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# New IEC Standard 62368-1 for Electronic Equipment

## INTRODUCTION

The regulation of power-based products and components is critical for product and user safety, and for decades the International Electrotechnical Commission (IEC) has dictated how information technology equipment and audio/video products are engineered. The IEC's traditional approach to equipment safety has been product-dependent and incident-based, making the previous standards (IEC 60950-1 and IEC 60065) more reactive and less adaptable to emerging technologies.

Another regulation, IEC 62368-1, became the single default standard on December 20, 2020, so designers no longer have the choice of complying with other standards. As the boundaries between audio/video and information/communications technology have blurred, the hazards-based standard applies to a wide scope of applications and focuses on the energy within the equipment and the environments they are intended for instead of the products themselves. This future-proof approach aims to encourage manufacturers to address known hazards in the design and intended use of the product, whether enterprise-level applications or in-home devices.

## SCOPE AND CRITERIA

The scope of the new standard is fairly broad and includes all applications that were previously covered under different standards, or not covered at all. This includes electronic equipment up to 600 volts such as point-of-sale, banking, and other telecommunication and office equipment; speakers, surveillance cameras, smart home devices, and other audio/video equipment; and smart Internet of Things (IoT) devices, laptops, mobile devices, gaming systems, and other battery-powered electronic devices.

Although IEC 62368-1 has been in effect for years, designers had a choice of whether to comply with 60950 or 60065 over 62368-1 depending on the application, but that is no longer possible. Now, the hazard-based approach takes into consideration how a device is designed and where it will be used to determine testing and evaluation criteria, as well as which protection components should be used within the device.

While the evolution of the power-based standards may seem complicated, this new approach allows for greater safety and design flexibility.

## COMPLIANCE TESTING

Protection components are often used in designs to help increase long-term reliability and to comply with equipment tests such as IEC 62368-1. In order to determine the parameters of some of the tests, it is necessary to determine the overvoltage category that applies. The overvoltage category is based on where the device connects to the electrical grid—the closer the proximity to the grid, the higher the category and the hazard. For example, an electric meter on the outside of the house that is connected by a service wire to a transformer is considered Overvoltage Category IV, while the electric breaker panel inside a house would be in a lower Overvoltage Category. Personal devices such as PCs, routers, notebooks, tablets, and their power supplies fall within Overvoltage Category II.

Using the Overvoltage Category along with the line voltage, engineers can determine the withstand voltage rating. For power adapters connecting to 120 volt outlets, the withstand voltage rating is 1500 volts. But for adapters connecting to 240 volt outlets, the withstand voltage rating increases to 2500 volts. This rating is an important component when it comes to part selection and testing criteria.

The new standard also includes three tests related to the use of varistors and gas discharge tubes (GDTs) for surge protection, which were not included in older standards. As varistors are exposed to surge events they can wear out over time, eventually becoming a hazard themselves. IEC 62368-1 now refers to varistors as a possible ignition source, which is why the additional tests have been included.

The varistor overload test (the Annex G.8 portion of the standard) is a stress test that progressively steps up the power in the varistor. The test applies double the rated voltage of equipment, starting with a higher resistance and running each instance until the temperature stabilizes. Subsequent tests are run with a lower resistance and higher current until a fuse, thermal disconnect, GDT, or other mechanism safely opens the circuit.

The temporary overvoltage test is similar but defines specific current values and test duration. In both cases, the varistor cannot cause damage. Both overvoltage tests can be bypassed if the varistor rating is increased as defined in Table G.10 of IEC 62368-1, although if an engineer sizes the varistor to avoid the test it will have a ripple effect and result in higher ratings on downstream devices, which adds costs.

The basic insulation test evaluates the electric strength of equipment with an unreliable ground bond—most non-industrial plugs. This test is not required if the ground meets the defined criteria of a reliable ground.

CHOOSING COMPLIANT SOLUTIONS

**Power adapters.** Universal power adapters—which are commonly used in IT equipment—allow the same electronics to be used worldwide by accepting a wide range of voltage inputs, such as 90 to 240 volts AC.

**Fuses.** Selecting the correct fuse is critical to preventing damage from overcurrent events as well as passing fault testing. When selecting the right fuse, a common checklist can be used for most purposes:

- It must achieve its purpose in the circuit and should not do anything when the circuit is operating normally.
- It must avoid tripping as a nuisance—it must not open during normal operations or during surge pulse testing. This can be achieved by calculating the energy of the predictable pulses and comparing it to the melting point of the fuse. By targeting a proper ratio between the two values, engineers can be confident that the fuse will not nuisance trip during predictable pulses.
- The voltage rating of the fuse must be at least as large as the maximum rating of the power supply or system voltage.
- The fuse should have a maximum fault current rating higher than the maximum available fault current of the location where it will be used. This breaking capacity or interrupt rating can show engineers how much current the fuse can safely interrupt.
- The fuse should fit in the available space within the application.
- The fuse must meet required third party certifications, including UL or IEC requirements.

These requirements can be used to identify the best fuse for the application. For example, Littelfuse recommends its 3.15A fuse in the 215 Series due to higher breaking capacity, or the 392 Series if the application has less space and can tolerate a lower breaking capacity.

**Surge protection.** While there are several surge protection technologies available, including varistors, TVS diodes, protection thyristors, and GDTs.

To determine the best solution for the application, engineers should first consider whether the ground is considered reliable. Many home, office, and commercial spaces have unreliable ground connectors—wall sockets with a loose earth connector or a damaged ground terminal in the plug, for example. Reliable ground connectors typically exist in industrial applications where the ground is hardwired in, or the equipment does not function without a sound ground connection.

For unreliable ground applications, IEC 62368-1 states that when used in the common mode—between lines and protective earth or between neutral and protective earth—varistors can be used with a GDT as long as they comply with the Annex G.8 varistor overload test. For varistors used in the differential mode—line-to-line or line-to-neutral—they simply need to meet the criteria as described in G.8. To choose the right varistor, its minimum continuous operating voltage should be at least 1.25 times the max voltage rating of the equipment, and its surge rating determines what diameter should be used. GDTs should also pass the electric strength test to ensure it can withstand additional voltage and comply with the new standard. Once a series of GDT and varistor are chosen, the pair needs to pass the overload and temporary overvoltage tests as well.

For the universal power adapter example, a 300-volt thermally-protected varistor can protect the line-to-line and line-to-neutral connections of the power supply unit from voltage transients and lightning while meeting minimum surge requirements. A 3000 V GDT combined in series with a 300 V varistor can be used in both line-to-ground and neutral-to-ground connections.

While this is the most common surge protection solution for many electronic applications, other solutions can be considered as well. When comparing technologies, engineers should consider:

- The clamping voltage, which shows how well the device can protect during a surge event, with lower being better
- The let-through energy during a surge event—again, lower is better
- The leakage current
- The lifetime after multiple surge events
- The size and cost

## CONCLUSION

IEC 62369-1 introduces a new way to approach electronics product testing by requiring engineers to take known hazards and use environments into consideration when designing a product. This hazards-based approach aims to keep pace with advances in technology while giving product designers more flexibility within the framework.

As manufacturers ensure that their products and components are certified to IEC 62369-1, they can take an approach that uses new, innovative design and construction methods. Partnering with a distributor well-versed in the new standard that offers a variety of compliant components can help designers find the right solutions for safe and effective products.