
**Practice Note for Control of Air Pollution
in Semi-Confined Public Transport Interchanges**

**Environmental Protection Department
30 December 2022**

**ENVIRONMENTAL PROTECTION DEPARTMENT
PRACTICE NOTE FOR PROFESSIONAL PERSONS**

**Control of Air Pollution
in Semi-Confined Public Transport Interchanges**

Introduction

This Practice Note is applicable to new public transport interchanges (PTIs) under planning/design stage at the time of issuance of this Practice Note and built thereafter.¹

2. This Practice Note sets out the air quality guidelines inside PTIs and outlines the major considerations and guidance for the design and management of PTIs to meet these guidelines.

3. A PTI is a facility where passengers can board, alight from and interchange between different modes of public transport such as franchised buses, taxis, public light buses (including both green and red minibuses) or coaches. In Hong Kong, many PTIs are semi-confined ones located under the podiums of residential or commercial complexes, and surrounded by structural columns or walls. Air pollutants will accumulate to high concentrations inside these semi-confined PTIs if the mechanical ventilation there is not sufficient.

4. The professional persons can help by ensuring proper design, operation and maintenance of mechanical ventilation systems in semi-confined PTIs, to prevent air pollution problems from arising.

Air Quality Guidelines

5. Passengers usually stay inside a PTI for a relatively short period of time (i.e. 10 minutes or less on average). Air pollutants from public transport including carbon monoxide (CO) and nitrogen dioxide (NO₂) are the key air pollutants of concern inside semi-confined PTIs. At excessive concentrations, CO may block the absorption of oxygen by the blood and cause impairment of coordination and deleterious effects, especially to pregnant women and those with heart illnesses. NO₂ may affect the lungs and cause breathing difficulties and respiratory irritation.

Note

¹ For existing PTIs or new PTIs with design (including the layout and ventilation system) already finalised at the time of issuance of this Practice Note, the ProPECC PN 1/98 shall continue to apply.

6. To protect public health, the air quality at passenger waiting areas inside a semi-confined PTI should meet the air quality guidelines in Table 1.

Table 1: Air Quality Guidelines

Air Pollutant	Averaging Time	Maximum Concentration * Not to be Exceeded ($\mu\text{g}/\text{m}^3$)
Carbon monoxide (CO)	1 hour	30,000
Nitrogen dioxide (NO ₂)	1 hour	200

*Expressed at the reference condition of 293K and 101.325kPa (one atmosphere)

7. In practice, the air quality guideline on NO₂ poses the key challenge in the design of semi-confined PTIs. The PTI design should make the best endeavours so that passengers inside semi-confined PTIs are not exposed to air quality of more than 200 $\mu\text{g}/\text{m}^3$ of NO₂ for a one-hour averaging time of exposure.

Design Considerations

8. To prevent air pollution problem, the semi-confined PTIs should be properly designed so that the air quality guidelines set out in Table 1 are able to be met. Main factors to be considered in the design are listed below:

Location and Background Air Quality

- (a) A semi-confined PTI should be located in an area with access to good background air, i.e. away from possible air pollution sources as far as possible. The background air quality should be estimated by taking the 95-percentile of the pollutant concentration data from either (1) the most relevant full year monitoring results of the Environmental Protection Department (EPD)'s air quality monitoring stations; or (2) the most relevant full year modelling results of the EPD's regional air quality model at the PTI located grid-cell, which can be found in the following website:

https://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_aqa_mode1.html

The Layout

- (b) To help minimise the accumulation of air pollutants, the design of a PTI should facilitate cross ventilation by, including but not limited to, provision of two opposite-sided openings of similar size strategically located, avoiding same direction of

vehicular entrances and exits as far as possible, and avoiding solid walls or other barriers which inhibit natural air flow, so as to enhance air movements across the PTI. In cases there are site constraints rendering the cross ventilation with two opposite-sided openings infeasible or in the event the PTI is placed in the basement, the ventilation system of the PTI shall be further enhanced so that the air quality guidelines set out in Table 1 are still able to be met.

- (c) If a separate air-conditioned passenger waiting compartment is provided for the PTI, the compartment shall be designed and managed making reference to ProPECC PN1/03 Practice Note for Managing Air Quality in Air-conditioned Public Transport Facilities. Under the situation where all boarding passengers using the PTI are arranged to go straight to the public transportations from the air-conditioned passenger waiting compartments, this Practice Note would not apply to such PTI.

The Ventilation System

- (d) A PTI ventilation system should consist of fresh air supply units and exhaust air units, with the amount of fresh air supply greater than that of the exhaust air.
- (e) The fresh air inlets should be free from obstruction and located to capture fresh air of quality comparable to general ambient background level. They should be located as far away as possible from any major air pollution sources. The minimum separation from roads and highways can be determined by either (1) making reference to the appropriate buffer distance specified in Table 3.1 of Chapter 9 – Environment, Hong Kong Planning Standards and Guidelines published by the Planning Department on usage of open space site; or (2) using dispersion model.²
- (f) The exhaust air outlets should be free from obstruction and located as far away as possible from the PTI's own fresh air inlets to prevent short circuiting and from any nearby sensitive receptors to avoid causing air pollutant nuisance. Local prevailing wind direction at the exhaust air outlets shall be considered to avoid back flow problem.
- (g) Inside the PTI, the fresh air supply outlets should be positioned at a level to discharge fresh air towards the passengers. The velocity of fresh air shall be considered to prevent excessive air draft on passengers. The fresh air supply outlets and the extraction openings should be placed as far away from each other as possible, and should be configured to avoid air short circulation.

Note

² For more information on using dispersion model to assess the air quality impacts from open road emissions and other outdoor emission sources, please refer to EPD's Guidelines for Local-Scale Air Quality Assessment Using Models (https://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_aqa_model.html).

- (h) The ventilation system should be designed to cater for the ultimate design of PTI with the estimated maximum number/types of vehicles and pollution emissions.

Vehicular Emissions

- (i) The quantities of CO and NO₂ emissions from the vehicles should be estimated by considering:
- (i) the types, emission standards and models of the vehicles using the PTI;
 - (ii) the usage pattern and numbers of the vehicles, including speed, frequency, idling time and routing;
 - (iii) the tailpipe emission of vehicles of various emission standards. Please refer to EMFAC-HK of the EPD (https://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac-hk.html). For idling emission rates which are not available in EMFAC-HK, other international reference could be used as reference (such as PIARC: World Road Association);
 - (iv) if the information on the tailpipe NO₂ to nitrogen oxides (NO_x) ratio for a particular type of motor vehicle is not available, it should be taken as 28%. If further refinements are desirable, individual tailpipe NO₂/NO_x ratios of each vehicle type for appropriate year can be found in the following website: https://path.epd.gov.hk/initial_NO2X_ratio.html

Computer Simulation

- (j) Computational models such as computational fluid dynamics (CFD) can be used during design stage to optimise the effectiveness of the ventilation system in diluting and removing the emissions from vehicles and demonstrate the compliance of the air quality guidelines in Table 1 at the anticipated maximum emission scenario. The models shall be verified as appropriate, for instance, by using tracer gas to counter check the results of the CFD modelling. The project proponent of the PTI may consult EPD on the computational models and the verification method as necessary.

Management of PTIs

9. The management and maintenance parties of PTIs should draw up and implement a set of operation procedures, which should include the following:

Air Quality Measurement

- (a) To check if the air quality guidelines in Table 1 could be met, the PTI management and maintenance parties shall monitor the air quality inside the semi-confined PTI on a regular basis. The following points should be noted when conducting the air quality measurement:
- (i) Air quality measurement should be conducted at least once every two years. A continuous measurement for at least 24 hours should be conducted to observe the daily variation of the air quality inside the PTI.
 - (ii) The measurement equipment shall be United States Environmental Protection Agency (USEPA) designated methods³ or other equivalent methods recognised by other national authorities with proper calibrations before the measurement.
 - (iii) Subject to practicality, the measurement location that best representing the passengers' exposure within the PTI, i.e. near to where the passengers usually stay should be chosen and the air sampling inlet should be installed at the height of breathing level up to 2.5m high.
 - (iv) The air quality of the nearest EPD's General Air Quality Monitoring Station or the representative background air quality nearby, as applicable, during the measurement period could be reported together for reference purpose.

Event and Action Plan

- (b) Should there be a non-compliance with the air quality guidelines, actions in accordance with the Event and Action Plan in Table 2 shall be carried out.

Note

³ USEPA designation methods for the measurement of air pollutants are documented on the "List of Designated Reference and Equivalent Methods" available at USEPA's website: (<https://www.epa.gov/amtic/air-monitoring-methods-criteria-pollutants>)

Table 2: Event and Action Plan for Air Quality Control

<u>Event</u>	<u>Actions</u>
Exceedance of Air Quality Guidelines for one parameter in any hour in an air quality measurement exercise.	<ul style="list-style-type: none"> - Check whether the air ventilation system is operating properly. - Enhance the air quality monitoring inside the PTI (e.g. by increasing the sampling frequency and the number of sampling point). - Identify any external factors affecting the air quality inside the PTI (e.g. by measuring the air quality of the fresh air and comparing it with the data at EPD’s General Air Quality Monitoring Station, or with the representative background air quality nearby as applicable; by identifying any nearby air pollution sources).
Exceedance of Air Quality Guidelines for one parameter in any hour in two air quality measurement exercises or more.	<ul style="list-style-type: none"> - Identify the air pollution problems (e.g. by examining the level of exceedance, the duration of exceedance and the affected areas). - Formulate practicable mitigation measures to reduce the exposure to the air pollutants incurred by the passengers and draw up an implementation plan of mitigation measures. - Implement the mitigation measures according to the implementation plan.

Mitigation Measures

- (c) If an air pollution problem is identified inside a semi-confined PTI, the PTI management shall take appropriate actions, which can be either management measures or engineering measures, to minimise the air pollutant’s exposure time and exposure levels incurred by the passengers.
- (d) The PTI management shall take into consideration the actual conditions inside the semi-confined PTI, such as practicability, to draw up an effective implementation plan of mitigation measures. Some commonly adopted management and engineering measures are provided below for reference:

Management Measures

- (i) **Deployment of Lower Emission Franchised Buses**
Liaise with the franchised bus operators to deploy more environmental friendly buses at the PTI.
- (ii) **Separation of passengers from pollution sources**
Keep the passenger waiting area away from the source of pollution (i.e. vehicle tail pipe) as far as possible, such as by constructing a separate air-conditioned waiting compartment or by re-organising the bus stop distribution inside the PTI subject to site constraints and sufficiency of passenger waiting space.
- (iii) **Reduction of idling emissions**
Give instructions to all drivers using the PTI to switch off the vehicle engines while waiting.

Engineering Measures

- (iv) **Provision of adequate ventilation**
Ventilation system shall be provided in a semi-confined PTI. A regularly reviewed fan operation schedule, or a pollution-level-interlocked fan operation system shall be incorporated to allow sufficient ventilation. If the problem is due to the poor quality of the fresh air being drawn in, air purifying units may be considered to be installed to pre-treat the fresh air to remove the air pollutants of concern.
- (v) **Inspection and maintenance of ventilation system**
The ventilation system shall be inspected and maintained at regular intervals for proper operation and to minimise down time.
- (vi) **Upgrading and replacement of ventilation system**
If the existing ventilation system is found inadequate to provide sufficient ventilation for most of the time, upgrading or replacement of the system shall be considered.

Enquires

10. Enquires on the Practice Note can be made to the Air Science Group of the Environmental Protection Department (Telephone: 2838 3111, Facsimile: 2827 8040, Email: enquiry@epd.gov.hk).



(Janice S W TSE)

Director of Environmental Protection

Environmental Protection Department
33/F, Revenue Tower
5 Gloucester Road
Wan Chai, Hong Kong