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Mil-Std-461G Specified for Surgical Suite Lighting

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Mil-Std-461G

Specified for Surgical Suite Lighting

What is the purpose of Mil-Std-416G in surgical suites? If you follow along you will understand how it was chosen and why it is important to patient safety.

Patient Safety

During surgery, the patient's health is monitored using sensitive electronic medical devices. Some of these devices measure very small voltages taken from the outer surface of the body to indicate things like heart (ECG) or brain activity (EEG) as well as levels of sedation and respiration. These devices are connected to the patient with conductive pads and leads. The typical measurements are in microvolts (1µV= .000001 volt) and are very small indeed.

These values are displayed over time on a graph. This is what creates that pattern we are all familiar with from hospitals. However, there is much more information gathered and if it's accurate, it can help the medical staff understand patient health moment by moment throughout the surgical procedure. Accuracy is improved without interference from electrical equipment.

The patient's health and safety is crucial during surgery and is monitored accordingly.

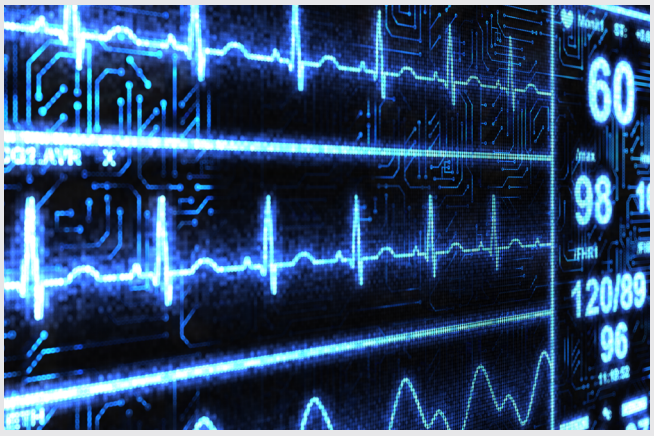
EMI and RFI

Electrical devices can radiate and conduct electrical noise to other electronics, especially those designed to sense electrical signals. As an example, radios and TVs are designed to receive broadcast signals and can have interference from nearby running motors or distant lightning. This is called EMI or electromagnetic interference. RFI or radio frequency interference is the higher frequency noise. A similar situation existed in the surgical suite. High power lighting loads are running just a few feet above a patient. The patient and their connections to the ECG or EEG can act like an antenna, receiving both signals and noise. The lighting fixtures are identified as a source of RF noise in the surgical suite, creating interference with the proper measurement of the patient.

There are two types of interference, conducted and radiated. Conducted interference are emissions which travels back from the fixture power wiring into the hospital electrical system and to the electrical equipment used during surgery. This noise can affect many kinds of equipment, not just devices like ECG and EEG.

Radiated interference emissions travel from the fixture, through the air, like a transmitter. The patient and their leads are the antenna, and the equipment is the receiver. The receiver must separate the noise from the signal. It would be far better if there were less noise. Because the lighting fixtures are using high frequency switch-mode power supplies to drive LEDs. that are placed just over the patient, they create both conducted and radiated emissions.

Proper care needs to be taken in fixture selection to be sure that the fixture has arrested conducted and radiated emissions. The care comes in the form of testing to relevant standards.



Federal Communications Commission certified is enough, Right?

The FCC CFR 47, Part 15 regulates “Unintentional radiators” such as LED drivers. The FCCs concern is primarily the protection of residential and business concerns. In short, the FCC’s concerns or requirements are not the same as a surgical suite. What is needed is a standard that addresses medical/surgical concerns.

Who called the Military?

Military Standard 461G is included in surgical lighting specifications because they have many of the same concerns. Aboard ship or aircraft there are many sensitive devices that need to work without interference and you cannot just move it away from the RF source, which was the FCCs solution if you didn’t like the results on your radio or TV. The standard contains many requirements, but two main components were selected for evaluation of medical lighting fixtures, ***conducted*** and ***radiated*** emissions.

The testing must be done in a special RF noise-controlled laboratory that looks more like NASA than the Army. The measurements are made by highly trained engineers working in faraday cages and anechoic chambers.

- Conducted Emissions (CE102) measures the power leads exiting the fixture across the RF spectrum from 10kHz to 30MHz.
- Radiated Emissions (RE102) measure the transmitted noise measured at 1 meter from the fixture using various antennae and from every angle. A “spectral sweep” or amplitude of noise measured across the spectrum from 10kHz to 18GHz.

These are compared to an established maximum value for each part of the spectrum. You will see in ***Chart No. 1 and Chart No. 2*** blue lines that represents the maximum noise level. The orange lines represent the conducted and radiated emissions measured in the lab. Staying below the limits means that the fixture controls emissions to avoid interference with sensitive medical equipment.

LED Drivers fall into two major classes by the FCC:

• Most drivers are Class A. Device for use in business/industrial/commercial environments.

• Class B. Device for use in a residential environment, as well as use in industrial or commercial environments. (The emission limits 10 dB more restrictive than Class A devices.)

MIL-STD-461G is a United States Military Standard:

It describes the requirements for and how to test equipment for electromagnetic compatibility. Many civilian organizations also use this standard.

The 461G edition was approved for use in 2015, adding, among other, additional requirements for higher frequency devices.

Anechoic (non-echoing) Chamber absorbs RF emissions for better measurements.

Mil-Std-461G Emission Charts

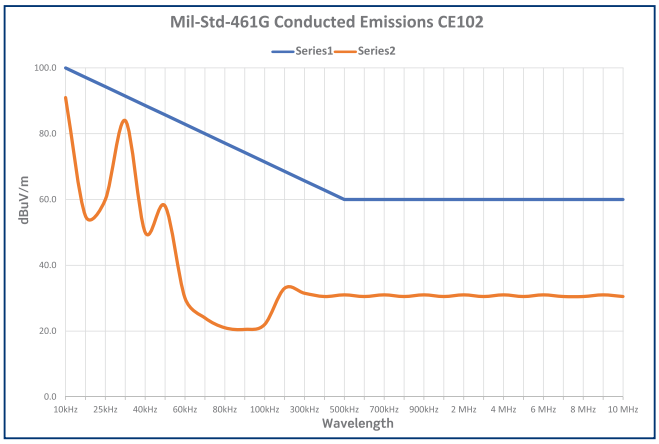


Chart No. 1 - Conducted Emissions - Fixture tested is MSUi-2x4

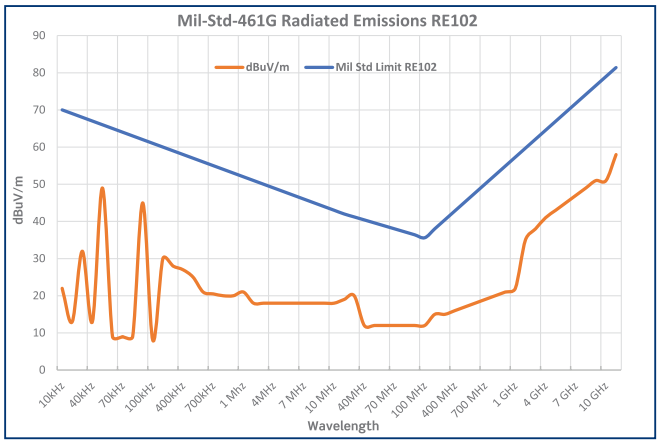


Chart No. 2 - Radiated Emissions - Fixture tested is MSUi-2x4

Please note that these charts are recreations of more complicated charts spanning several pages. While the actual charts show more data, more accurately, they would not be helpful here. If you would like to see the actual report, contact your local sales agent.

What Mil-Std-461G actually means for Lighting

Almost every fixture will need some mitigation of emissions in order to pass these tests. The most common way to pass conducted emissions is with a specially tuned medical grade filter combined with high quality drivers selected especially for their electrical properties. The filters absorb and ground the noise created by the drivers. How radiated emissions are controlled is very specific to the fixture and is highly technical. It involves proper driver selection as well as things like exposed wire and circuit board trace length and ground planes among other design elements.

When properly designed the lighting can just light the room and provide a EMI clean space without interference.

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