



## HVAC Systems: Assessing the HVAC System as part of your IAQ Investigation

Mr. Sean Chester

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Founder: Apex Solutions





Clean air.....Why should we care?



## Contaminants!

The air we breath is as important as the food we eat and the water we drink.

Outdoor air is also indoor air!

Indoor air can be more polluted than outdoor air!

Air is a delivery system for disease



23 Aug


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# Finding it hard to breathe? Air quality in Joburg worst in the world, according to index

Alex Patrick

news24

 Comments

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The Washington Post  
*Democracy Dies in Darkness*

Climate Environment Weather Climate Solutions Climate Lab Green Living Business of Climate

CLIMATE AND ENVIRONMENT

## The hidden toll of air pollution on office workers

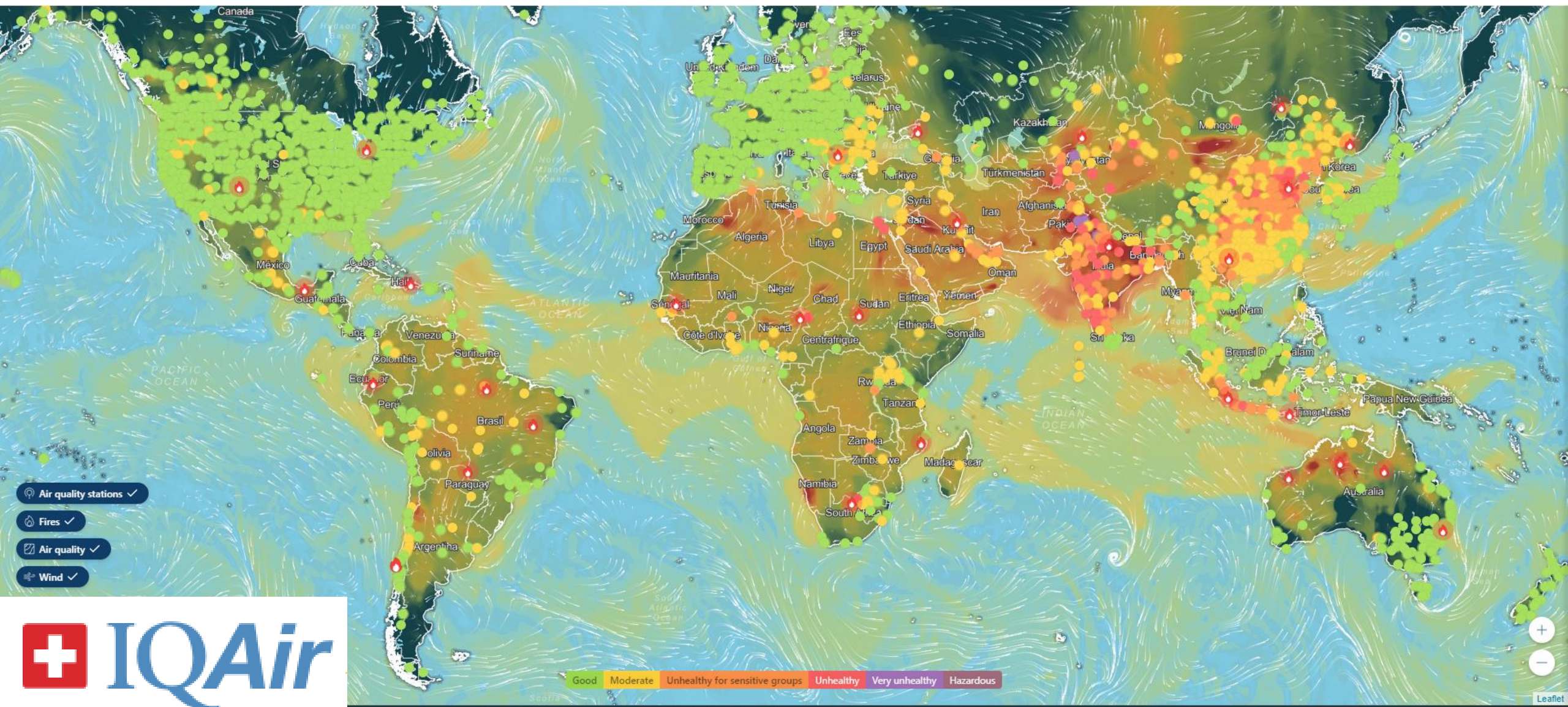


By [Chris Mooney](#)

June 14, 2016 at 3:18 p.m. EDT
























# IQ Air outdoor pollution levels



<https://www.iqair.com/air-quality-app>

# Durban outdoor pollution levels (forecast)

Day	Pollution level			Weather	Temperature	Wind
Today	Moderate	53 AQI US		 90%	20° 17°	 18 k
Thursday, Nov 9	Good	36 AQI US		 40%	19° 18°	 10.8
Friday, Nov 10	Good	47 AQI US			22° 17°	 25.2
Saturday, Nov 11	Moderate	52 AQI US		 70%	28° 18°	 28.8
Sunday, Nov 12	Good	32 AQI US		 70%	20° 19°	 32.4
Monday, Nov 13	Good	42 AQI US		 80%	20° 17°	 14.4
Tuesday, Nov 14	Good	27 AQI US		 60%	20° 17°	 18 k

# Applicable IAQ Legislation

- The OHS Act (Section 8)
- Hazardous Biological Agents Regulations, 2022
- Environmental Regulations for Workplaces, 1987 Regulation 5 (Ventilation) of the
- National Building Regulations, Part O (SANS 10400)
- NEMAQA

## GOVERNMENT NOTICES • GOEWERMENTSKENNISGEWINGS

### DEPARTMENT OF EMPLOYMENT AND LABOUR

NO. R. 1887

16 March 2022

OCCUPATIONAL HEALTH AND SAFETY ACT, 1993

HAZARDOUS BIOLOGICAL AGENTS REGULATIONS, 20...

#### Scope of application

2. (1) Subject to sub regulation (2), these Regulations apply to every employer or self-employed person at a workplace where—

- (a) an HBA is produced, processed, used, handled, stored or transported; or
- (b) exposure to an HBA may occur.

(2) Regulations 8, 14, 15, 16 and 17 do not apply to an employer or self-employed person at a workplace where the exposure is restricted to a Group 1 HBA.

<i>Orthomyxoviridae:</i>	
Influenza (human)	2 (V)
Severe acute respiratory syndrome-2 (SARS CoV2)	3*(V)

# Applicable Legislation: NEMAQA, 2004

## 3. NATIONAL AMBIENT AIR QUALITY STANDARD FOR PARTICULATE MATTER (PM<sub>2.5</sub>)

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
24 hours	65 µg/m <sup>3</sup>	4	Immediate - 31 December 2015
24 hours	40 µg/m <sup>3</sup>	4	1 January 2016 - 31 December 2029
24 hours	25 µg/m <sup>3</sup>	4	1 January 2030
1 year	25 µg/m <sup>3</sup>	0	Immediate - 31 December 2015
1 year	20 µg/m <sup>3</sup>	0	1 January 2016 - 31 December 2029
1 year	15 µg/m <sup>3</sup>	0	1 January 2030
The reference method for the determination of PM <sub>2.5</sub> fraction of suspended particulate matter shall be EN 14907			

# Draft Physical Agents Regulations

Table 4: Guideline levels for indoor air quality parameters.

IAQ Parameter	Level	Unit
Air temperature	20 to 28 (dry bulb temperature)	Degrees Celsius
Air velocity	0.1 to 0.8	meters per second (m/s)
Relative humidity	30 to 60	%
Carbon Dioxide	Not exceed the outdoor concentration by more than 600ppm	Parts per million (ppm)
Carbon Monoxide	10	mg/m <sup>3</sup>

## Countries / Organizations incorporating CO<sub>2</sub> into their Ventilation Law and Guidance Documents

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- **USA, UK, Australia Denmark, Germany, Norway, Slovenia**
- **South Africa** – DEL Code of Practice: Managing Exposure to SARS-COV-2 in the Workplace
- **WHO – REHVA – ASHRAE - ILO**



Standard 241, *Control of Infectious Aerosols*,



The Chartered  
Society for Worker  
Health Protection

**CO2 Monitoring and COVID-19 – Some Basics**

### **Covid-19 Guide on Ventilation and CO<sub>2</sub> monitoring**

**Ventilation and CO<sub>2</sub> measurements  
to combat airborne Covid-19 contamination**



# Airborne Pathogens

- Anthrax
- Aspergillosis
- Blastomycosis
- Chickenpox
- Adenovirus
- Enteroviruses
- Rotavirus
- Influenza
- Rhinovirus
- Neisseria meningitidis
- Streptococcus pneumoniae
- Legionellosis
- Measles
- Mumps
- Smallpox
- Cryptococcosis
- Tuberculosis
- Bordetella pertussis
- Severe acute respiratory syndrome (SARS)
- Middle East Respiratory Syndrome (MERS)
- SARS COV2 (COVID-19)

# IAQ Criteria Chemicals & HBA

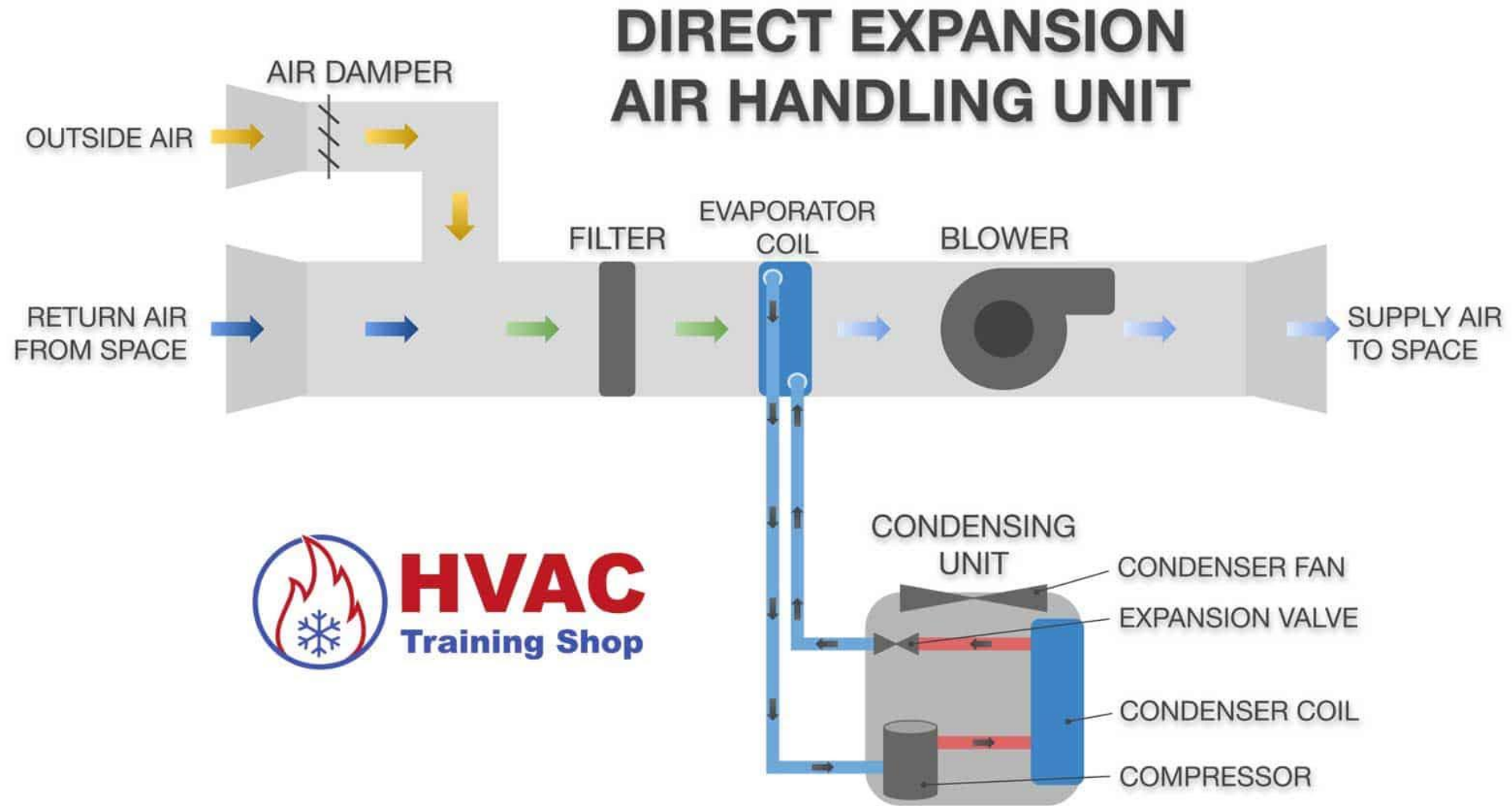
Parameter			Excellent Class	Good Class
Pollutant	Averaging Time	Unit		
Carbon Dioxide (CO <sub>2</sub> )	8-hour	mg/m <sup>3</sup>	1,440	1,800
		ppmv	800 <sup>a</sup>	1,000 <sup>a</sup>
Carbon Monoxide (CO)	8-hour	µg/m <sup>3</sup>	2,000 <sup>b</sup>	7,000 <sup>c</sup>
		ppmv	1.7	6.1
Respirable Suspended Particulates (PM <sub>10</sub> )	8-hour	µg/m <sup>3</sup>	20 <sup>d</sup>	100 <sup>d</sup>
Nitrogen Dioxide (NO <sub>2</sub> )	8-hour	µg/m <sup>3</sup>	40 <sup>c</sup>	150 <sup>e</sup>
		ppbv	21	80
	1-hour	µg/m <sup>3</sup>	100 <sup>c</sup>	200 <sup>c</sup>
		ppbv	53	106
Ozone (O <sub>3</sub> )	8-hour	µg/m <sup>3</sup>	50 <sup>b</sup>	120 <sup>f</sup>
		ppbv	25	61
Formaldehyde (HCHO)	8-hour	µg/m <sup>3</sup>	30 <sup>b</sup>	100 <sup>b</sup>
		ppbv	24	81
	30-minute	µg/m <sup>3</sup>	70 <sup>c</sup>	100 <sup>c</sup>
		ppbv	57	81
Total Volatile Organic Compounds (TVOC)	8-hour	µg/m <sup>3</sup>	200 <sup>b</sup>	600 <sup>b</sup>
		ppbv	87	261
Radon (Rn)	8-hour	Bq/m <sup>3</sup>	150 <sup>g</sup>	167 <sup>c</sup>
Airborne Bacteria	8-hour	cfu/m <sup>3</sup>	500 <sup>h,i</sup>	1,000 <sup>h,i</sup>
Mould	---	---	Assessment in form of prescriptive checklist in Annex 3 <sup>j</sup>	

Ref: Hong Kong Guide on Indoor Air Quality Certification Scheme

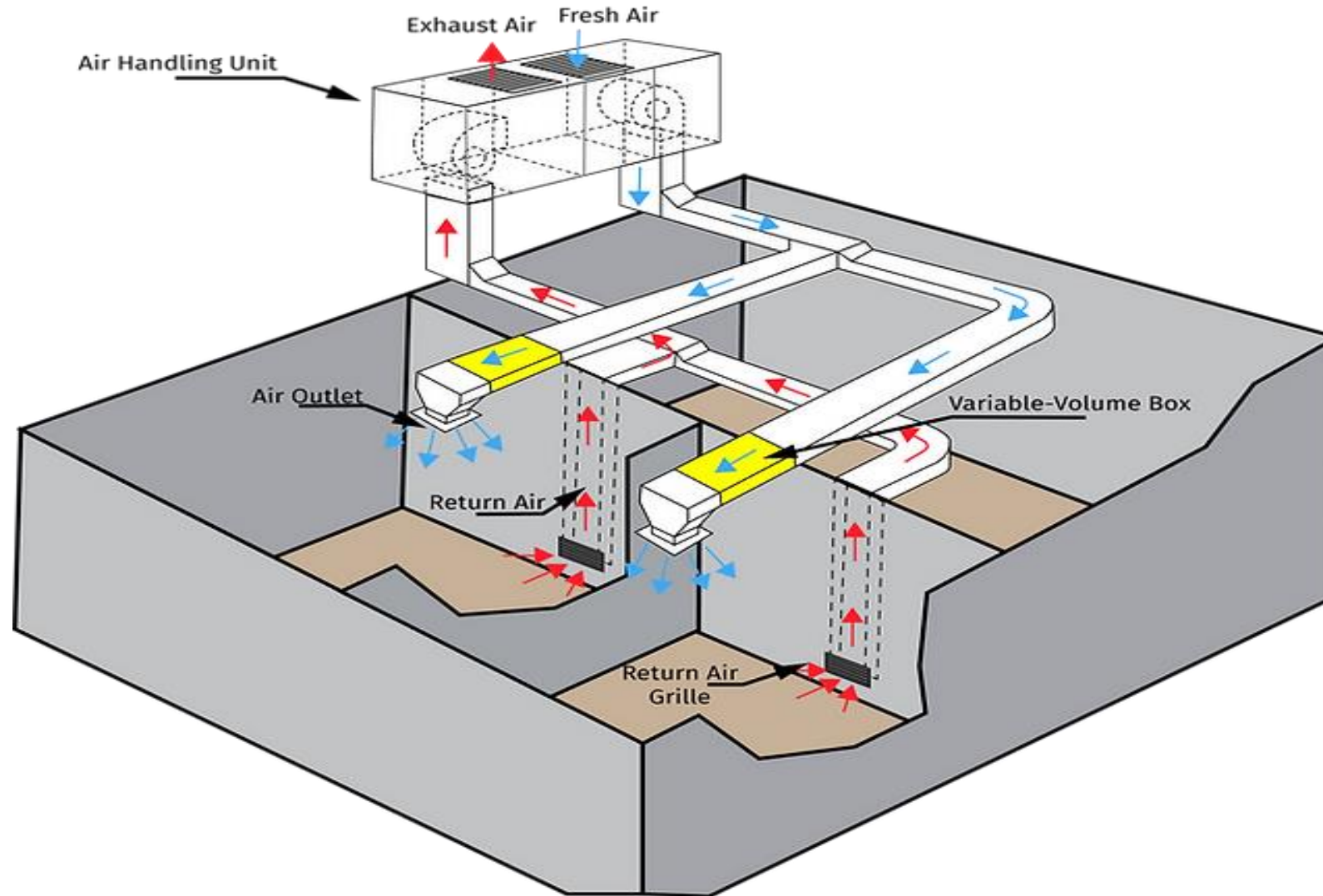


## Site Risk Assessment

# Site Risk Assessment: Understanding the AHU



# Site Risk Assessment: Understanding the AHU





Tools



Tools

CO<sub>2</sub> / PM / temperature / % RH  
Laser Measuring Device  
Anemometer  
Smoke Tubes  
Torch

RTM

# OHS Conference IAQ Standard (CO<sub>2</sub>)



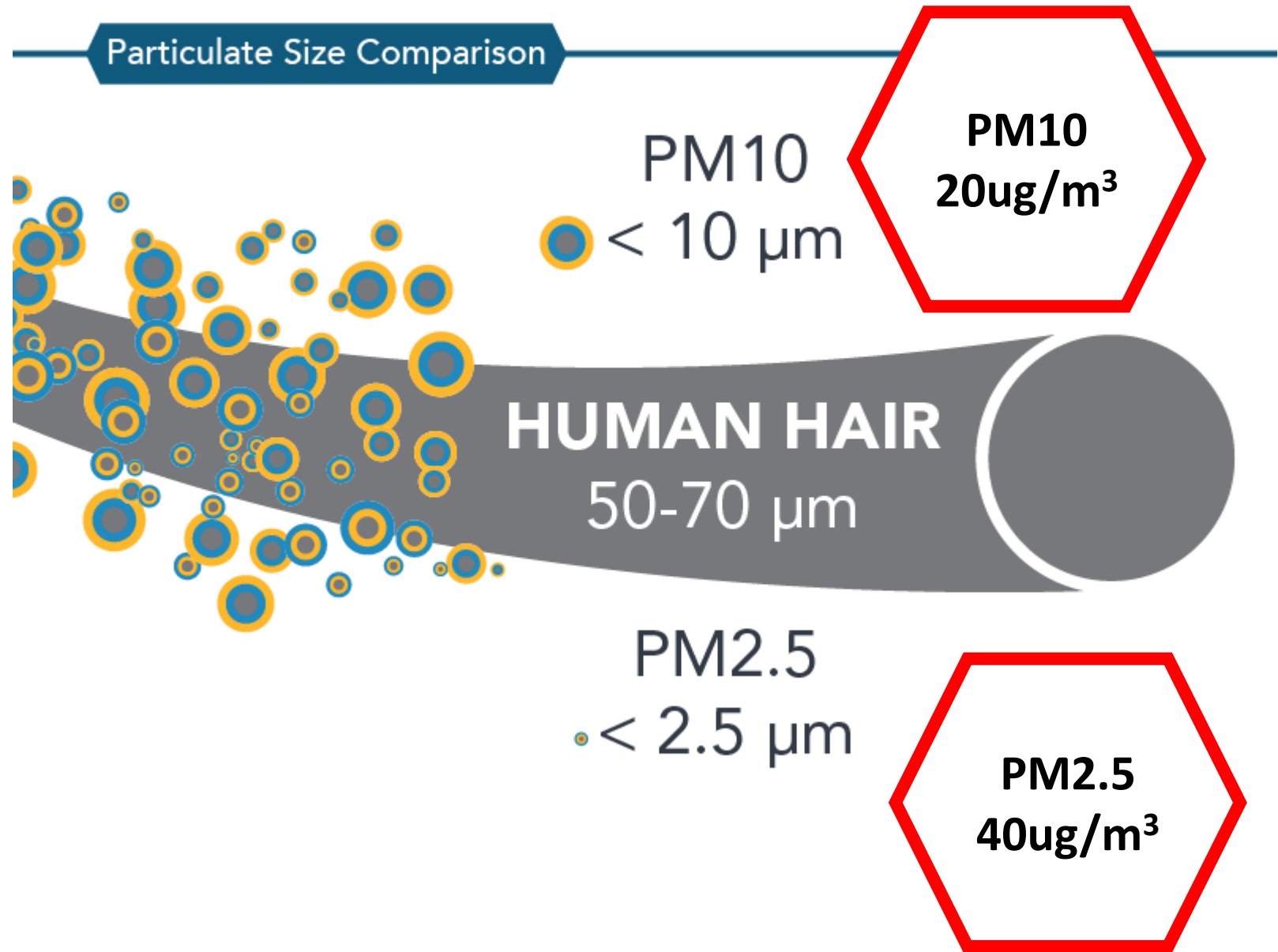
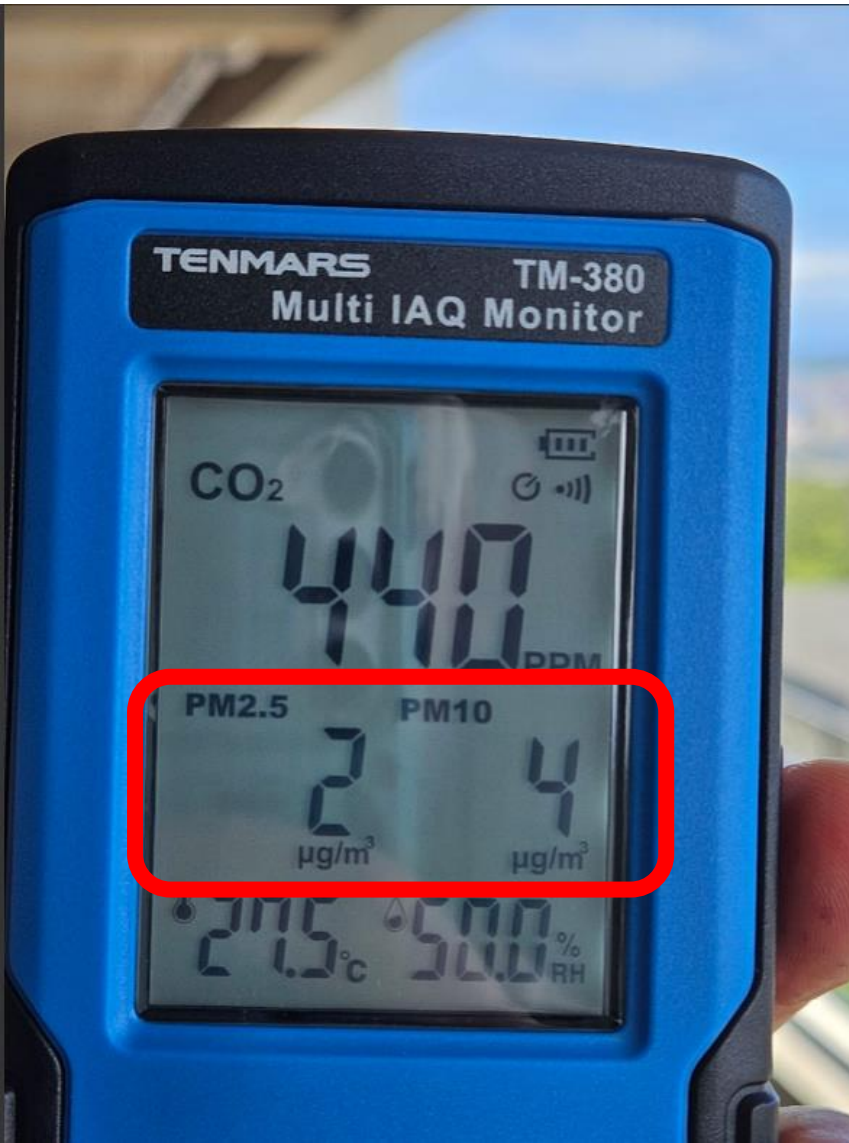
IAQ Standard:

440 + 600 =

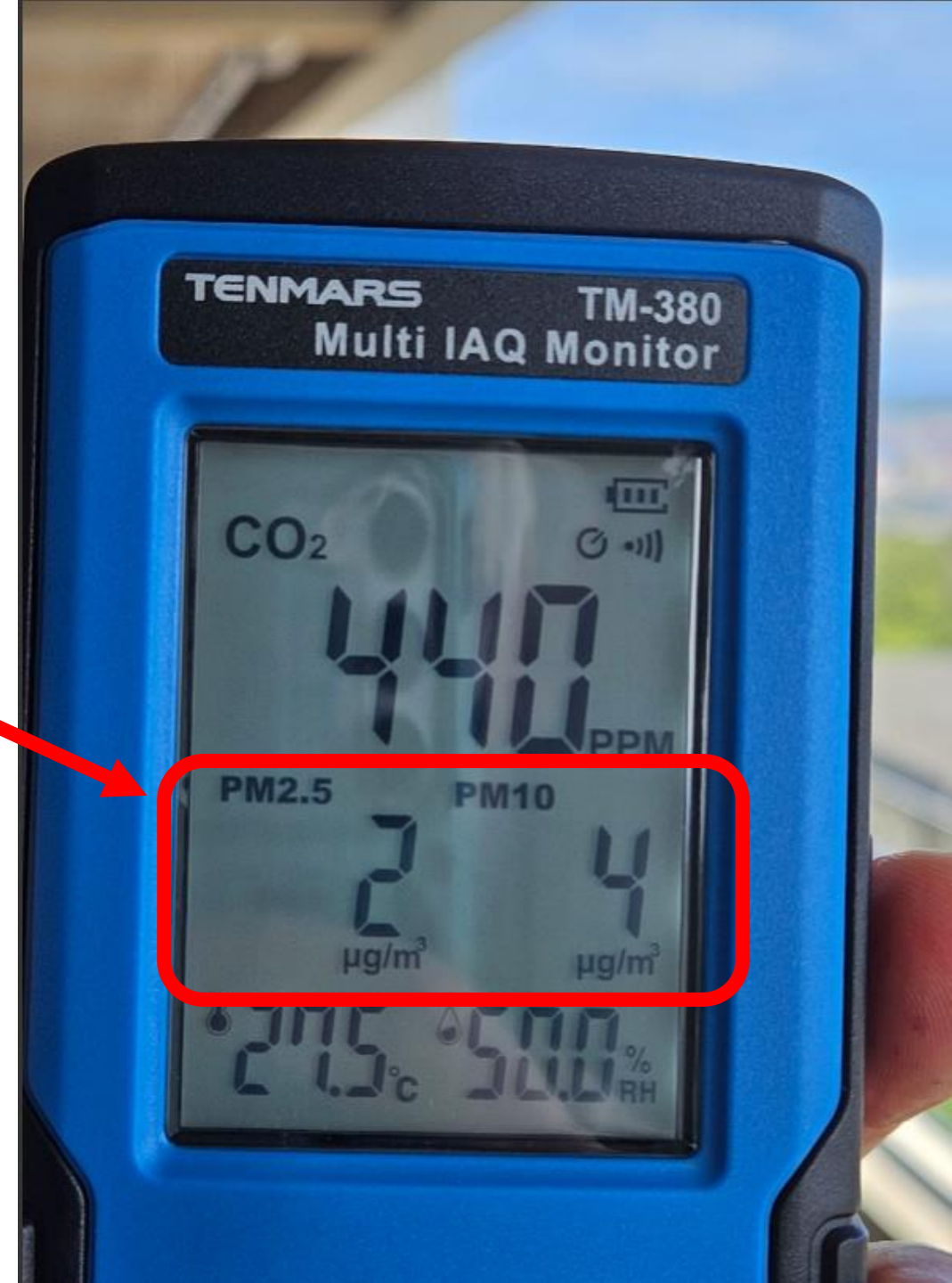
**1040ppm**

Carbon Dioxide	Not exceed the outdoor concentration by more than 600ppm	Parts per million (ppm)
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# OHS Conference IAQ Standards (PM10 and PM2.5)



Usefulness of PM Results = FILTRATION!



# CO<sub>2</sub> and Risk Assessment

**The lower the CO<sub>2</sub> and PM concentrations, the lower the IAQ Risk**

CO<sub>2</sub> as an (INDIRECT) proxy for determining the ventilation rate of an occupied building

PM – Outdoor pollution levels – test effectiveness of the AHU filtration efficiency



# CO<sub>2</sub> as a direct pollutant – Health Effects

Building a  
business case  
for economic  
impacts

2000-3000 ppm	Restrictive lung behaviour and elevated blood CO <sub>2</sub>	3 hours
2000 ppm	Kidney effects in animals (likely calcification) - incomplete study	Chronic studies
1900 ppm	Reduced sleep quality, drowsiness	8 hours
1400-3000 ppm	Significant impairment of cognitive function including fatigue	2.5 to 8 hours
1200 ppm	Reduced cognitive function	2.5 hours
1000 ppm	Harmful changes in respiration, circulation, and the cerebral cortex	A short time



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## Site Risk Assessment: Basic RA Process for Conferences

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Monitor the outdoor concentrations of CO<sub>2</sub> and PM

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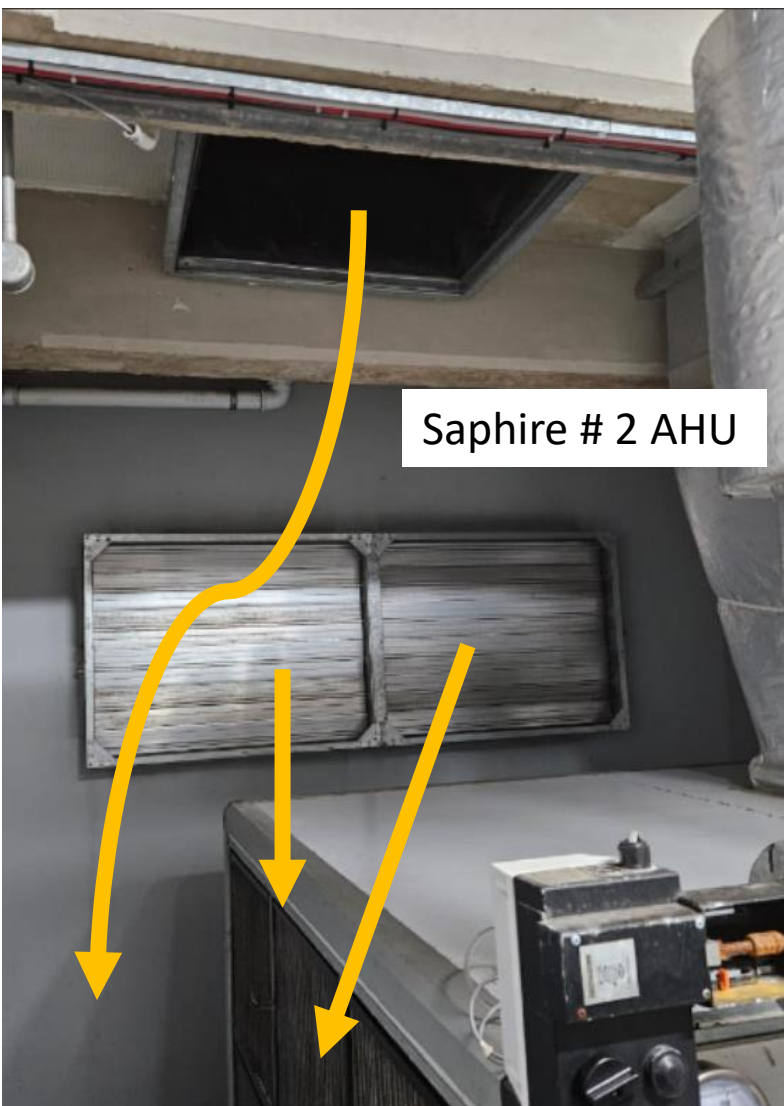
Inspect the key HVAC Components

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Real-Time (Roving) Monitoring on site

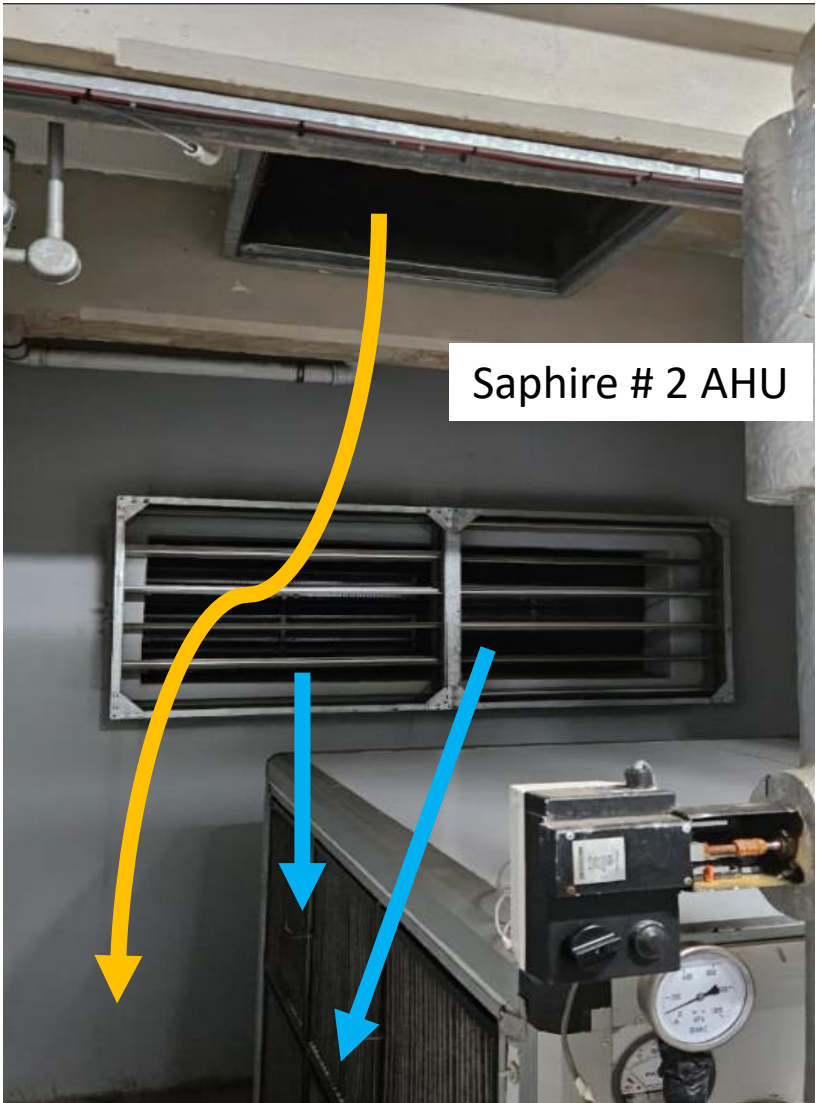
# Site Risk Assessment

Inspect the key HVAC Components (AHU, Filters, Outdoor Air Intakes, Return Air Ducts and Supply Diffusers)



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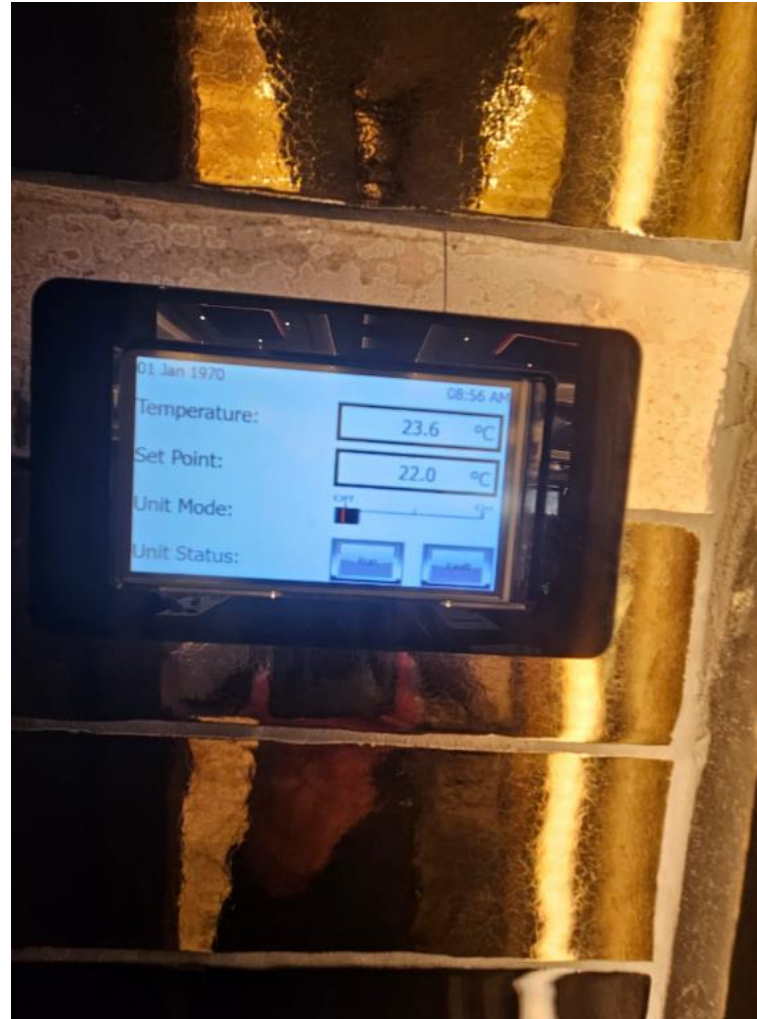


# Site Risk Assessment: Intake plenums adjustment



330ppm reduction - Compliant

# Site Risk Assessment: Control units – Operators are everywhere!



# Site Risk Assessment: Control units – should be locked!



350 ppm  
reduction -  
Compliant

## Looking at solutions:

- Must be energy conscious BUT recognize that ventilation is **Safety Critical Equipment**
- Restore HVAC to original design
- Remove obstructions and short circuits
- Promote cross ventilation
- Educate and influence AC Technicians, Maintenance and Facilities Managers
- RT Monitor Outdoor and system CO<sub>2</sub> and PM



**There is a huge opportunity for  
integrated partnerships in this space**

# GREENFLAG

## CERTIFICATE OF COMPLIANCE

This is to confirm that:

Department of Employment and Labour  
OHS Conference 2023  
Coastlands Hotel, Musgrave, Durban

Was monitored on the 07 – 09 November 2023

### Apex Solutions

Inspector:	Approved Supplier
Sean Chester ID: SM01	Apex Solutions <a href="https://apexsolutions.africa">https://apexsolutions.africa</a> <a href="mailto:info@apexsolutions.co.za">info@apexsolutions.co.za</a>

and is hereby deemed **COMPLIANT** with the GreenFlag Association's certification criteria to provide a healthy public space that significantly mitigates the risk of spreading airborne pathogens like COVID-19, through implementing the following key barriers:

Management Systems / Ventilation / Social Distancing / Occupancy Rates /  
Mask Use / Disinfection & Sanitisation



POWERED BY  
PRIVYSEA

Certificate Number:  
AGFS39

Expiry Date:

9 November 2024

Issued by:

The GreenFlag Association

[info@greenflagassociation.com](mailto:info@greenflagassociation.com)

[www.greenflagassociation.com](http://www.greenflagassociation.com)



Congratulations to the DEL  
OHS Team on selecting and  
managing a healthy space  
for learning and sharing!

# Thank You!





Mr. Sean Chester  
Exposure Specialist



“Choose a job you love, and you will never have to work a day in your life” - Confucius