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Are electrical problems breaking your mass spectrometers?

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By AMETEK® - Powervar

Laboratory environments rely on some of the highest-level analytical instruments used in industry, not the least of which are mass spectrometers. As long as the analyst-to-machine ratio is roughly 2:5 and the facility has enough space and power resources, there isn't necessarily a standard for how many of these instruments can be present in a laboratory. Plus, most of them may be in use on any given day.

Maintenance and operation of these instruments demands no less than absolute meticulousness on the part of laboratory analysts and technicians. This is a tall order given the number of these machines present in a laboratory and the frequency with which they may be used on a particular day. A facility with two instruments may typically run between 10 and 15 samples in a regular day, and as many as 20 or more during a busy stretch. This is precisely why personnel have meticulous, redundant calibration processes intended to all but guarantee the accuracy of sample results on these rigorously worked machines.

Anomalous errors

Even then, however, there are some variables that are outside of their control that may lead to errors or unusual glitches in the instrument. Hours of internal troubleshooting later, there's not much left to do other than fork over hundreds or even thousands of dollars for a high-level technician, or just give up and make an insurance claim.

A post-op might reveal that it was some issue with the motherboard, or that sensitive circuitry was somehow compromised. At this point, lab analysts cut their productivity losses and move on, without really giving the issue much more thought. After all, there's much to be done, and only so many hours in a day.

But what if they could preempt more of these problems? What if the reason they happened in the first place had nothing to do with the actual instrument, and everything to do with the electrical environment in which they were being run?

Protecting the integrity of results

The common assumption is that surge protectors are enough to protect electronics, but this couldn't be further from the truth. Any potential source of error in a laboratory environment must be addressed, and this includes high-frequency electrical noise that can be generated from other machines.

These could be HVAC systems, or a server room in a nearby office. It could be lighting fixtures and computer monitors, or even basic kitchen appliances. Any potential variable that could impact the operational integrity of a machine must be addressed.

Furthermore, anything greater than an infinitesimal margin for error can have dire consequences. In inductively coupled plasma mass spectrometry, for instance, mercury, lead or other metals can be detected at levels of part per quadrillion. In some cases, identifying traces that barely exceed this limit can be a matter of urgency.

When consultants bring environmental samples to a lab analyst to test for traces of harmful inorganic compounds such as arsenic or cadmium, a lot depends on the accuracy of these results. Elements such as lead, for example, are capable of causing severe neurological disorders and other health problems.

Likewise, pharmaceutical companies rely on various forms of mass spectrometry, including ICP-MS, but also high-performance liquid chromatography-mass spectrometry and gas chromatography-mass spectrometry. These instruments may be used for research purposes, including the development of new medications.

According to laboratory analytics expert David Armstrong, laboratories that serve the environmental industries and pharma often have other analytical equipment capable of sullying the electrical environment in such a way that could impact the quality of electricity powering mass spectrometers.

"They will have things like microwave digestion – that's very common in both the pharma and environmental industry because they're taking samples that are either solid or very dense liquid that have to be digested and put into a solution that the instrument can handle," Armstrong said. "You can also get things like drying ovens and furnaces, and if these cycle off and on, they might create some issues on the power side."

In addition to possibly creating a need for more frequent calibrations to ensure the accuracy of samples, power problems that may lead to mysterious performance glitches that precipitate downtime for troubleshooting. This can eat into revenue and have a negative impact on client relationships. Inaccurate or late data will invite customers to take their samples elsewhere. Armstrong noted that each hour an instrument is down can cost approximately $200 worth of revenue. If the problem demands costly, higher-level troubleshooting, this $200 can quickly become $1,200 or more.

Isolating analytical instruments with power conditioners

Regardless of the size of a laboratory and the type of mass spectrometry being executed – GC-MS, ICP-MS or HPLC-MS – laboratories need to hold the original equipment manufacturer's feet to the fire, because their clients will not hesitate to do the same.

"The burden is on laboratories to create credible data, and people are making major decisions based on data they receive from them," Armstrong said. "They should be doing all they can to ensure the high quality of that data."

This includes creating a hospitable electrical environment by isolating mass spectrometers from high-frequency noise. Power conditioners built into mass spectrometers and other analytical laboratory instruments essentially create a bubble around sensitive analytical instruments that filters out power leakages from other electronics.

At the end of the day, the OEM will not be the one to suffer because of power inefficiencies in a laboratory environment. It will be the laboratory analysts and technicians who, after days of troubleshooting and choruses of customer complaints, learn that the best prognosis for why their instrument stopped working is "something went wrong with the motherboard."

Electricity is the lifeblood of analytical instruments. Make sure it stays clean.

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