugged or Rugged Extreme laptops to use the same docking stations. The Latitude 7220 Rugged Extreme Tablet also features its own docking pogo connector, with desk, vehicle, or backpack pogo connector peripheral options.

Users have the freedom to share docking stations on vehicles for various laptops or transfer their devices easily between docks: from a desk to a vehicle, from one vehicle to another or across multiple stations in a larger vehicle.

Dual batteries with hot swap capability

Dell Rugged devices offer optional dual batteries for customers that require continuous and extended battery life. The hot-swappable batteries are designed to discharge linearly so that a device will use one battery fully, then switch to the secondary battery when the first battery is depleted. Alternatively, you can travel light by using only one battery when your device doesn't require long battery life, such as when it is docked. When it's time to charge, you can also spend less time waiting: Dell ExpressCharge delivers an 85 percent charge in an hour.

For teams with multiple Dell Rugged devices, battery cross-compatibility helps to reduce clutter and move battery resources where you need them most. Dell Rugged 5420, 5424 and Rugged Extreme 7424 laptops use the same batteries, and the Latitude 7220 and 7220EX Rugged Extreme Tablets use the same batteries.
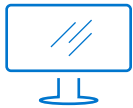
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