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CLEAN AIR ON CAMPUS: HOW WE ENSURE QUALITY INDOOR AIR QUALITY, INCLUDING DURING HAZE

Clean indoor air helps students stay healthy and learn well: This factsheet outlines Singapore American School's comprehensive indoor air quality (IAQ) management framework. Designed to maintain healthy learning environments year-round, our centralized air-handling systems, continuous sensor networks, and proactive haze protocols ensure that air purity consistently exceeds national standards.

This factsheet explains how we keep the air clean, how we check it, what we do during haze, and answers common questions.

Glossary
The list below explains what the technical words in this factsheet mean:

- **IAQ (indoor air quality):** How clean and healthy the air inside a building is.
- **PM2.5:** Tiny specks of dust and smoke, about 30 times thinner than a hair. They are small enough to get deep into the lungs.
- **MERV:** A rating for how well a filter catches particles. Higher numbers catch smaller particles.
- **HEPA:** A very fine filter used in our purifiers. It catches almost all particles, including smoke.
- **PSI and 1-hour PM2.5:** Singapore's official air readings from NEA. The 1-hour PM2.5 reading tells us what to do now; the 24-hour PSI forecast helps us plan the next day.
- **VOCs (volatile organic compounds):** Gases given off by paint, glue, cleaning products and furniture.
- **CO2 (carbon dioxide):** The gas we breathe out. High levels mean a room needs more fresh air, and can make people sleepy.
- **Building management system:** The computer that runs and monitors our air conditioning.

Step 1: Keeping pollution out in the first place

Many indoor air problems start inside the building, so we deal with them first.

- **Fumes (VOCs and formaldehyde):** We choose low-fume paints, glues, cleaning products and furniture, so fewer fumes get into the air.
- **Stuffy rooms (CO2):** Sensors check CO2 all the time, and the system brings in more fresh air when a room gets stuffy. Fresh air helps students stay alert.
- **Mould and dust mites (humidity):** We keep humidity between 40% and 65% and clean regularly, so rooms don't get damp.

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Step 2: Cleaning the air before it reaches classrooms

Large central air-handling units, which are very different from home air conditioners, serve most classrooms. They filter all the air before it reaches rooms, and our building management system controls and monitors them all day.

Keeping haze out

We pump a little more clean, filtered air into our buildings than we let out. This keeps the air pressure inside slightly higher than outside, so when a door opens, air flows out rather than in. This helps keep haze out, and works best when doors and windows stay closed.

Regular maintenance

SAS Facilities inspects and replaces filters, cleans the cooling coils and ducts, vacuums with HEPA-filter vacuums, and checks for leaks, all on a regular schedule.

Filters

- **Everyday filters (MERV 9):** Catch dust, pollen and larger particles.
- **Haze filters (MERV 14):** When NEA's 1-hour PM2.5 reading goes above 55 µg/m³, or indoor PM2.5 goes above 25 µg/m³, we switch to finer MERV 14 filters, as SS 554 requires during haze. These catch at least three-quarters of the smallest smoke particles, and about 9 in 10 of slightly larger ones.

Fresh air and UV lights

- **Fresh air:** Each room gets enough fresh air to meet Singapore's ventilation standard, SS 553.
- **UV lights:** UV-C lamps inside the air-handling units shine on the cooling coils and drain pans to keep them free of mould and bacteria.

Dyson air purifiers throughout the school

Many spaces throughout the school have a Dyson Big+Quiet Formaldehyde purifier. Their main job is to act as a combined air quality sensor network. There are currently more in the elementary school and parts of the high school than other places as we are currently watching for any formaldehyde levels in newly constructed spaces. Each one has a sensing radius of up to 100 m² and these units also help augment other systems in the event of identified air quality issues through the following:

- **HEPA H13 filter:** Catches 99.95% of particles as small as 0.1 microns, including smoke and dust (Dyson's test figure).
- **Carbon filter:** Catches smells and gases like benzene and nitrogen dioxide (NO2).
- **Formaldehyde filter:** Breaks formaldehyde into water and carbon dioxide. It never needs replacing.
- **Sensors:** Each unit measures the air and speeds up by itself when the air gets dirtier. During haze we set them to run on high.

Checking the air all day

Sensors always measure air. They report to our building management system, which raises an alarm if a reading drifts out of range. We use three kinds:

- **Wall sensors (uHoo Aura):** Fitted in every learning zone. They measure 13 things: PM1, PM2.5, PM4, PM10, carbon dioxide (CO2), carbon monoxide (CO), chemical fumes (TVOC), formaldehyde, temperature, humidity, air pressure, light and noise.
- **Purifier sensors:** The Dyson purifiers measure particles and formaldehyde, and adjust their fan speed to match.
- **Duct sensors:** Sensors inside the air-handling units check the air coming back from rooms, so the system can adjust how much fresh air it brings in.

Our air quality targets

We use Singapore Standard SS 554:2026, the code of practice for indoor air quality in air-conditioned buildings, and follow NEA's haze advice. Our targets meet SS 554, and some are stricter. The table shows each target and what we do if a reading goes above it.

Environmental Parameter	Our target	Reference	What we do if it's too high
PM2.5	< 25 µg/m³	SS 554:2026 (24-hour average)	**Above 25 µg/m³ indoors, or NEA 1-hour PM2.5 above 55 µg/m³ outdoors:** Switch central units to MERV 14 filters, run purifiers on high, and look for any indoor source.
PM4 (respirable particles)	< 40 µg/m³	SAS target (SS 554: < 50 µg/m³)	**Above 40 µg/m³:** Check the fresh air intakes and replace pre-filters.
Carbon Dioxide (CO_2)	< 800 ppm	SAS target, from NEA guidance (SS 554: < 700 ppm above outdoor air)	**Above 800 ppm:** Bring in more fresh air, and air out classrooms during breaks.
Total VOCs (TVOC)	< 260 ppb (< 600 µg/m³)	SS 554:2026 (8-hour average)	**Above 260 ppb, or if there is an odour:** Find and remove the source of the fumes.
Formaldehyde (CH_2O)	< 0.08 ppm (< 100 µg/m³)	SS 554:2026 (30-minute average)	**Above 0.05 ppm:** Find the source, such as new furniture or glue. ES purifiers break formaldehyde down.

Relative Humidity (RH)	40% – 65%	SS 554 (below 65%); 40% lower limit is an SAS target	**Above 65%:** Adjust the cooling system to dry the air and prevent mould.
Air Temperature	24.0°C – 25.0°C	SS 554 (at least 24°C)	Adjust thermostats through the building management system for comfort.
Air Movement	0.1 m/s – 0.3 m/s	SAS target (SS 554: < 0.8 m/s)	Adjust air vents so air moves without drafts.
Total Bacteria Count	< 500 CFU/m³	SAS target (SS 554: < 1,000 cfu/m³)	Check the UV-C lamps and clean the cooling coils.

Our procedures

All maintenance and air quality work follows our internal procedure, SASFAC-SOP-51 Indoor Environmental Air Quality.

What changes during haze

We follow NEA's 1-hour PM2.5 readings and 24-hour PSI forecasts. The SAS Haze Policy sets out when outdoor activities change or stop. Inside, we follow the haze mode in SS 554: we switch to MERV 14 haze filters, run purifiers on high, and keep doors and windows closed.

Twice a year, independent labs accredited under SAC-SINGLAS also test our air, to check that our own sensors are accurate. They take air samples from rooms across campus and test them for particles, gases, bacteria and mould.

Frequently Asked Questions

Q: Why isn't there an air purifier in every classroom?

A: The simple answer is we don't need them as we aim to clean the air before it reaches a room and not clean the air when it is already inside the room.

Most of our classrooms get their air from large central air-handling units, not from small units like those you may use at home. These units filter all the air before it reaches the room, and keep rooms at slightly higher pressure than outside so haze is pushed out when a door opens. During haze we switch to finer filters. (MERV 14) this level of filtration means the air is very likely of a much higher quality than that can be achieved in a domestic environment.

Sensors in every learning zone measure PM2.5 all day. If a room reads above our indoor limit of 25 µg/m³, we find out why and fix the cause, for example a door left open.. Our purifiers are in each Elementary School learning community. They were placed there mainly to act as sensors to check formaldehyde levels which could be a risk in newly constructed spaces and to act as extra sensors, they do not aim to clean the air for every room.

Q: How do you know when to change the filters?

A: We use technology to monitor our building.

1. **Purifiers:** each unit tracks how long it has run. When the filter is due, the screen shows a filter warning and Facilities gets an alert.
2. **Central air systems:** a calendar is not a good guide for these big units. Instead, a gauge measures how hard air has to push through each filter. As a filter fills with dust, that pressure rises. When it gets too high, our building management system raises a "filter dirty" alarm and we replace it.

Q: How do you monitor air quality on campus?

A: Indoor air quality across our campus is continuously monitored through a real-time network of **110 dedicated sensors**, utilizing both our **uHoo air quality monitors** and **Dyson air units**.

These sensors give our Facilities team real-time data on key indoor environmental parameters—including **PM2.5 (fine particulates)**, temperature, humidity, carbon dioxide (CO_2), and total volatile organic compounds (TVOCs)—across all classrooms, offices, and shared community spaces. The acceptable levels are **Singapore Standard SS 554:2026**

External Reference Framework

Our indoor air quality work is based on these standards and guidelines:

- **Singapore Standard SS 554:2026:** Code of practice for indoor air quality in air-conditioned buildings.
- **Singapore Standard SS 553:2026:** Code of practice for air-conditioning and mechanical ventilation in buildings.
- **NEA advice on air-cleaning devices:** how to choose a portable air cleaner by its Clean Air Delivery Rate (CADR) and room size.
- **MOE and MSE haze measures for schools:** MOE press release (15 Sep 2019) and MSE written reply to a parliamentary question (7 Nov 2023).
- **WHO Global Air Quality Guidelines (2021):** World Health Organization health-based targets for particulate matter and toxic gases.
- **ASHRAE Standard 62.1-2022:** Ventilation and Acceptable Indoor Air Quality.
- **ASHRAE Standard 52.2-2017:** Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- **RESET Air Standard:** Performance-based standard for real-time continuous indoor air quality monitoring.
- **WELL Building Standard v2:** International WELL Building Institute (IWBI) Air Concept performance thresholds.
- **US EPA IAQ Tools for Schools:** United States Environmental Protection Agency guidance for school environmental management.