ACHIEVING VALIDATED CORROSION CONTROL IN SENSITIVE ELECTRONICS FACILITIES

The degradation of electrical control equipment by corrosive gases is a well-known effect. In fact, virtually all manufacturers of sensitive electronic/electrical equipment specify the required environmental conditions for their equipment as part of the warranty conditions. These specifications set limits for temperature, relative humidity and chemical contaminants as they all influence the rate of corrosion.

The components that are most susceptible to damage are printed circuit boards (PCBs), exposed contacts and conductors. Hydrogen sulphide (H2S), sulphur dioxide and trioxide (SO2, SO3), chlorine (Cl2), nitrogen dioxide (NO2) and hydrogen fluoride (HF) are some of the commonly known corrosive gases that effect electronic and electrical control equipment.

A. WHAT DETERMINES THE IMPACT OF EXPOSURE

Corrosive gases originate from the raw materials and/or chemicals used in various industrial process. Industries with higher prevalnce of these gases are; oil and gas, pulp and paper, mining and metal refining and waste water treatment.

Concentration of corrosive gases in industrial areas & electronic hubs are classified as G4 Severe, in ANSI/ISA-71.04-2013. A commonly applied standard that focuses on airborne contaminants and observed rates of corrosion for copper and silver metals.

B. WHY THE ROUTINE SOLUTIONS MAY NOT BE EFFECTIVE

Routine solutions are installation of air filters or treatment systems which by themsleves do not have the capability to to take care of the certain critical aspects:

Infiltration & exfiltration: unwanted leakages allow ingress from potential contamination sources

Room air movement: controlling air movement between the zones via pressure relationships and attaining optimised mixing efficiency for removal of tiny droplet nuclei generated within the space

Demand Control Ventilation: which ensures optimal multiple space ventilation at any given time for dilution of the contamination.

C.
HOW TO ATTAIN COMPREHENSIVE CORROSION CONTROL?

The solution lies in designing a system using multi zone transport analysis of contaminants (including acidic gases), and validation of building performance in terms of:

A. Ambient Air Quality - where noxious gases & pollutants in the ambient air are measured

B. Ventilation & Air Mixing - ensured for effective displacement of contaminants and corrosive gases

C. Infiltration & Exfiltration - unwanted leakages are identified and accounted for

D. Room Air Movement - room to room air movement is controlled via pressure relationships (fig. 1)

E. Indoor Air Quality - Now the corrosive gases can be removed by molecular filtration with temperature and humidity conditioned air to achieve the desired environmental conditions and monitoring of acidic gases.

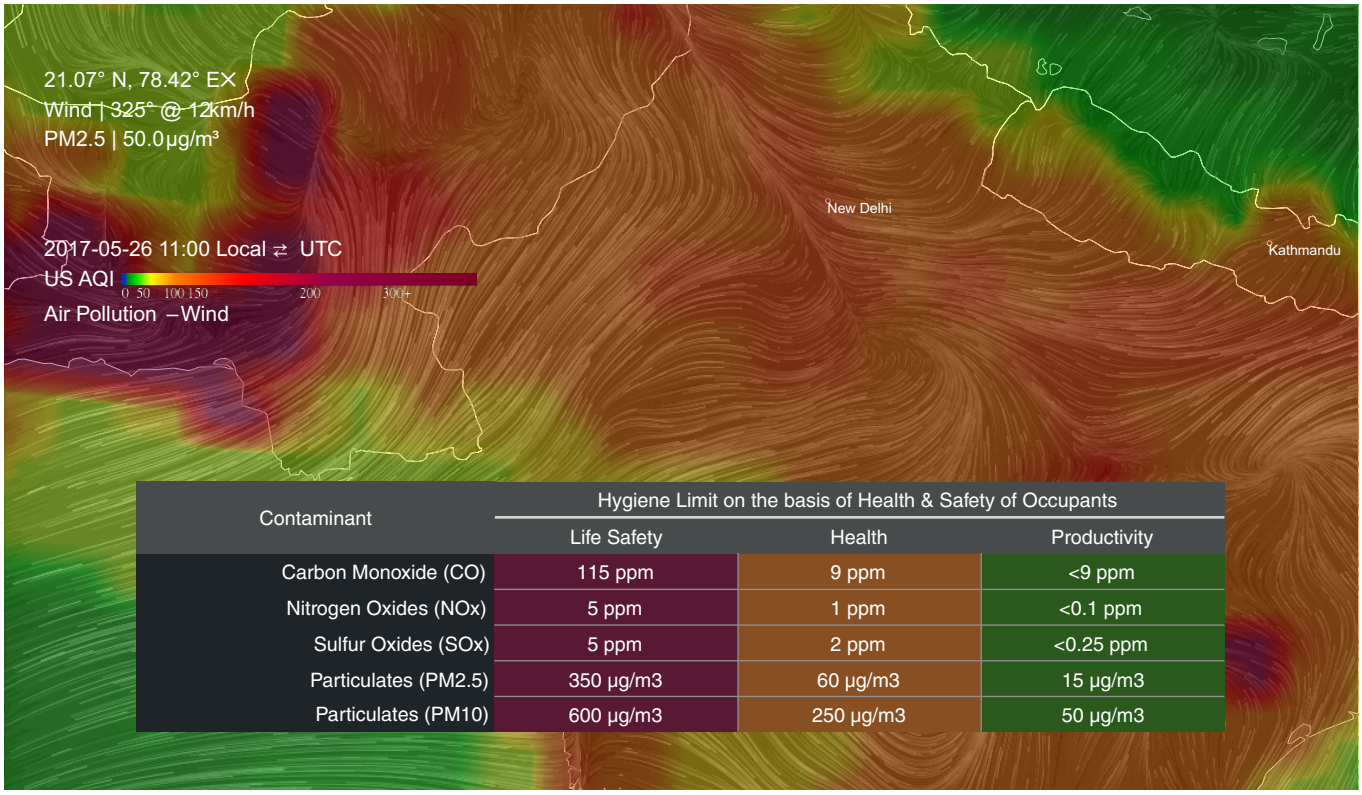
D.
VALIDATED CONTAMINATION CONTROL

HOW IT WORKS?

Ambient Air Quality

Using historical wind pressure and ambient air quality data survey, a building model is prepared with respective orientation and layout. (fig. 1a). These findings are validated by mesh of portable neural sensor (AAQ) and remote monitoring & analytics software.

Areas inside the building are then demarcated according to the ISA classification (fig 1b).



Contaminant	Hygiene Limit on the basis of Health & Safety of Occupants		
	Life Safety	Health	Productivity
Carbon Monoxide (CO)	115 ppm	9 ppm	<9 ppm
Nitrogen Oxides (NOx)	5 ppm	1 ppm	<0.1 ppm
Sulfur Oxides (SOx)	5 ppm	2 ppm	<0.25 ppm
Particulates (PM2.5)	350 µg/m3	60 µg/m3	15 µg/m3
Particulates (PM10)	600 µg/m3	250 µg/m3	50 µg/m3

Figure 1a

ISA Classification of Reactive Environments (ANSI/ISA 71.04-2013)

COPPER REACTIVITY LEVELS (A/month)		G1 (MILD)	G2 (MODERATE)	G3 (HARSH)	G4 (SEVERE)
		< 300	< 1,000	< 2,000	> 2,000
GROUP	GAS	GAS COCENTRATION (parts per billion)			
A	Hydrogen sulphide (H_2S)	< 3	< 10	< 50	50
	Sulphur dioxide (SO_2)	< 10	< 100	< 300	300
	Sulphur trioxide (SO_3)				
	Chlorine (Cl_2)	< 1	< 2	< 10	10
	Nitrogen oxides (NO_x)	< 50	< 125	< 1,250	1,250
B	Hydrogen fluoride (HF)	< 1	< 2	< 10	10
	Ammonia (NH_3)	< 500	< 10,000	< 25,000	25,000
	Ozone (O_3)	< 2	< 25	< 100	100

Figure 1b

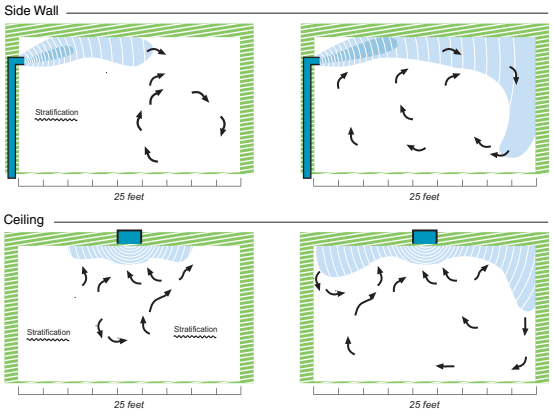


Figure 2a

Selection based on NC 30

Air Mixing

In larger areas, desired air mixing efficiency plays a crucial role in removal of toxic elements in indoor air, thus impacting the overall indoor air quality.

Stratification and improper mixing can lead to increase in accumulation of the corrosive acidic gases (as illustrted in fig. 2a) and can be avoided by .....

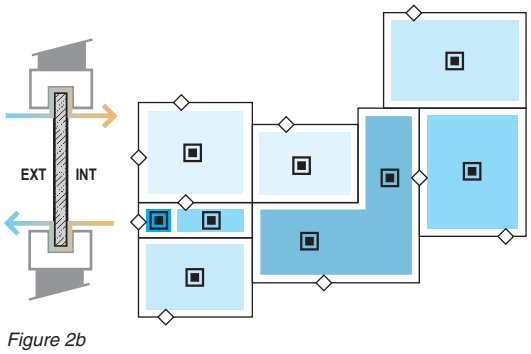


Figure 2b

Infiltration & Exfiltration

Uncontrolled flow of outdoor and exhaust air is predicted by using effective leakages based on various building materials and partition.

Necessary makeup air should be adjusted in real-time for source capture ventilation.

Room-to-room airflows are calculated using multi zone airflow analysis in building systems driven by

- Mechanical means
- Wind pressures acting on the exterior of the building
- Buoyancy effects induced by the indoor and outdoor air temperature difference

These are then validated by mesh of portable neural sensor (Pressure) and remote monitoring & analytics software

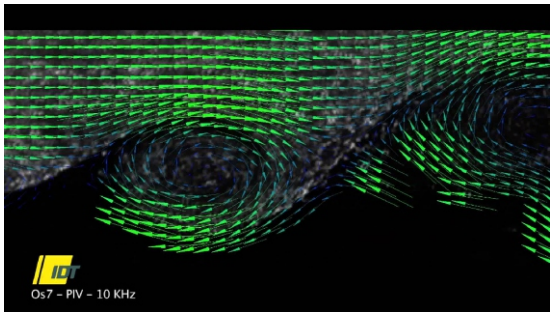


Figure 3a

Room Air Movement

Controlling room to room air movement via pressure relationships will helps in isolating the cleanest zone of concern. PCB Production area or Sensitive Electronics room.

Therefore our goal is to achieve better mixing efficiency with entrainment flow while choosing right air outlets & their location.

Air mixing efficiency is predicted by multi-zone air flow analysis CFD simulation. Validated by mesh of portable neural sensor (Flow) and remote monitoring & analytics software.

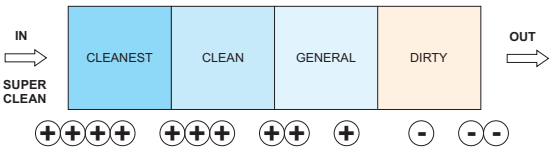


Figure 4a *Controlling Air Movement via Pressure Relationships*

Controlling Air Movement

Using Differential Pressure Relationship:

• We can optimise the room air movement to create the ante room effect by installing zone regulation devices at return air paths.

• Additionally, a protective environment room can also be created for sensitive electronics based on the area classification.

Indoor Air Quality

Since building conditions are dynamic, they should be monitored with a room pressure monitor with alarm to be raised if the make up is beyond the limit of corrosion control unit.

Corrosive acidic gases can also be measured as required.

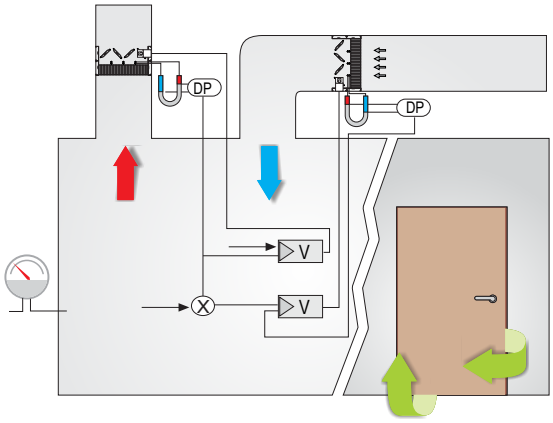


Figure 5a

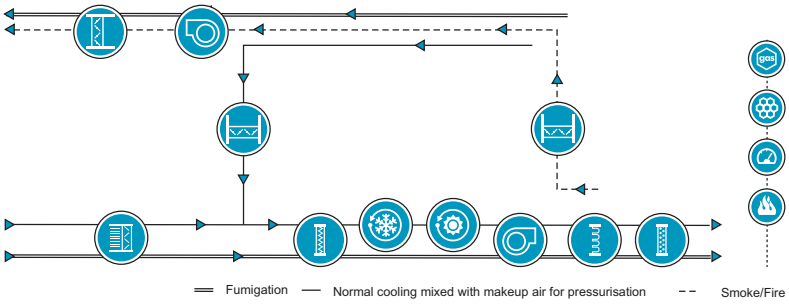


Figure 5b

Ensuring Optimal Filtration and Adsorption

Defined by using building performance results and achieved by deploying

• Additional corrosion control unit with airflow monitoring control stations to achieve necessary pressurisation

• Strategic use of room cleaner (fan filter unit) i.e. without disturbing the room air movement

• Online filter scanning for checking the integrity and performance of molecular filters with aerosol challenge

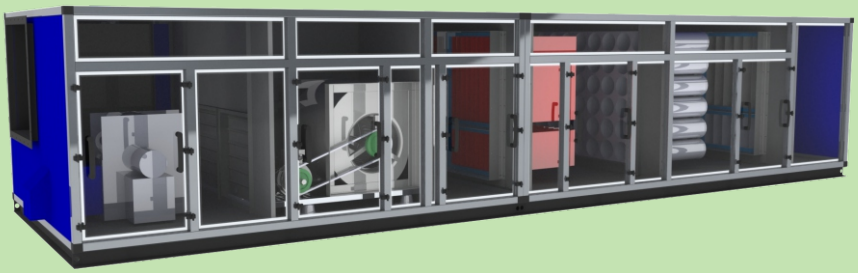
E.
COMPONENTS OF A VALIDATED CORROSION CONTROL SYSTEM

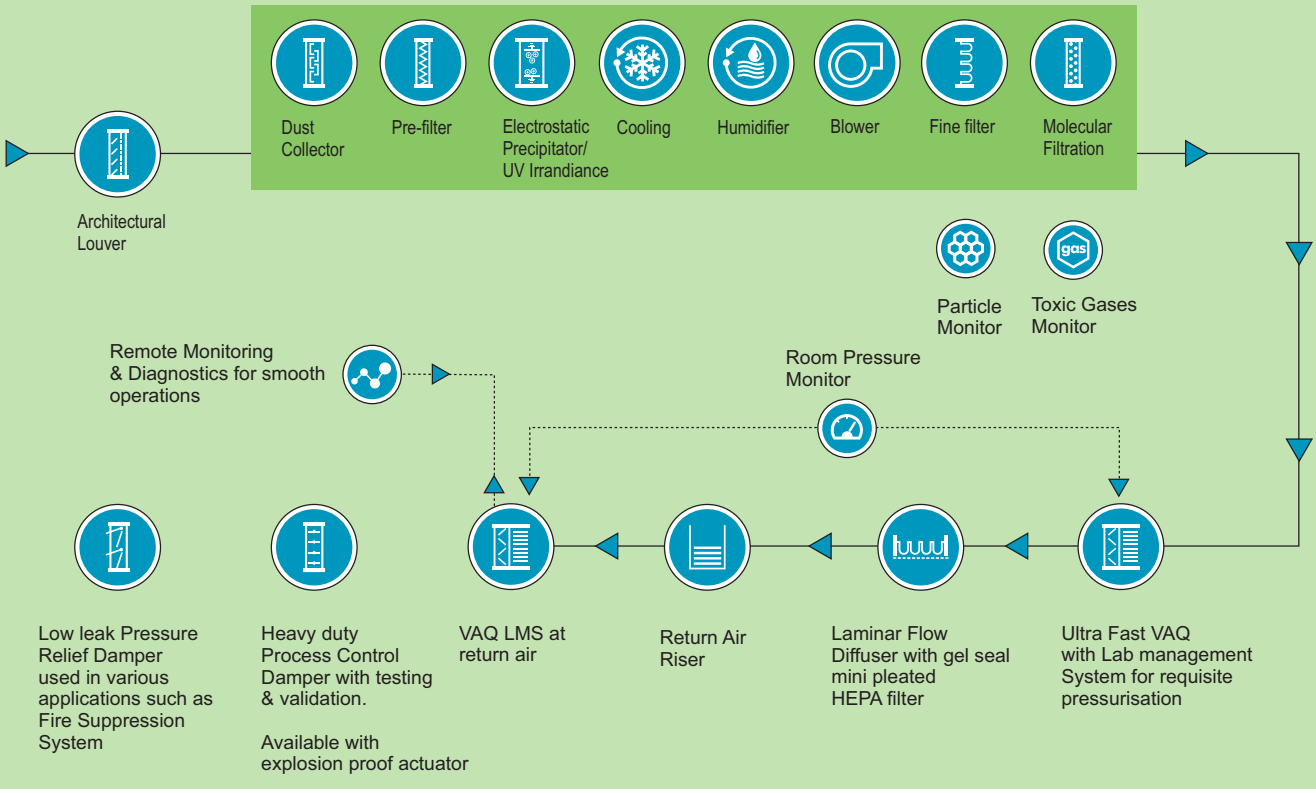
1. Corrosion Control Unit

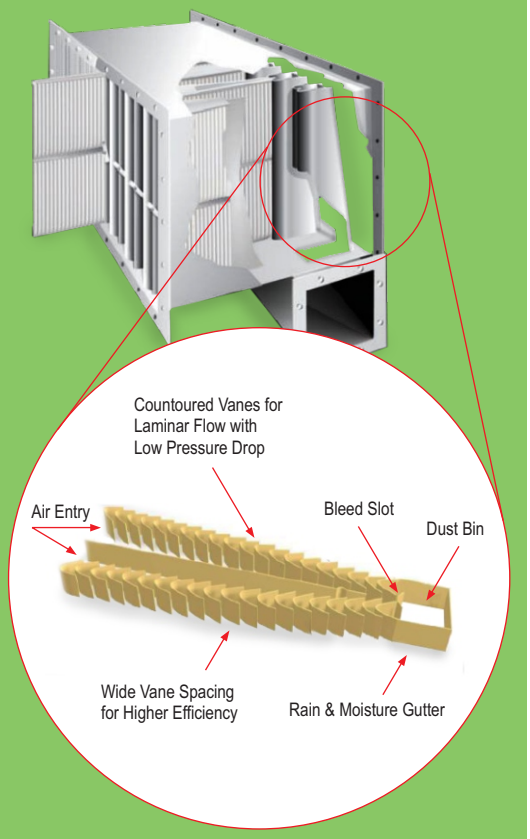
Contamination control unit, with double stage molecular filtration targets the range of acidic gases. Chemical adsorption ensures that previously adsorbed target contaminants are not subsequently desorbed into clean air with preliminary dust arrestance. It is complete with a fast running (15s) VAQ station installed at fresh air intake with room pressure monitor, door latch, indoor air quality monitor, and advanced application specific control.

- Suitable for air capacity of upto 6000 cfm.
- Construction: 18 G 1.2 mm thick SS304 With IE3/IE4 motor and suitable VFD panel
- Incorporates smoke extraction features and modulating smoke dampers installed at return air, mixed air, & exhaust air
- Equipped with primary G4 (MERV-8) and final F9 (MERV-15) filters to achieve defined hygiene limits.

Corrosion Control Unit







2. INERVANE / DYNAVANE
Self Cleaning Inertial Separator

It is designed to handle large volumes of air at high velocities, while operating at a constant airflow resistance for use in single and multi-stage filtering systems. As the mixture of dust and air enters the Innervane, most of the air changes direction, separating itself from the dust as it passes through the vanes.

Because of its greater mass and natural movement (inertia), the dust continues in a straight line with 10% of the incoming air (the "bleed air") through the bleed slot and into the dustbin duct.

The dust-laden bleed air can then be discharged directly back to the surrounding atmosphere or into a secondary dust collector.

Specifications

Inertial separators are factory fabricated and assembled. Each unit consists of a housing, a bleed air manifold, cell bodies, blade packs, bullnoses, and inlet screen. The innervane consists of one or more cells as per airflow and resistance requirements. Individual cells include two removable blade packs.

HOUSING : Welded steel construction with continuous standing flanges around the periphery of both the air entering and the air exiting sides.

BLEED AIR MANIFOLD: Welded steel construction with continuous standing flange. Manifolds are sized to provide uniform airflow through each cell's dust bin for proper balance and dust removal.

BLADE PACKS: Heli-arc welded steel construction. Vanes are individually formed and welded, arranged to provide a circuitous path to the air flow and redirect the air toward the clean air outlet.

BULLNOSE : Aerodynamically formed to provide proper air entry. One bullnose required for each two blade pack.

BLEED SLOT : Steel construction and a rounded entry config. to minimize obstruction or plugging under heavy dust concentrations.

INLET SCREEN : 26-gauge, four-mesh, galvanized hardware cloth supported by a double layered 16- gauge galvanized steel frame.

EFFICIENCY : Not less than 93%, when tested as per general requirements outlined in SAE J726. Standardized Coarse Air Cleaner Test Dust at a clean airflow rate of 1000 CFM (1700 m3/h) per single cell using a bleed rate equaling 10% of inlet airflow. Inlet to clean air outlet resistance not exceeding 1.20" w g. (0.30 kPa) at 1000 CFM (1700 m3/h) clean airflow

3. CAMCARB or DEEP BED
Designed as per the Air Quality Study

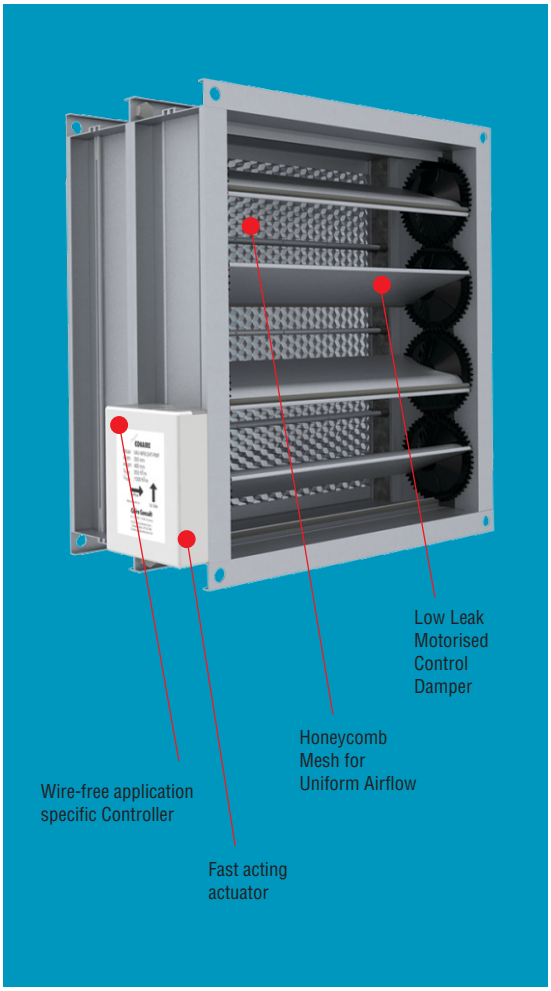
The CamCarb CG is a molecular filter suited for moderate duty applications in process and industrial environments. Mounting on its dedicated holding frame ensures elimination of all internal leaks, achieving very high efficiency values. Thus, ideally suited for use in recirculation/return air systems in corrosion control applications. It can also be used in make-up air systems in applications where low or moderate gas concentrations are expected.

Specifications

Made of extremely corrosion resistant plastics.

The air-inlet end cap features a radiused profile to reduce pressure drop and a pair of co-moulded TEP thermo-elastic gaskets to eliminate air by-pass.

Each cylinder is filled using a vibratory technique to ensure perfect packing density of the filtration media. The cylinders are mounted and dismounted from the base plate using a standard 24 mm wrench.



4. VAQ Station for Room Pressurisation

The Variable Air Quantity station regulates airflow within desired minimum and maximum levels for contamination control through room pressurisation. Installed at fresh, return, exhaust & mixed air paths as shown in schematic 5a, or described in schedules, the station incorporates an accurate air measuring station and a motorized low leak control damper in one assembly.

It comes with a pressure independent application specific wire-free mesh controller with multi-hop self-forming, self- optimizing and self healing wireless mesh network with baud rates configured to 76800 bps, i.e. 8 times faster than conventional wired system.

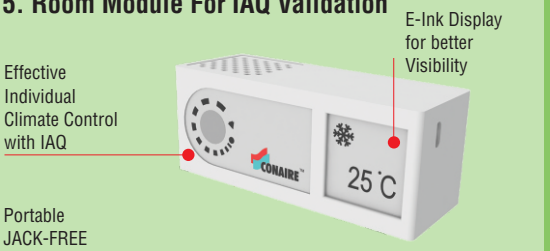
Construction

Available in custom sizes to suit duct or air outlet dimensions and dynamically calibrated to required airflow ranges with non linear calibration routine to provide accurate airflow measurement. Available in various mounting options or configurations, the stations include position feedback directly mounted on damper blades with a rapid average pitot tube for end to end verification.

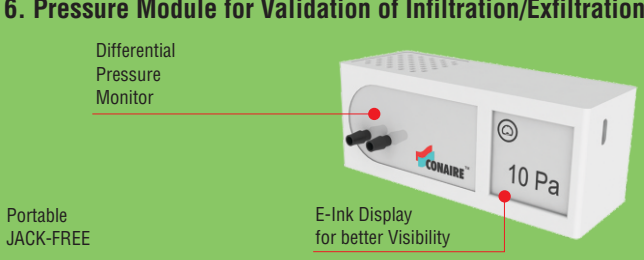
Rated for airflow measurement in accordance with AMCA standard 611 and tested for Class II leakage as per AMCA standard 511.

Click here for more on Contamination Control through Room Pressurisation.

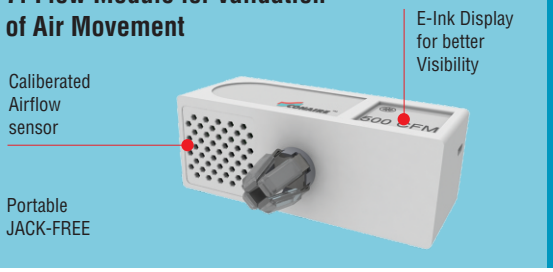
5. Room Module For IAQ Validation



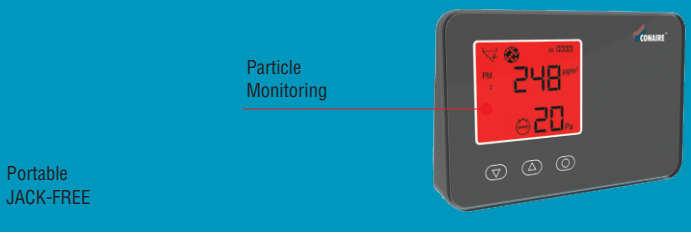
6. Pressure Module for Validation of Infiltration/Exfiltration



7. Flow Module for validation of Air Movement



8. PM/Noxious Gas Module for Validation of Ambient Air Quality



F.

DESIGN & ANALYSIS SERVICES FOR VALIDATED CONTAMINATION CONTROL

Comprehensive Air Quality Analysis

Initial Multi-zone transport analysis consists of:

AMBIENT AIR QUALITY : Corrosive Acidic Gases & Pollutants in the Ambient Air or generated nearby as per ISA, using Wind Pressure and Contaminant Data (WPC) initial building model is prepared.

INFILTRATION & EXFILTRATION : Unwanted Leakages estimated in to building model using ASHRAE effective leakages table.

ROOM AIR MOVEMENT : Stimulate your building air distribution efficiency for calculating air change effectiveness.

INDOOR AIR QUALITY : Pollutants or Microbial aerosol generated within The Space, their fate and transport as per NIST, with above analysis and sample data correction, 24h and annual exposure report of contaminant and acidic gases submitted.

Validation

Each result reported by Transient Contamination Analysis is Validated/Corrected by most advance portable neural sensor for Pressure, Flow, Temperature, Humidity, Ambient Air Quality, and Indoor Air Quality using most advanced evaluation techniques such as Particle Image Velocimetry. Presented with building predictive contamination model linked to nearest live Wind Pressure and Contaminant data.

NEED MORE INFORMATION?

For your application queries let's set up a meeting / presentation.

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