

By A/Prof Chandra Sekhar
Convenor of Working Group

Updates on Development of SS Indoor Air Quality in Air-Conditioned Buildings

18 January 2007



Outline

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3. Approach and Contents
4. International Development in IAQ
5. Issues under Deliberation
6. Summary

The background consists of several overlapping, semi-transparent, curved shapes in various shades of green, ranging from light lime to a darker, more saturated green. These shapes create a layered, organic effect. Centered on this background is the word "Background" in a bold, blue, sans-serif font.

Background

Need for SS Indoor Air Quality (IAQ)

- One of the main occupational and environmental health issues identified
- Complements the Workplace Safety and Health Act, which will be expanded to cover all workplaces
- Replaces NEA Guidelines for IAQ in Office Premises (1996)
- Serves as National Standard on IAQ
- Provides assessment criteria for BCA's Green Mark for Buildings

Target Users

- Government agencies (BCA, MOM, NEA)
- Real estate developers
- Building owners & occupants
- Building designers & architects
- Building management service providers
- Facility managers
- Occupational health & safety personnel

Committees

Building Construction Standards Committee
(BCSC)



Technical Committee (TC) on Facilities
Management



Working Group (WG) on IAQ

Working Group

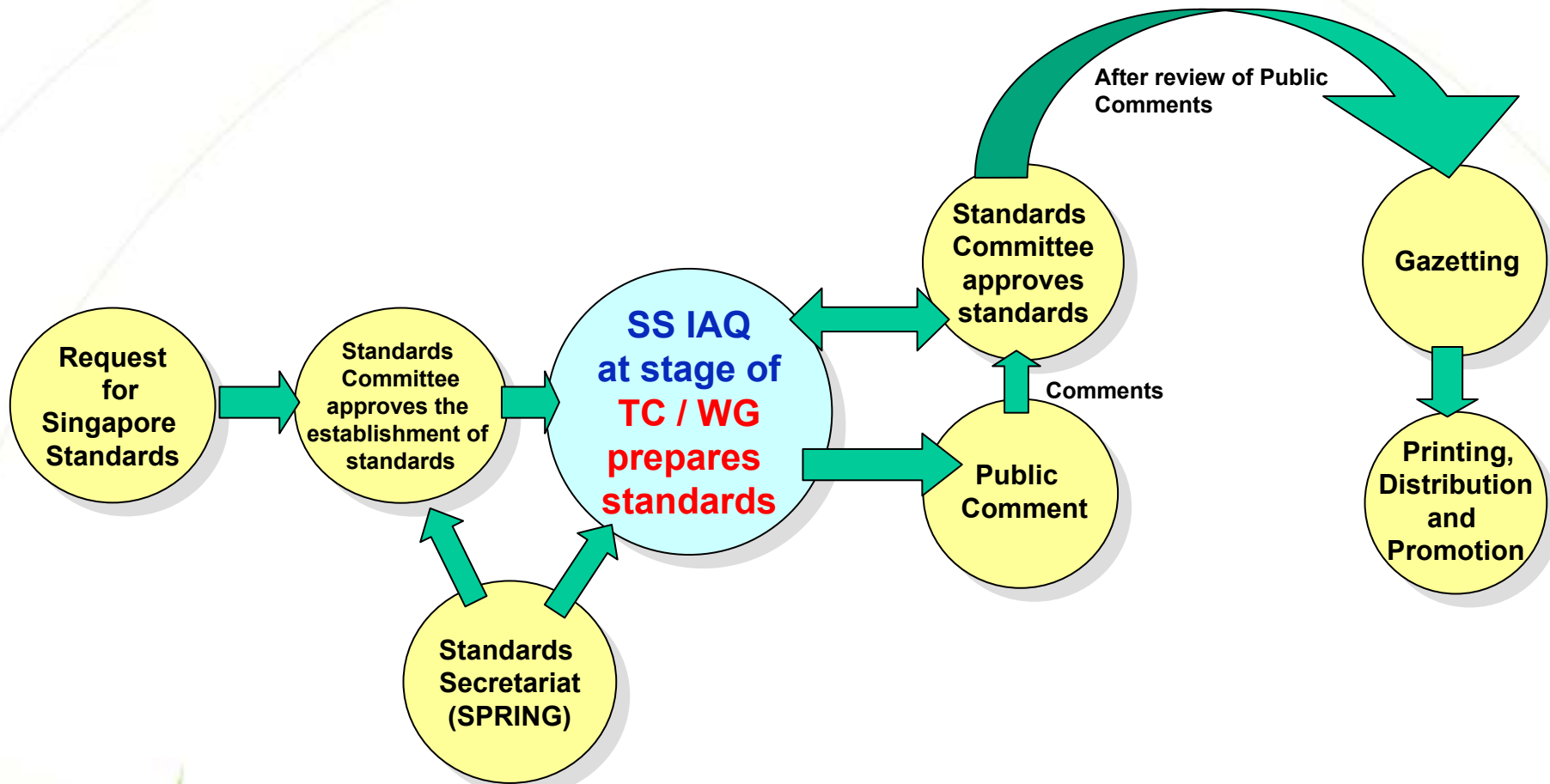
Co-Convenors:

- **A/Prof Chandra Sekhar (NUS) and Mr Tan Kia Tang (MOM)**

Members (technical experts):

- ✓ *Dr Bong Tet Yin*
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- ✓ *Mr Darion Lim*
- ✓ *Dr Ooi Peng Lim (MOH)*
- ✓ *Mr Sumarni Bin Sarmin*
- ✓ *Assoc Prof Tham Kwok Wai (NUS)*
- ✓ *Ms Jennifer Yap (NEA)*

Standardisation Process – Establishment of Singapore Standards



Scope and Purpose

Scope

SS IAQ is applicable to

Office premises	√
Commercial buildings	√
Institutional buildings	√
Industrial buildings	X
Residential buildings	X

SS IAQ covers:

- thermal environmental factors
- physical environmental factors



Purpose

- specify IAQ that will be acceptable to building occupants
- minimise potential adverse health effects

What is acceptable air quality?

ISO definition

- where substantial *majority* of building occupants express no dissatisfaction; and
- in which there are not likely to be known contaminants at concentrations leading to exposures that could pose a significant health risk

The background is a solid light green color with several overlapping, semi-transparent, curved shapes in a slightly darker shade of green. These shapes create a layered, organic effect, resembling overlapping leaves or abstract architectural forms. The text is centered in the middle of the page.

Approach and Contents

Contents of SS IAQ

The Clauses:

- 1 Scope
- 2 Key References
- 3 Strategies for achieving good IAQ
- 4 Parameters & measurement
- 5 Training & certification of IAQ personnel
and
Annexes

Key References

NEA Guidelines for Good IAQ in Offices Premises (1996)

SS CP 13 Mechanical ventilation & air-conditioning in buildings

ISO 16000, 16017, 16813, ISO DIS 16814

WHO Air Quality Guidelines

ASHRAE 55 Thermal Environment Conditions for Human Occupancy

ASHRAE 62 Ventilation for Acceptable IAQ

EU Directive: European Energy Performance in Building

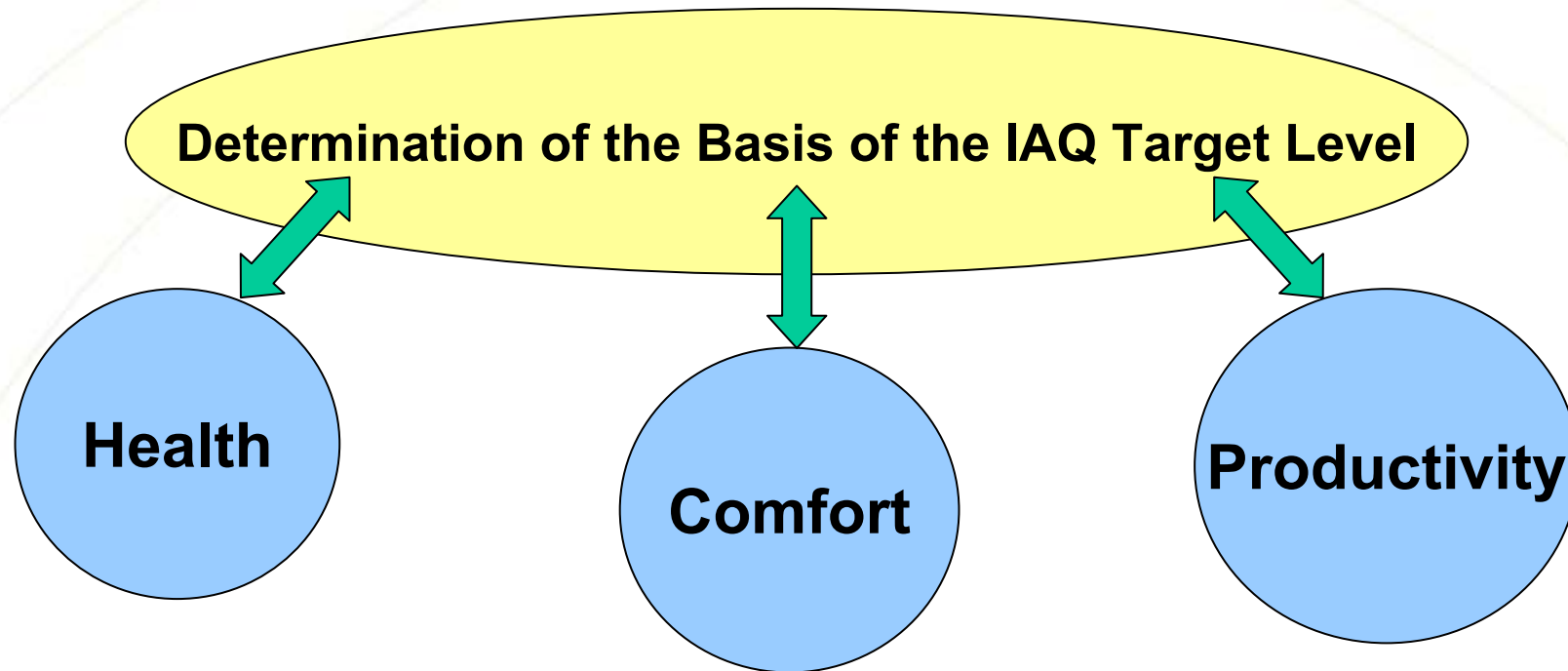
USA OSHA IAQ

Hong Kong: Guidance Notes for the management of IAQ

Malaysia DOSH: CP on IAQ

Strategies for Achieving Good IAQ

(Section 3)



- Control & prevention of IAQ & health-related problems
- Best practices that can help to improve IAQ during design, construction, commissioning, operation, renovation & maintenance of a building

Parameters & Measurement

(Section 4)

- Targeted contaminants approach for sampling and tests
 - Recommended IAQ parameters
 - Optional IAQ parameters
- Sampling strategies
- Measurement methods

Recommended IAQ Parameters

1. Micro-climatic Parameters

- Room air temperature
- Relative humidity
- Air movement

2. Chemical Parameters

- Carbon dioxide
- Carbon monoxide
- Formaldehyde
- Respirable suspended particles (aerodynamic diameter less than 10 μm sampled with a size selective device having a median cut off of 4 μm)
- Total volatile organic compounds that are photoionisable (at 10.6 eV)

Optional IAQ Parameters

- Ultra-fine particles
- Nitrogen dioxide
- Ozone
- Radon
- Asbestos

Training & Certification of IAQ Personnel

(Section 5)

- IAQ auditing & monitoring to be conducted by competent persons
- Laboratories performing analysis of IAQ parameters to be accredited under the Singapore Laboratory Accreditation Scheme (SINGLAS) administered by Singapore Accreditation Council (SAC)

Annexes

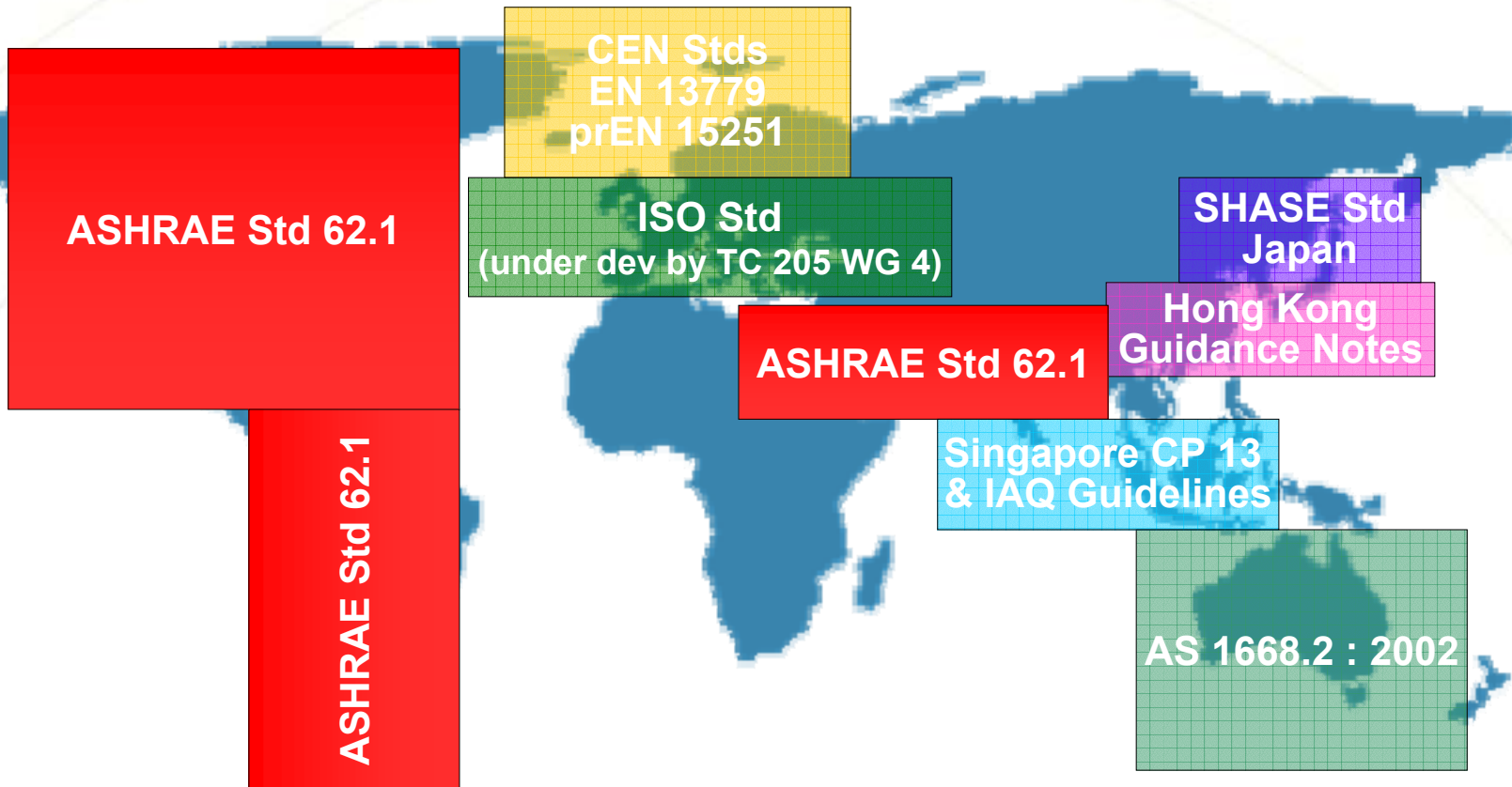
Information to help users:

- Apply the standard e.g. identifying IAQ problems, signs & symptoms of sick building syndrome & building-related illness, sample inspection checklist / survey questionnaire, air cleaning devices
- Appreciate the benefits of implementing good IAQ e.g. highlighting relevant local & overseas studies to show link between IAQ & health / productivity
- Be aware of current IAQ development & to prepare for future changes in the revision of SS IAQ (including resource information links to useful IAQ websites)

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International Developments in IAQ

International Standards - A Summary



International efforts in writing & reviewing standards relating to indoor environment

- International Organization for Standardisation (ISO)
- European Committee for Standardisation (CEN)
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

Research on IAQ still ongoing



Not possible to agree on one international standard



Most existing Standards/Guidelines

- Criteria/requirements given as ventilation rates

International efforts in writing & reviewing standards relating to indoor environment (cont'd)

In all Standards more than one procedure is included:

Prescriptive Method

Minimum ventilation rates can be found in a table listing values for different types of space

Analytical Procedure

Calculation of required ventilation rate on the basis of pollutant type, emission rates and acceptable concentration

All proposed Standards deal with HEALTH issue, not just COMFORT issue

ISO

Standards under Development by TC 205 Building Environment Design

Scope:

Standardisation in the design of new buildings and retrofit of existing buildings for acceptable indoor environment and practical energy conservation and efficiency. Indoor environment includes air quality, thermal, acoustic and visual factors.

TC 205/WG 4

Indoor air quality

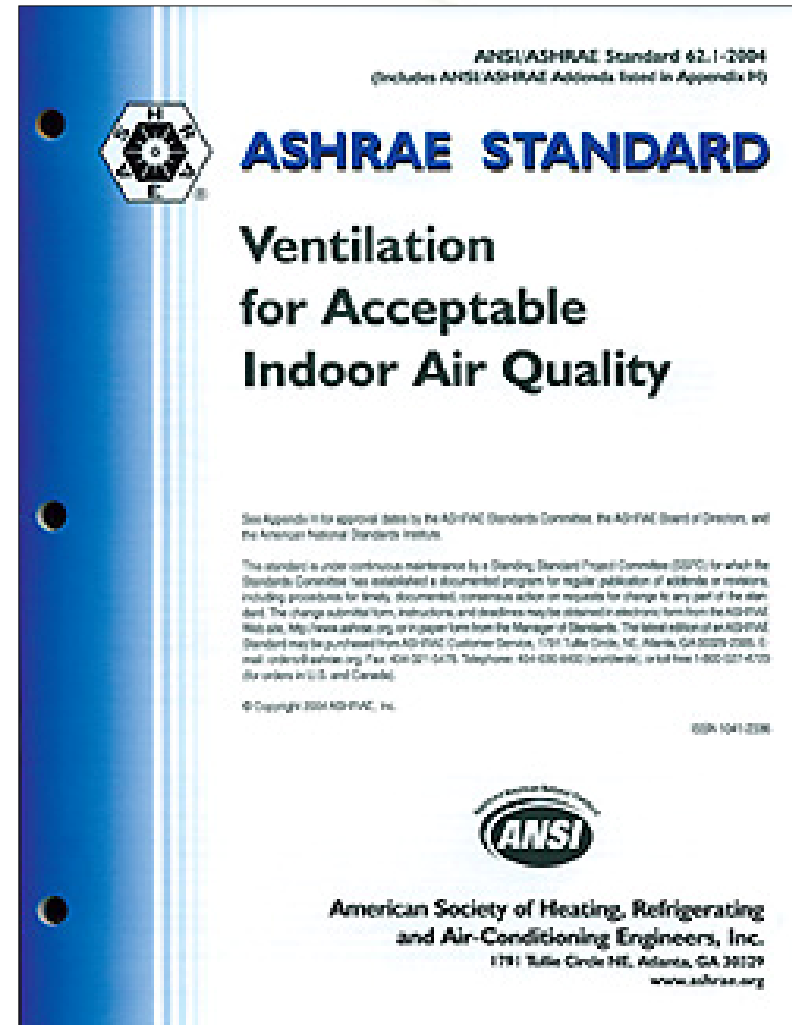
ASHRAE

SSPC 62.1 to maintain and revise Standard 62.1 on continuous maintenance.

Cognizant TC : TC 4.3 Ventilation Requirements and Infiltration

Considers CHEMICAL, PHYSICAL and BIOLOGICAL contaminants that can affect IAQ.

Thermal Comfort requirements not included. (Separate Standard for Thermal Comfort – ANSI/ASHRAE Standard 55)



Key Features of ANSI/ASHRAE Standard 62.1-2004

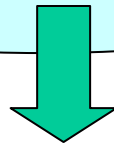
Outdoor Air Quality

Systems & Equipment

O/A Intake
Dehumidification Systems
Drain Pans
Air Classification & Recirculation

Procedures

Ventilation Rate Procedure
IAQ Procedure



- Table 6-1 Minimum Ventilation Rates in Breathing Zone (Excludes Smoking)
- Zone Air Distribution Effectiveness
- System Ventilation Efficiency
- Dynamic Reset (Demand Control Ventilation)

Construction and System Start-up

O & M

Minimum outdoor air requirement for comfort air- conditioning

Type of Building / Occupancy		Singapore CP13-1999 (L/s per person)	ASHRAE Standard 62.1-2004			
			People outdoor air rate (L/s.pers)	Area outdoor air rate (L/s.m ²)	Occupant density (occ/100 m ²)	Combined outdoor air rate (L/s per person)
Restaurants		4	3.8	0.9	70	5.1
Offices		6.5	2.5	0.3	5	8.5
Class-rooms	Daycare (through age 4)	7.4	5	0.9	25	8.6
	Classroom (age 5 – 8)		5	0.6	25	7.4
	Classroom (age 9 plus)		5	0.6	35	6.7
	Lecture Classroom		3.8	0.3	65	4.3

Europe

**CEN :
Comité Européen de Normalisation**

European Committee for Standardisation

CEN Standard

EN 13779

Ventilation for non-residential buildings – Performance Requirements for ventilation and room-conditioning systems

Specifies different ways of expressing the quality of the indoor air

Category	Description	Classification Parameters			
		CO ₂ level ppm	Perceived Air Quality decipols	Classification by O/A per person l/s per person	
				Non- smoking	Smoking
IDA 1	High IAQ	≤ 400	< 1.0	➤ 15	> 30
IDA 2	Medium IAQ	400 - 600	1.0 – 1.4	10 – 15	20 – 30
IDA 3	Acceptable IAQ	600 - 1000	1.4 – 2.5	6 – 10	12 – 20
IDA 4	Low IAQ	> 1000	< 2.5	< 6	< 12

CEN TC 156

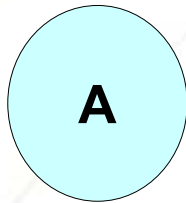
DRAFT European Standard prEN 15251 (May 2005)
**“Criteria for the Indoor Environment including thermal
Indoor air quality, light and noise**



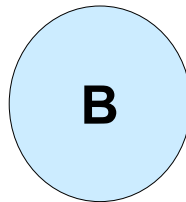
**Parameters & criteria based on existing CR1752
and other related Standards/Guidelines**

If this draft becomes a European Standard, CEN members are bound to comply with the CEN Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration

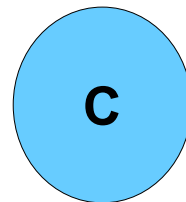
Standard specifies three categories of indoor environment



High level of expectation – leads to a highest % of Satisfied Occupants in respect of indoor environment



Medium level of expectation



Moderate level of expectation

IAQ and ventilation evaluated with samples from different AHUs & zones of building

Ventilation Method

Building meets criteria of a specific category if 95% of rooms representing the floor area of building meet specified ventilation criteria of the same category (Prescriptive Method)

Air Quality Method

Building meets criteria if the maximum CO₂ concn. in the rooms/exhaust air from rooms representing 95% of occupied area is below the values recommended (Analytical Method)

Hong Kong

Guidance Notes for the Management of Indoor Air Quality in Offices and Public Places

September 2003

**Indoor Air Quality Management Group
The Government of the Hong Kong Special Administrative
Region**

Scope

GN to be used as a general guidance document in

- Formulating IAQ policies
- Designing buildings and building services for acceptable IAQ
- Setting operation and maintenance procedures
- Investigating IAQ complaints
- Mitigating problems if they arise

GN is NOT a ventilation standard or a detailed manual for assessing indoor air pollutants

GN will be used in conjunction with acceptable guidelines for ventilation such as the [latest ASHRAE Std 62.1](#)

IAQ Benchmark

- 2-level IAQ objectives established to act as benchmark for evaluating and assessing IAQ
- Objectives comparable to international health-based air quality standards
 - encourage building owners to aim for the best IAQ

**“Excellent”
Class**

Represents an excellent IAQ that a high-class 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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Issues under Deliberation

Issues under deliberation

1. Considering energy efficiency for buildings in the Draft Code
2. Streamlining with SS CP 13 Mechanical Ventilation and Air-Conditioning Requirements
3. Considering IAQ standards for ozone, fine particles, Total volatile organic compounds (TVOC)

Summary

Summary

- Better air quality minimises incidence of sick building syndrome & building related illness
- Better IAQ leads to increased work productivity
- Better IAQ leads to improved quality of living
- Quality of built environment is a competitive advantage to draw investors & tourists

国际商会领袖发表联合声明

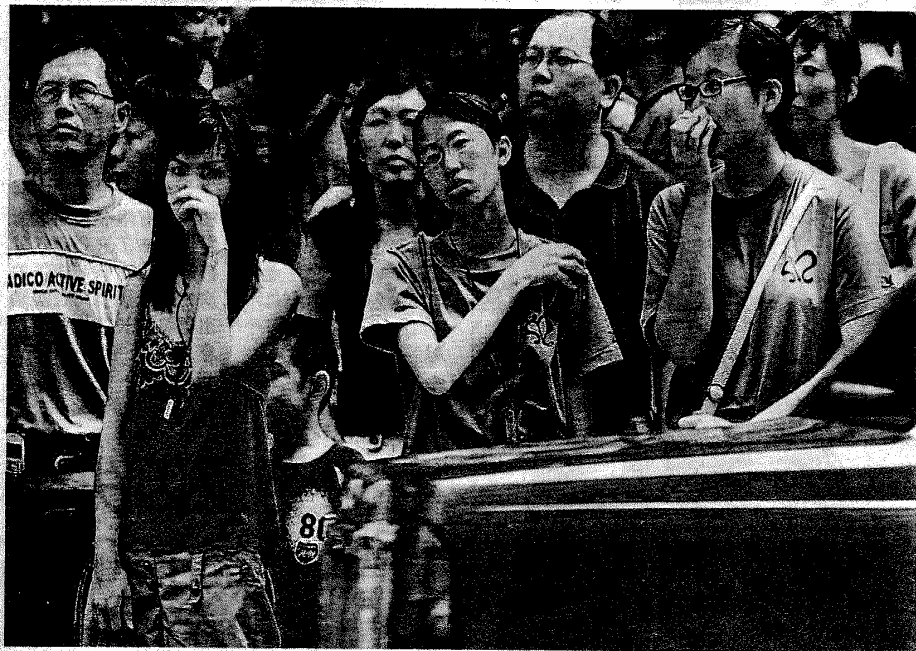
港若不解决环境污染 将失去国际商贸中心地位

(香港综合讯) 英、澳、日、加、美等国际商会领袖昨天在香港发表联合声明，指香港特区政府若不采取行动处理日趋严重的环境污染问题，香港就会失去其作为国际商贸中心的地位。

据法新社报道，这些外国商会领袖及成员同香港特首曾荫权开会，他们吁请港府正视解决日益危害香港的污染问题。上个周末，国际商会发出了警告，经常笼罩香港的浓雾已让外国投资却步。

各国商会领袖在联合声明中说：“大家都十分关注，在环球竞争日益激烈的情况下，环境问题不断恶化，对社会、民众、孩童的健康，以及商业和让人羡慕的国际地位造成不利影响。”

随着烟雾经常恶化危险程度，环境污染成了烫手的政治问



题。去年，因空气素质太差，香港有50天以上的能见度是少过一公里。港府的解释是，环境污染主要是中国南部珠江三角洲工业化所造

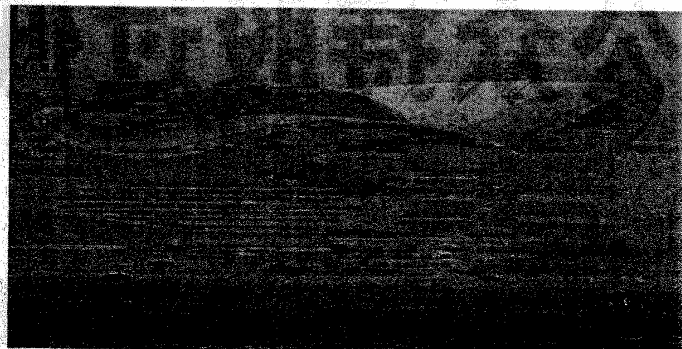
成的，而环保团体则将空气污染归咎于香港的燃煤发电站和柴油驱动的巴士。

根据当地美国商会的一项调查，笼罩在香

港上空厚厚的烟雾已经让好些外籍专业人士萌生离意。在140个受访的高层管理人士当中，有将近80%认为，香港的吸引力正在下降当中；

五个人当中，有四个说，他们认识的专业人士中，有的人曾因空气污染而考虑离开，有的已经离开。

在这项调查报告公



↑在烟雾笼罩下，维多利亚港一带的能见度大受影响，从近处都看不清香港会议展览中心。

←香港空气污染情况日趋严重，一些路人受不了脏空气，捂着鼻子过马路。

(法新社)

如果我们不支持或不呼吁香港和广东政府处理相关问题，让大家能够再安全呼吸的话，经济之风还会不会往香港吹？

——美国商会主席马可宝

布后，美国商会主席马可宝(Steve Marcopoto)呼吁香港特区及广东省政府加大解决环境污染的力度。

他说：“这项调查是为了让大家停下来想想，如果我们不支持或不呼吁香港和广东政府处理相关问题，让大家能够再安全呼吸的话，经济之风还会不会往香

港吹？”

港府及民间团体 近来频频“出招”

据中新社报道，为了解决空气污染的问题，香港政府及各民间团体，近来频频“出招”。曾荫权先在立法会答问大会宣布，公务员夏天可穿便服上班；接着在电台说，要立法

强制停车熄火；后来又发起“蓝天行动”，呼吁全城投入，为打造蓝天尽一份力。

香港环保团体也发起了“八八八熄灯行动”，在8月8日晚上8时，让香港全城熄灯三分钟，以强烈姿态呼吁政府正视普罗大众对改善空气质量的渴求。

World Health Organisation

The Right to Healthy Indoor Air

Report on a WHO Meeting

Bilthoven, The Netherlands
15–17 May 2000

Indoor air quality (IAQ) is an important determinant of population health and wellbeing. People in modern societies spend most of their time in indoor spaces such as at home, work, school and in vehicles. Exposure to the hazardous airborne agents present in many indoor spaces causes adverse effects such as respiratory disease, allergy and irritation of the respiratory tract. Improperly or poorly ventilated combustion appliances pose a real risk of acute poisoning by carbon monoxide. Indoor exposure to radon and environmental tobacco smoke increases the risk of lung cancer. Many chemicals encountered indoors cause adverse sensory effects, giving rise to a sense of discomfort and other symptoms.

The control of indoor air quality is often inadequate in spite of its significant role in determining health. Tensions and conflicts often occur between individuals suffering from indoor air pollution and those whose actions negatively influence indoor air quality. Most exposure to indoor air occurs in private homes, where intervention by public regulation is often considered a violation of personal freedom. Furthermore, commercial interests have often delayed the implementation of indoor air pollution controls in spite of scientific evidence of the harmful impact of such pollution on health.

To a large extent, the inadequate quality of indoor air arises from a poor articulation, appreciation and understanding of the basic principles underlying the policies and actions related to indoor air quality. As a result, the general public is familiar neither with those principles nor with their associated rights.

A WHO Working Group was convened to agree on a set of statements on “The right to healthy indoor air”, derived from fundamental principles in the fields of human rights, biomedical ethics and ecological sustainability. These statements inform the individuals and groups responsible for healthy indoor air about their rights and obligations, and empower the general public by making people familiar with those rights.

For any enquiries on Draft SS IAQ, please contact:

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Management

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Thank You