

## Understanding Air Pollutants and Air Quality Standards

### Types, Sources and Health Effects

The major sources of pollutants and their health effects are summarized in *Table A1.1*.

**Table A1.1** *Sources of Emissions, Characteristic and Health Effect of Air Pollutants*

Air Pollutant	Sources	Health Effect
Sulphur dioxide (SO <sub>2</sub> )	<ul style="list-style-type: none"> <li>• combustion of sulphur-containing fossil fuels</li> <li>• power plant</li> <li>• marine vessel</li> <li>• motor vehicle</li> </ul>	<p><u>High level</u></p> <ul style="list-style-type: none"> <li>• impairment of respiratory function</li> <li>• aggravate existing respiratory and cardiac illnesses</li> <li>• increased morbidity and mortality rates</li> </ul> <p><u>Low level</u></p> <ul style="list-style-type: none"> <li>• chronic respiratory diseases</li> </ul>
Nitrogen Oxides (NO <sub>x</sub> )	<ul style="list-style-type: none"> <li>• power plant</li> <li>• motor vehicle</li> <li>• fuel combustion</li> <li>• space heating</li> </ul>	<p><u>Long term exposure</u></p> <ul style="list-style-type: none"> <li>• lower resistance to respiratory infections</li> <li>• lung development impairment</li> <li>• aggravate existing chronic respiratory diseases</li> </ul>
Particulate Matter (PM)	<ul style="list-style-type: none"> <li>• diesel vehicle exhaust</li> <li>• power plant</li> <li>• crustal derived dust</li> <li>• marine aerosol</li> <li>• diesel fuel</li> </ul>	<ul style="list-style-type: none"> <li>• increased morbidity and mortality rates at high level exposure</li> </ul>
Volatile Organic Compounds (VOCs)	<ul style="list-style-type: none"> <li>• building material</li> <li>• cleaning agent</li> <li>• cosmetics, wax</li> <li>• carpet</li> <li>• furnishing</li> <li>• laser printer / photocopier</li> <li>• printing materials</li> <li>• adhesive, sealant</li> <li>• paint varnish and solvent</li> </ul>	<ul style="list-style-type: none"> <li>• toxicological effects on the central nervous system, liver, kidney and blood</li> <li>• eye irritation: burning, dry, gritty; watery eyes</li> <li>• throat irritation: dry throat</li> <li>• respiratory problems: shortness of breath; bronchial asthma</li> <li>• headaches; poor concentration; dizziness, tiredness, irritability</li> </ul>

An extensive discussion of the impact of air pollutants on health is provided in the Air Quality Guidelines for Europe ([www.euro.who.int/document/e71922.pdf](http://www.euro.who.int/document/e71922.pdf)) published by the World Health Organization (WHO).

### Standards – Hong Kong, Mainland China, International

#### Hong Kong

The Air Pollution Control Ordinance (APCO), which is the principal law for managing air quality in the HKSAR, established the Air Quality Objectives (AQOs) and provides the framework for controlling air pollution from stationary sources and motor vehicles. The AQOs are summarized below.

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**Table A2.1 Hong Kong Air Quality Objectives**

Air Pollutant	Concentration ( $\mu\text{g m}^{-3}$ ) <sup>(a)</sup>				
	1 hour <sup>(b)</sup>	8 hour <sup>(c)</sup>	24 hours <sup>(c)</sup>	3 months <sup>(d)</sup>	1 year <sup>(d)</sup>
Sulphur dioxide (SO <sub>2</sub> )	800	-	350	-	80
Total suspended particulates (TSP)	-	-	260	-	80
Respirable suspended particulates (RSP) <sup>(e)</sup>	-	-	180	-	55
Nitrogen dioxide (NO <sub>2</sub> )	300	-	150	-	80
Carbon monoxide (CO)	30,000	10,000	-	-	-
Photochemical oxidants (as Ozone O <sub>3</sub> ) <sup>(f)</sup>	240	-	-	-	-
Lead (Pb)	-	-	-	1.5	-

Notes:

(a) Measured at 298K (25°C) and 101.325 kPa (1 atmosphere)

(b) Not to be exceeded more than three times per year

(c) Not to be exceeded more than once per year

(d) Arithmetic means

(e) Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometers or smaller

(f) Photochemical oxidants are determined by measurement of ozone only

*Indoor Air Quality Standards*

To improve indoor air quality (IAQ) and promote public awareness, the HKSAR Government has implemented an IAQ Management Program. One of the core tasks of the program is to launch a voluntary IAQ Certification Scheme for offices and public places. Indoor Air Quality Objectives (*Table A2.2*) have been recommended to minimize the impact on health and to promote the comfort and well-being of all building occupants. A set of 2-level IAQ Objectives has been established to act as the benchmark for evaluating and assessing indoor air quality.

**Table A2.2 Hong Kong Indoor Air Quality Objectives**

Parameter	Unit	Excellent Class <sup>(a)</sup>	Good Class <sup>(a)</sup>
Room Temperature	°C	20 to < 25.5	< 25.5
Relative Humidity	%	40 to < 70	< 70
Air Movement	m/s	< 0.2	< 0.3
Carbon Dioxide (CO <sub>2</sub> )	ppmv	< 800	< 1000
Carbon Monoxide (CO)	$\mu\text{g}/\text{m}^3$	< 2,000	< 10,000
Respirable Suspended Particulates (PM <sub>10</sub> )	$\mu\text{g}/\text{m}^3$	< 20	< 180
Nitrogen Dioxide (NO <sub>2</sub> )	$\mu\text{g}/\text{m}^3$	< 40	< 150
Ozone (O <sub>3</sub> )	$\mu\text{g}/\text{m}^3$	< 50	< 120
Formaldehyde (HCHO)	$\mu\text{g}/\text{m}^3$	< 30	< 100
Total Volatile Organic Compounds (TVOC)	$\mu\text{g}/\text{m}^3$	< 200	< 600
Radon (Rn)	Bq/m <sup>3</sup>	< 150	< 200
Airborne Bacteria	cfu/m <sup>3</sup>	< 500	< 1000

Note:

(a) 8-hour average

**“Excellent” Class** represents an excellent IAQ that a modern and comfortable building should have.

**“Good” Class** represents the IAQ that provides protection to the public at large, including the young and the aged.

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More details can be found in the “*Guidance Notes for the Management of Indoor Air Quality*” ([www.iaq.gov.hk/cert/doc/GN-eng.pdf](http://www.iaq.gov.hk/cert/doc/GN-eng.pdf)) published by the *Indoor Air Quality Management Group of the HKSAR Government*. Details of the IAQ Certification Scheme can be found in the “*A Guide on Indoor Air Quality Certification Scheme for Offices and Public Places*” ([www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf](http://www.iaq.gov.hk/cert/doc/CertGuide-eng.pdf)).

### *Guidelines on Air Pollution Control for Major Polluting Operations*

The HKSAR *Environmental Protection Department* (EPD) published a set of guidance note on Best Practicable Means (BPM) for 27 specified processes to control air emissions ([www.epd.gov.hk/epd/english/environmentinhk/air/guide\\_ref/guide\\_best\\_pract.html](http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_best_pract.html)).

## **Mainland China**

### *Ambient Air Quality Standards and Emissions Standards*

China’s State Environment Protection Agency (SEPA) promulgated an *Ambient Air Quality Standard (GB 3095- 1996)* and established three levels of standards based on three types of land usage. The concentrations of air pollutants should comply with the ambient air quality standards at the boundary of the site.

( [www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=12](http://www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=12))

( [www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=12](http://www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=12) )

([www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=70](http://www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=70) )

In addition, SEPA established an *Integrated Emissions Standard of Air Pollutants (GB 16297-1996)* to control the air emissions from stacks. Industries with stack emissions are required to meet this integrated emissions standard. Three levels of emissions limits and allowable concentrations of 33 types of air pollutants have been established based on the age of the industrial facility and the location of the emissions sources.

( [www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=30](http://www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=30))

Separate emissions standards for thermal power plants, boilers and industrial kilns and furnaces have also been stipulated by SEPA.

Thermal Power Plants (GB 13223-2003)

[www.ep.net.cn/ut/bz/pdf/hdc.pdf](http://www.ep.net.cn/ut/bz/pdf/hdc.pdf)

Boilers (Coal-fired, oil-fired & gas-fired) (GB 13271-2001)

[www.ep.net.cn/ut/bz/pdf/381-1.pdf](http://www.ep.net.cn/ut/bz/pdf/381-1.pdf)

Industrial Kilns and Furnaces

[www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=102](http://www.ep.net.cn/cgi-bin/dbbz/doc.cgi?id=102)

### *Indoor Air Quality Standards*

SEPA developed a set of indoor air quality standards ([www.ep.net.cn/ut/bz/pdf/735-1.pdf](http://www.ep.net.cn/ut/bz/pdf/735-1.pdf)) for residential developments and offices, which include:

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- Four physical parameters including temperature, relative humidity, air flow and fresh air intake volume;
- 13 chemical parameters including sulphur dioxide, nitrogen dioxide, carbon monoxide, carbon dioxide, ammonia, ozone, formaldehyde, benzene, ethylbenzene, benzyl [a] pyrene, particulates and total volatile organic compounds;
- Biological parameter including bacteria; and
- Radioactive parameter including Radon.

### **International Air Quality Standards**

Tables A2.3 to A2.5 provide the commonly used international ambient air quality standards, including the Air Quality Standards developed by the *U.S. Environmental Protection Agency (USEPA)*, *World Health Organization (WHO)*, *World Bank* and *European Union (EU)*.

**Table A2.3 Sulphur Dioxide (SO<sub>2</sub>)**

Averaging Time	US ppm	WHO µg m <sup>-3</sup>	World Bank µg m <sup>-3</sup>	EU µg m <sup>-3</sup>
10 min	-	500	-	-
15 min	-	-	-	-
1 hr	-	-	500	350
24 hr	0.14	20	-	125
1 yr	0.03	-	100	20

Note:  
(a) Total SO<sub>x</sub>

**Table A2.4 Nitrogen Dioxide (NO<sub>2</sub>)**

Averaging Time	US µg m <sup>-3</sup>	WHO µg m <sup>-3</sup>	World Bank µg m <sup>-3</sup>	EU µg m <sup>-3</sup>
1 hr	-	200	-	200
24 hr	-	-	500	-
1 yr	100	40	100	40

**Table A2.5 Respirable Suspended Particulates (RSP or PM<sub>10</sub>)**

Averaging Time	US µg m <sup>-3</sup>	WHO µg m <sup>-3</sup>	World Bank µg m <sup>-3</sup>	EU µg m <sup>-3</sup>
24 hr	150	50	-	50
1 yr	50	20	-	40

Notes:

- Only those pollutants for which HKAQOs have been established are listed in the tables.
- The EU standards are derived from the so-called "AQFD Daughter Directives". The national standards for some EU countries may be slightly different and/or more stringent than those shown.