FLUKE®

Indoor air quality: Can your schools pass the test?

Application Note

Ask many school administrators about the air quality inside their buildings, and the frank answer is liable to be "Well, we don't know."

They should. School air quality and student performance go together as naturally as breathing in and breathing out.

In the words of the U.S. Environmental Protection Agency (EPA), "Good indoor air quality contributes to a favorable learning environment for students, performance of teachers and staff, and a sense of comfort, health, and well-being. These elements combine to assist a school in its core mission educating children."[1]

This article provides key facts about why school air quality is so important, plus the building blocks to start developing an air quality management plan to help your schools provide a healthy and comfortable indoor environment and minimize risk and liability.

Measuring ambient temperature and relative humidity to evaluate air comfort.

A threat to the school's educational mission

Poor IAQ can compromise the learning environment, trigger health problems among students and staff, and snowball into major issues of remediation and liability.

- A 2004 review by the U.S. Department of Education identified adverse health effects related to the presence of chemical pollutants, lead, biological pollutants such as mold, allergens and airborne particles.
- The same study concluded that "it is also likely that inadequate IEQ (indoor environmental quality) conditions are common in U.S. schools and lead to adverse effects on students and teachers."[2]
- The EPA reports that asthma, often triggered by airborne agents, causes more school absenteeism than any other chronic childhood condition, and costs students 14.7 million missed days a year.[3]

1 U.S. Environmental Protection Agency (EPA) IAQ Tools for Schools Kit, IAQ Coordinator's Guide.
2 A Summary of Scientific Findings on Adverse Effects of Indoor Environments on Students' Health, Academic Performance and Attendance, page 10, U.S. Department of Education, 2004.
3 Asthma Facts, U.S. EPA, May 2005.

- In Seattle, one of many systems dealing with mold problems in schools, four schools are under repair and administrators are surveying IAQ district wide. One board member, citing the district's slow response to mold complaints, called for the district to pay the medical bills of all affected students and staff. At the same time the district faces a $20 million budget shortfall, and was considering a proposal to close ten schools.

"(IAQ) is definitely a significant issue for schools, but so is money, and so is time," says Rich Prill, building science & IAQ specialist with the Washington State University Extension Energy Program. "So unless (school administrators) have an immediate IAQ problem, it is typically a back burner thing."

Under a federally-supported program, Prill and his associates take a satchel of measurement instruments to about 100 Northwest schools each year and assess the air quality in occupied classrooms, measuring such IAQ factors as temperature, relative humidity and moisture, air flow, carbon dioxide (CO2) and levels of airborne particles.

But when a resource such as Rich Prill is not available, how does an administrator or facility manager know an IAQ problem exists? Better yet, how can school staff identify changing conditions and prevent problems from ever cropping up?

Creating an IAQ management plan

Begin your planning by reviewing the existing indoor air quality standards. The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) publishes guidelines for ventilation, air filtration and temperature and humidity management. The National Air Duct Cleaners Association (NADCA) has specifications for duct cleaning.

Keep in mind that even when standards are still under development (such as for airborne particles or mold spores), your IAQ management program can establish benchmarks that enable you to deal with emerging problems before they turn into an expensive liability.

Perhaps the most widely known IAQ resource for schools is the *EPA Indoor Air Quality Tools for Schools Kit.*[4] The kit contains a wealth of information and many useful checklists that help guide administrators and others through the indoor air quality management task.

The WSU Extension Energy Program has also developed this "3-Step IAQ Program" for schools in Washington, Oregon, Idaho and Alaska.

4 http://www.epa.gov/iaq/schools/tools4s2.html

Step One—Identify a coordinator for IAQ in each building, typically the head custodian, the facility director, or an HVAC (heating, ventilation and air conditioning) technician.

Step Two—Do a thorough top to bottom, inside and out IAQ walk-around of the facility and assess the specific IAQ challenges for each building—whether it's particles, moisture, ventilation, pollutants or comfort.

Step Three—Create an IAQ program to address the challenges. The program starts by taking credit for what is already being done, and then adopting some additional good practices to address existing deficiencies. Prevention is the goal.

The key to prevention is to first understand the building from an IAQ perspective: the Step Two assessment provides a documented "baseline" of conditions. Now the conditions in the buildings can be routinely monitored for such critical IAQ factors as temperature, humidity, CO2, and particle levels. Not only do these routine measurements provide early warning if the numbers deviate from the norm, but the record provides evidence of proper operation and attention to good practice.

With a well-planned IAQ monitoring and control program, using the right instruments, the facility director, maintenance technician, or head custodian can:

- Help identify indoor air quality issues before they become major problems
- Improve comfort and increase teacher performance and student achievement
- Reduce health risks and exposure to asthma triggers
- Pinpoint causes and avoid costly and/or unnecessary and ineffective repairs
- Clearly demonstrate the district's commitment to providing adequate indoor air quality
- Avoid negative publicity, loss of community trust, litigation and financial liability

Infrared thermometers are a convenient way to check for temperature differences along pipes that could indicate a moisture leak.

Benchmarks

Both the walk-around inspection and the subsequent IAQ management program are focused on five basic benchmarks of indoor environmental quality.

- **Moisture.** In addition to opening the way for mold growth, excess moisture can cause unsightly stains and even structural damage. "Add water and you've got mold," Prill says. "If you've got any water leaks, which most buildings do, you need to address that immediately. The "best" water leak is one that is small enough it doesn't cause extensive damage and big enough that you find it in time. So we suggest moisture meters to locate wet materials. Bigger districts can probably benefit from a thermal imaging device that's sensitive enough to show the temperature difference between wet materials and dry materials. That's a good way to find hidden moisture, and track down the source of a leak."
- **Comfort.** The right combination of temperature and relative humidity is essential, but comfort is what people feel, not what a thermometer or humidity tester say it is. Prill uses an infrared thermometer to measure surface temperatures and spot problems. A room thermostat might read 72 degrees Fahrenheit, but occupants feel hot. The infrared thermometer reveals that the ceiling surface may be is 85 degrees, and further investigation shows the unvented attic space above is 140 degrees. In winter, cold walls and window surfaces can have just the opposite effect—occupants feel cold in spite of air temperatures in the comfort zone.
- **Cleanliness.** "Typically in schools the cleaning is based on appearance, not on health," Prill says. "If it looks clean, good enough. But we find that carpets that look clean can contain huge amounts of particles. Many of these particles are allergy and asthma triggers. So how do the custodians or janitorial staff keep abreast of quality control? Are you spending the time, money and equipment where you need to?

  "By having some kind of a particle measurement you can look at various areas and say, "Gee, how come this wing of the building has ten times more particles than the other wing?" It could be that one custodian is not doing as good a job, or his/her vacuum equipment isn't working. Maybe the kids are tracking in too much dirt from the playground. Measurement is just a way to get a handle on reality."

  Prill uses a laser particle counter to get real time counts of the number and size of particles present and track down their source. Instead of assuming high particle counts are caused by dirty ductwork, and spending thousands on cleaning, Prill advises schools to count the particles in air from supply ducts. If the supply air is cleaner than room air, the HVAC system is likely not the problem.
- **Ventilation.** A key job for the HVAC system is removing stale or polluted inside air and replacing it with cleaner outside air. ANSI/ASHRAE Standard 62-2001, *Ventilation for Acceptable Indoor Air Quality*, calls for 15 cubic feet per minute of outside air supply for each student. Inadequate supply can allow levels of carbon dioxide to climb above the ASHRAE guideline of 1,000 parts per million (ppm). Excess CO2 also suggests that other pollutants and particulates are also accumulating. The CO2 meter makes it easy to routinely tour the various zones and note whether the proper amount of outside air is being supplied. CO2 measurement also identifies over-ventilation of zones. Over-ventilation can waste energy, increase wear and tear on equipment, and create comfort problems. Another significant benefit is that the occupants can see for themselves that they are getting the fresh air they deserve. The CO2 meter, particle counter and infrared thermometer help keep a check on the cleanliness and temperature of air coming into the room. An airflow capture hood determines supply air volume.
- **Pollutant control.** Point sources of pollutants must be identified and controlled and in general, air should flow from clean to dirty. That means air moves from the hallway into and through the restroom to be vented outside. Air moves into the chemistry lab and storage areas 24/7 to protect occupants in adjacent spaces in case of a mistake, leak or spill. Prill uses a chemical tracer smoke to track the direction of airflow, and carries a carbon monoxide tester to check for the presence of dangerous combustion gases.

Careful maintenance also prevents the HVAC system itself from turning into a pollutant source. Heating and cooling coils, drip pans and ducts must be kept dry and clean, filters changed and properly sealed, motors and drive systems checked for correct mechanical and electrical performance. Proper air flow through filters and coils means energy efficiency, too. Prill finds that paying attention to IAQ often uncovers energy saving opportunities—in fact, these energy savings can easily pay for your IAQ equipment and efforts.

Information takes center stage

The success of a school IAQ program ultimately lies with securing the understanding, buy in and support of students, staff, and community.

"Education and communication are absolutely key," Prill says. "The schools need to be proactive. If people come to you asking questions, it's too late – – it looks like you're being reactive instead of proactive. You need to provide information before they ask.

"We suggest they adopt an IAQ program and market that. Advertise it. Talk it up. Once you start talking about it, people's fears or anxieties are relieved because they know someone's in charge, someone's paying attention. And a little bit of knowledge goes a long way, especially with numbers. You can say 'Look, no particles coming out of the ducts, relative humidity is okay, the CO2 numbers show fresh air being delivered, and air is moving into restrooms, locker rooms, storage, mechanical rooms—the right way . . . "clean to dirty." This approach clearly demonstrates you're paying attention and doing what you can in a very real and practical fashion.' That makes a big difference in giving people confidence."

Documentation can also build a strong defense against legal claims. Air quality test equipment can pay for itself over time, by documenting that the building is operated in a healthy and safe fashion, according to Prill. "It's going to be pretty hard to come after you if the building is clean and dry and comfortable. A lot of districts, especially the bigger ones, are finding that having documentation, and having numbers, really pays," he adds.

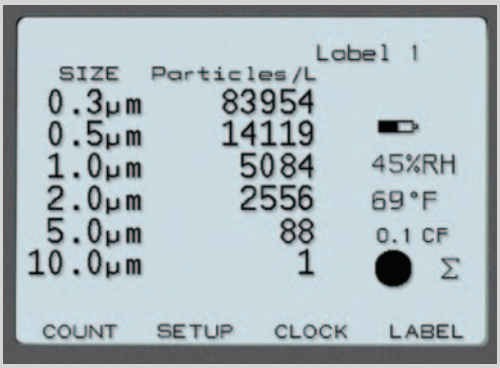
"If schools have documentation, then it's hard to suggest that they're negligent. That's what schools are trying to do: follow good practice."

Using a particle counter to evaluate air quality at the supply vent.

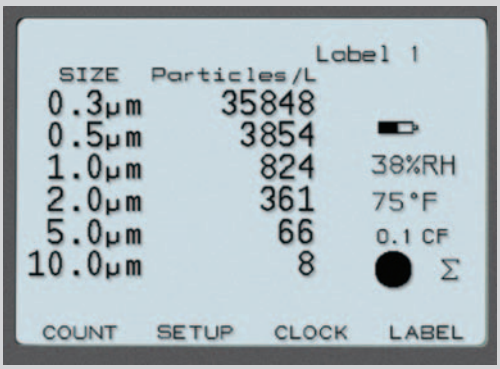
Particle count examples

Here are three sample readings from a Fluke 983 Particle Counter, taken in and around an elementary school.

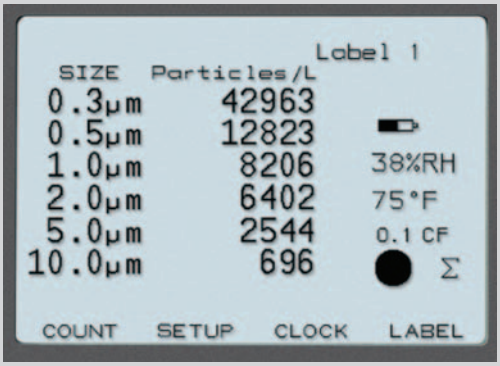
This sample was taken outdoors. It's the baseline for comparing indoor measurements to.



This sample was taken from ambient classroom air. From this sample alone we can't tell where the pollutants are coming from, but note that they are significantly less than the baseline outside readings. Use the particle counter near the supply ducts, doors, windows, and other areas of possible contamination, to determine whether a repair is necessary.



This sample was taken near the carpet, right after people had walked by, to simulate the effect of particles kicked up by student activity. Compare the particle counts to the baseline. This could suggest the need to vacuum more frequently, ideally with a HEPA-installed vacuum, to reduce the risk of asthma. Note especially the elevated levels of particulates between 1 and 10 microns, when compared to the ambient readings.



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Web access: http://www.fluke.com

Printed in U.S.A. 7/2005 2519671 A-EN-N Rev A