DEGREE CONTROLS, INC.
Your Partner for Airflow Sensing & Controls
18 Meadowbrook Dr., Milford, NH 03055
603.672.8900 or 1.877.334.7332
603.249.9653
www.degreec.com

Application Note Series

Air Quality Series – Measure and Monitor Airflow for Health and Safety

Product Platforms: Air Velocity Sensors, Airflow Switches, Multi-Point Airflow Sensing, Airflow Alarms & Monitors & Visualization
Purpose: Measure and monitor air velocity, temperature and humidity for health and safety
Testing Range: 0.15 m/s to 20 m/s [30 fpm to 4000 fpm]

ABSTRACT:

Airflow is vital for the safety and comfort of building occupants, energy efficiency, and extending the life of buildings and building components. The COVID-19 pandemic has served to highlight the importance of airflow as well as anemometers and airflow measurement and monitoring tools to keep people safe and minimize hazards. Ventilation systems around the world are being evaluated and improved with a focus on health measures and indoor air quality.

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Part 1: Rooster™ Pressure100 for Pressurized Spaces

Making Space for Patient Care:

As a result of the COVID-19 pandemic, hospitals are implementing increased patient capacity by making additional spaces for patient care. Maintaining these rooms or spaces at negative pressure is critical to ensure safety of surrounding areas and minimize cross-contamination.

Rooster™ Pressure100 – Fast to Setup, Easy to Use:

The Rooster™ Pressure100 air pressure monitor and alarm from Degree Controls can *verify negative pressure prior to placing a room into service* and *provide continuous monitoring of the room thereafter*. The Pressure100 is a plug and play system, fast to setup, and easy to use. With a glove friendly, color touchscreen for configuring alarm set points and output behavior, the Pressure100 alarms audibly and visually, and can also be easily integrated into your laboratory or building management system. The Pressure100 displays real-time air pressure and conveys safety by updating the color of the background screen. Critical alarms are augmented with a blinking LED. In addition to air pressure and pressure mode, the Pressure100 monitors and displays temperature and relative humidity, and features data logging export via the built USB port for your documentation and compliance recordkeeping.

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Figure 1 Monitor Room Air Pressure for Safe Patient Care Spaces

Airflow Safety Support:

Contact Degree Controls for help with airflow safety and pressure measurements for negative isolation rooms and negative air pressure environments. Our Rooster™ Airflow Alarm & Monitor platform provides users with a reliable, high-accuracy, hassle-free safety airflow safety and compliance (NSF/ANSI-49 & OSHA) solution for laboratories, clean rooms, and critical ventilation systems.

Part 2 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* reviews airflow management tools for engineering controls.

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Part 2: Airflow Management Tools for Engineering Controls, Health & Well-Being

Note: Part 1 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* presents the Rooster™ Pressure100 air pressure monitor and alarm to verify and monitor pressure for safe patient care spaces.

Airflow for Health and Well-Being:

There's a lot we don't yet know about COVID-19, however the CDC, ASHRAE, and OSHA agree that engineering controls are an effective means of protecting employees and communities. Engineering controls are methods built into the design of buildings, equipment or processes to minimize hazards, and one of the strategies is to remove hazards through air ventilation:

- Ensure appropriate air-handling systems are installed and maintained,
- Ensure engineering controls function as designed, and
- Improve engineering controls using the HVAC system.

Consider increasing ventilation rates, and adding technology such as airflow monitoring and alarms, as you review your ventilation systems.

Airflow Management to Help Control Transmission:

Degree Controls manufactures airflow safety products to check and monitor these engineering controls, as well as air velocity, temperature and humidity sensors for embedded applications. Our extensive portfolio includes:

- Switches to alarm when airflow falls below a safe level,
- air velocity and temperature sensors to send analog/digital outputs to building ventilation and control systems,
- custom fan control solutions, which can connect directly to your larger building control systems,

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- Rooster™ alarms and monitors for airflow or zone pressurization, temperature and humidity, and
- visualization products to verify airflow patterns, detect leaks, and test air filters.

Please see our complete product line at degreec.com.

Figure 2 Air Velocity Sensors, Airflow Monitor & Fog Generator

Grateful to the Science Community:

We are extremely grateful to scientists worldwide for their ongoing efforts to understand the coronavirus and develop treatments and vaccines. As the scientific community learns more about the impacts of air quality and airflow on transmission, we stand ready to support. Don't hesitate to contact Degree Controls to learn more about our airflow management products and services.

Part 3 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* discusses increasing ventilation and airflow measurement and monitoring to understand ventilation systems and identify changes in performance.

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Part 3: Increasing Ventilation for Health & Well-Being

Note: Part 2 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* reviews airflow management tools for engineering controls.

Ventilation for Safety:

Recent guidance from ASHRAE is to consider increasing ventilation rates to help protect against the transmission of COVID-19, and as a result, many are working to become familiar with an unfamiliar topic.

Minimum Ventilation Rates for Spaces:

Ventilation is the intentional and controlled introduction of outdoor air into a space. It can improve air quality by diluting and displacing hazards, and also affects the temperature and humidity of a space and direction of air flow within the space.

Section 6 of ASHRAE Standard 62.1 provides minimum ventilation rates for spaces including classrooms, restaurant dining rooms, health clubs, and more. The rates consider contamination sources originating from building occupants and their activities, as well as from the building itself. This reference for determining outdoor airflow requirements illustrates how outdoor air rates vary with type of occupancy, density of occupants within the space, and the floor area of the space, and *helps us to gain insight* into increasing ventilation rates.

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Increasing Ventilation:

Clean, fresh air is generally a good thing, although outdoor source pollutants must be considered. Suggestions for increasing ventilation rates include:

- Check and clean your ventilation system.
- Increase total supply air, and outdoor air, by opening diffusers or adjusting dampers.
- Run systems longer. Temporarily scale back the use of energy conserving demand-controlled ventilation.
- Add hardware. An air-side economizer, for example, can bring cool, outside air into a building and distribute it.

If your building doesn't have a ventilation system, opening windows and decreasing the number of occupants in the space are options, in addition to increasing natural ventilation through larger openings.

Figure 3 Ventilation to Improve Indoor Air Quality

Airflow Awareness:

Measuring and monitoring airflow will allow you to understand your existing ventilation system, record changes as ventilation systems are adjusted and improved, and discover ventilation issues quickly, as they occur.

Standard airflow measurement techniques can be used for measuring outdoor air intake. Install air velocity and temperature probes at key points in your ventilation system to provide real-time

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feedback to your controller or control system. Get further assurance that target air volume is being added to/removed from a space by installing a Rooster™ monitor for real-time display of air changes per hour (ACH). Unintended flow reversals can also be quickly detected with a B-Series bi-directional sensor to output airflow direction, along with air velocity and temperature, in real-time.

Measuring velocity in turbulent air can be simplified by using handheld visualization tools to disperse fog into the environment. When the airflow paths are understood, measurement tools can be deployed.

We are with you when you're ready to begin your airflow improvements. Contact a Degree Controls representative to learn about our resources and airflow sensing and controls platforms.

Part 4 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* looks at filtration for safer indoor air and key roles of airflow and air velocity sensors in indoor air quality and air filter selection, operation and performance.

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Part 4: Air Filtration for Safer Indoor Air

Note: Part 3 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* discusses increasing ventilation and airflow measurement and monitoring to understand ventilation systems and identify changes in performance.

Air Filtration for Safer Indoor Air:

ASHRAE statements regarding transmission of SARS-CoV-2 convey that ventilation and filtration provided by HVAC (heating, ventilating, and air-conditioning) systems can reduce the airborne concentration of Covid-19 and thus lower the risk of transmission.

HEPA (high efficiency particulate air) filters are air filters designed to stop or capture very small particulates from an air stream at a highly effective rate. According to the U.S. Department of Energy, to qualify as HEPA, a filter must remove at least 99.97% of particles when tested with an aerosol with a size of 0.3 microns.

Airflow and Airflow Sensors for Indoor Air Quality:

Airflow and air velocity sensors play a major role in indoor air quality and air filter selection, operation and performance:

- Filtration efficiency, or the ability of the filter to remove contaminants from air passing through the HVAC system, is a big factor in filter selection. HEPA filter test standards establish efficiency under a specified air flow, and this data is included in manufacturer's specifications.
- Filters should be used at their rated pressure drop and face velocity to be most effective. Filter face velocity is the measured air velocity entering the filter, and the pressure drop

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of a filter is a measure of its resistance to airflow through it, given for specific face velocities. Rated pressure drop increases with air velocity.

- Although there are HVAC situations where increased airflow is beneficial, HEPA filters may experience a decrease in collection efficiency if they are operated at a face velocity exceeding manufacturer's specifications.

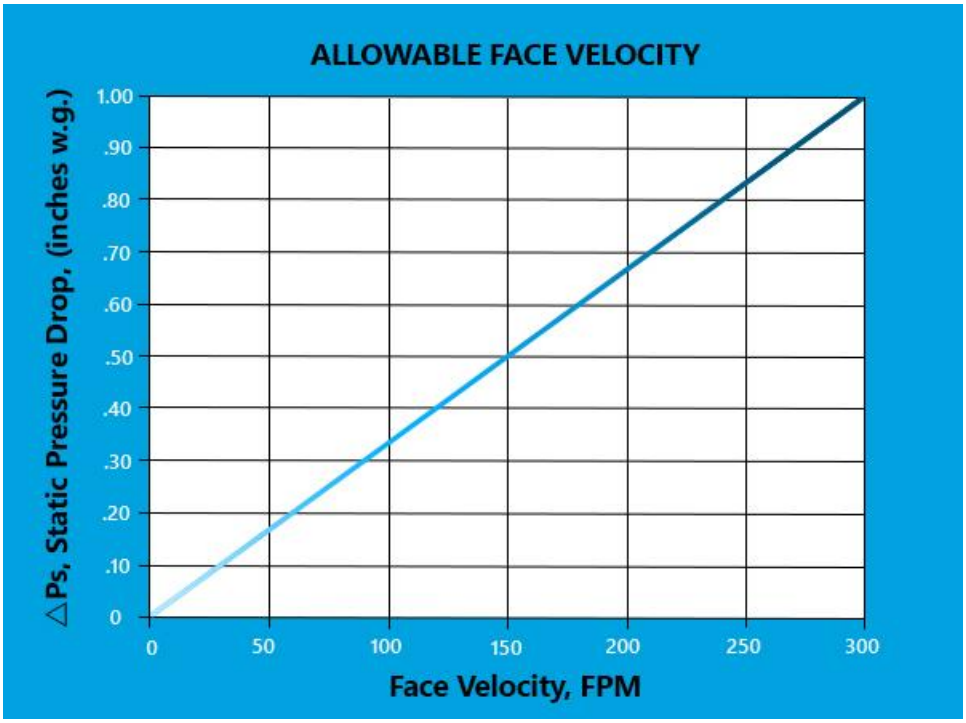

Figure 4 Example pressure drop vs face velocity for filter

Conduct Periodic and Quantitative Airflow Testing:

The control of airborne particulates is dependent upon many factors which include filter efficiency, air velocity and airflow uniformity. Airflow measurement and monitoring will allow you to identify any variations that might adversely affect filtration and system performance and thus increase the risk of contamination. Single or multipoint air velocity sensors should be used to measure face velocity across filters and verify flow at strategic points in the system. Airflow visualization products should be used to verify airflow patterns and identify turbulence which may negate the clean spaces you've worked so hard to establish. Our handheld foggers are portable, easy to use and show real-world airflow patterns immediately.

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Stay Safe:

Degree Controls will continue to support businesses worldwide as they adapt to the ongoing threat of Covid-19. Contact a DegreeC representative at sales@degreec.com for airflow products and product support. Please take care, and stay healthy and safe during these challenging times.

Part 5 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* discusses the assessment of airflow patterns for safety using visualization tools.

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Part 5: Air Velocity Measurement and Air Pattern Analysis for Safety

Note: Part 4 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* Safety looks at filtration for safer indoor air and key roles of airflow and air velocity sensors in indoor air quality and air filter selection, operation and performance.

Measuring Air Velocity & Analyzing Air Patterns for Safety:

We are not alone in our support of the use of airflow management tools for engineering controls, as well as airflow visualization products to verify airflow patterns and identify turbulence in indoor environments such as restaurants, classrooms, and manufacturing facilities. FDA guidance discusses the importance of clean areas for drug product quality and includes recommendations for measuring air velocity, as well as in situ air pattern analysis at critical product areas. As scientists around the world work on potential treatments and vaccines for COVID-19, the FDA continues in its oversight of drug and vaccine production and monitors manufacturers with its Current Good Manufacturing Practice (CGMP) regulations for ensuring quality and safety.

Airflow Visualization is Powerful:

Our foggers are easy to use and a good first step in understanding the airflow conditions of your indoor space. Smoke studies show airflow direction and uncover areas of turbulence and stagnant flow. Smoke study videos demonstrate and document the airflow characteristics and provide an effective means of communication and collaboration in your work to establish and maintain safe indoor air systems.

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Visualizing Airflow Patterns Across Industries:

The inclusion of aseptic techniques in dynamic smoke studies is an important factor in maintaining control and preventing contamination in pharmaceutical drug production, however the use of our handheld, portable foggers for airflow visualization is universal. Restaurant owners, facilities managers, sterile drug compounders and others all find value in the fast, effective results delivered by our foggers. Our smoke generators are used for initial assessments of airflow patterns and also serve as key companions to our air velocity sensors and airflow monitors in verifying ventilation systems and ensuring that they operate as designed.

Figure 5 Using Foggers to Assess Airflow Patterns is Universal

We Support Science During COVID-19, and Always:

We're rooting for science, and we will continue to support with airflow expertise and technology. Contact a Degree Controls representative to learn more about our airflow measuring, monitoring and visualization platforms. Be well, and stay safe--*together*, we will navigate these unprecedented times.

Part 6 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* reviews airflow measurement to validate CFD simulations.

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Part 6: Airflow Measurement to Validate CFD Analysis

Note: Part 5 of our *Air Quality Series – Measure and Monitor Airflow for Health and Safety* discusses the assessment of airflow patterns for safety using visualization tools.

Airflow Measurement to Validate CFD Analysis – Help Prevent the Spread of COVID-19:

The Coronavirus (COVID-19) pandemic is affecting all of us. As the world works toward reopening, simulation is one of the strategies being used to understand ventilation systems and how aerosols and droplets propagate. This allows managers of indoor (and outdoor) spaces such as offices, manufacturing facilities, restaurants, and lecture halls to better prepare and prevent the transmission of COVID-19.

Validation of CFD modeling with air velocity, temperature and humidity sensors from Degree Controls ensures prediction quality. HVAC and ventilation systems can vary widely, and airflow sensor placement strategy varies by application. Degree Controls offers a variety of airflow tools which are used by our clients to collect quantitative information. Examples include:

- °C SPAR (Sensor Pole Array) is a device with multiple air velocity sensors along its length. By mounting the °C SPAR to a telescoping base, a user can take readings at different heights and create an X-Y planar airflow analysis in a room. This technique is also useful for evaluating thermal stratification and the effectiveness of mixing air to achieve temperature equalization in your space.
- °C Grid is a pre-built, X-Y sensor array contained in a frame, used to study the planar airflow profile in room areas, ducting, HEPA filtration units, and airflow dampers. °C Grids are built with up to 200 sensors, each measuring air velocity and air temperature simultaneously. Experiments using a °C Grid at multiple locations can resolve 3D airflow plumes.

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- Our UAS1000 series of individual airflow, temperature and humidity sensors are connected together with our °C Port data acquisition instrument and AccuTrac™ datalogging software, which enables the user to position the sensors to create custom, multi-point sensing arrays. As the highest standard for multi-point airflow sensing, the UAS1000 product line is used around the globe for determining airflow patterns and velocity and temperature distributions.

Figure 6 Multi-Point Airflow Sensor Arrays for Quantitative Analysis

Clients are using air velocity, temperature and humidity sensing to verify that their computational simulations agree with physical reality, as well as to gain insight on the effects of inducement and entrainment, in real time. DegreeC continues to support them with our 25+ years of airflow expertise. In addition to our USB-based airflow sensors, we offer analog/digital probe style sensors and °C SPARs with analog output.

Stay safe now and throughout the reopening.

CONTACT:

To find out more about Degree Controls' sensor products and solutions, contact us at 1-877-degreeC, or visit our website at www.degreeC.com. Email sales inquiries to sales@degreec.com.

Degree Controls, Inc.
18 Meadowbrook Drive
Milford, New Hampshire, 03055
USA

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