CODE OF PRACTICE ON INDOOR AIR QUALITY

DEPARTMENT OF OCCUPATIONAL SAFETY AND HEALTH
MINISTRY OF HUMAN RESOURCES
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PREFACE

Good indoor air quality (IAQ) is required for a healthy indoor work environment. Poor indoor air quality can cause a variety of short-term and long-term health problems. Health problems commonly associated with poor IAQ include allergic reactions, respiratory problems, eye irritation, sinusitis, bronchitis and pneumonia.

IAQ problems occur in buildings that are served by a common ventilation and/or air conditioning system. IAQ problems can be due to indoor air pollutants or to inadequate ventilation.

There are many sources of indoor air pollutants and among the common ones are environmental tobacco smoke (ETS) emitted due to burning of tobacco products; various chemical substances such as formaldehyde emitted from furnishings; volatile organic compounds emitted from the use and application of solvents; and ozone emitted from photocopiers and laser printers. It should be noted here that ETS has been recognized as a human carcinogen by the Internasional Agency fro Research on cancer (IARC) in 2002 and exposure to it will increase the risk of coronary heart disease.

This code of practice has been drawn up to ensure that employees and other occupants are protected from poor indoor air quality that could adversely affect their health and well being, and thereby reduce their productivity.

Employers are encouraged to use this code of practice as a guide to comply with the general duties of employers prescribed under section 15 of the Occupational Safety and Health Act 1994 (Act 514). Even though compliance with this code is not mandatory at the moment, it can be used as evidence of good practice in a court of law.

Minister of Human Resources
Malaysia

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this Code of Practice is to set minimum standards that will protect the health of employees and other occupants of an indoor or enclosed environment served by a common mechanical ventilation and/or air conditioning system.

1.2 SCOPE AND APPLICATION

This Code of Practice will apply to all non-industrial places of work in industries listed under Schedule 1 of the Occupational Safety and Health Act 1994 (Act 514). The Code –

i) Establishes a set of maximum exposure limits for five commonly encountered indoor air contaminants of chemical origin;
ii) Describes a mechanism to identify, evaluate and control these indoor air contaminants;
iii) Specifies other appropriate occupational safety and health measures; and
iv) Does not apply to indoor air contaminants of biological origin such as mites, viruses and spores.

Appendix 1 gives further information on issues of indoor air quality and the common adverse effects associated with exposure to the five contaminants especially in indoor or enclosed working environment that is served by a common mechanical ventilating and/or air conditioning system.

1.3 DEFINITIONS

"bar" means a counter in a public building, restaurant or café in which alcohol or refreshment are served;

"cafeteria" means a restaurant where a person choose and pays for his meal at a counter and carry it to a table;

"ceiling limit" means the airborne concentration of a contaminant that is not to be exceeded at any time during the work shift;.

"commercial establishments" means any physical facility where the buying and selling of goods and services is carried out;

"discotheque" means a club etc for dancing to music;

"educational facilities and training facilities" means any enclosed facility designed to provide education and training through information or instruction or practical training including, but not limited to a school, institution, college, polytechnic, university, training centre and function or seminar rooms offered by establishment;

"environmental tobacco smoke" means substances in the indoor air arising from tobacco smoke;

"gaming establishment" means a public building or room where people play gambling games for money or risk a sum of money against another's on the basis of the outcome of an unpredictable event;

"health care facility" means any hospital, clinic, doctor's office, dentist's office, laboratories associated with health care treatment, and other establishments involved in the provision of health care;

"indoor air quality assessor" means an employee or any person appointed by the employer and registered with the Director General of Occupational Safety and Health to carry out assessments of risks to health, and includes an occupational hygienist;

"karaoke lounge" means a public room where people entertain themselves by singing, using a machine that plays only the music of songs so that people can sing the word themselves;

"non-industrial place of work" means an indoor or enclosed working environment that is served by a common mechanical ventilating and/or air conditioning system, where there are persons at work, such as but not limited to-

I. offices, educational and training facilities, commercial establishments, and health care facilities;
II. cafeterias and restaurants;
III. gaming establishment, pubs, bars, karaoke lounges and discotheque;

but does not include premises that are used primarily as manufacturing and production facilities and vehicles;

"normal business activity" means the typical or usual business activity;

"occupant" means any person in a place of work, and include an employee, client, patient, resident, patron, student, visitor or guest;

"occupational hygienist" means a person who possesses a college or university degree(s) in engineering, chemistry, physics, medicine, or related physical or biological sciences who, by virtue of special studies and training, has acquired competence in industrial hygiene.

"office" means a room, set of rooms or building where people work, usually sitting at desks;

"prescribed activities" means any activity that could pose health hazard to the occupants, including but not limited to-

(a) applying or removing floor coverings including carpeting, floor tiles and other surfaces;

(b) applying wall coverings;

(c) painting or the application of similar coatings;

(d) cleaning carpets;

(e) applying floor finishing and stripping products;

(f) applying pest control products; and

(g) applying caulking, sealing, or glazing compounds;

"pub" means a building serving alcoholic and other drinks, and often also food to the customer;

"restaurant" means any establishment which is primarily devoted to the serving of food to the public; and

"unacceptable" means the concentration of one or more air contaminants listed in column I of Table I have exceeded the maximum limits listed in column II of Table I; or, the safe work procedure for prescribed activities is not established and implemented; or, there are medical complaints at a point of time from employees or occupants related to the indoor air quality; or, any other situations related to indoor air quality deemed relevant by the indoor air quality assessor.

2. ASSESSMENT OF INDOOR AIR QUALITY

2.1 DUTY TO CONDUCT ASSESSMENT

2.1.1 Every employer should assess the risks arising from the indoor air quality at the place of work to the health of his employees.

2.1.2 The assessment should be carried out during normal business activity and must take into consideration the following:

(a) The sources of indoor air contaminants;
(b) Employees' exposure to environmental tobacco smoke;
(c) Employees' exposure to air contaminants, either from indoor or outdoor sources;
(d) The prescribed activities;
(e) The adequacy of mechanical ventilation at the place of work;
(f) The necessity to monitor an employee's exposure; and
(g) The necessary actions to be taken to improve the indoor air quality at the place of work.

2.1.3 The assessment carried out under paragraph 2.1.2, must include the measurement of the indoor air contaminants listed in column I of Table 1. **Appendix 2** gives further guidance on indoor air quality assessment.

Table I: List Of Indoor Air Contaminants and the Maximum Limits

Indoor Air Contaminants	Eight-hour time-weighted average airborne concentration	
	ppm	mg/m^3
Carbon dioxide	C1000	
Carbon monoxide	10	
Formaldehyde	0.1	
Respirable particulates		0.15
Total volatile organic compounds	3	

Where:

- *C is the ceiling limit*
- *mg/m^3 is milligrams per cubic meter of air at 25°Celsius and one atmosphere pressure*
- *ppm is parts of vapour or gas per million parts of contaminated air by volume*

2.1.4 The assessment referred to in paragraph 2.1.1 should be conducted by an indoor air quality assessor and the assessment report must be forwarded to the employer within one month upon completion of the assessment. **Appendix 3** describes the procedure for registration as an indoor air quality assessor with the Director General.

2.1.5 The assessment of indoor air quality should be repeated whenever there are changes in the indoor environment that affect the results of the latest assessment or not more than five years have elapsed since the last assessment. **Appendix 4** describes the changes that affect the assessment validity.

3. CONTROL OF INDOOR AIR QUALITY

3.1 DUTY TO CONTROL EXPOSURE

3.1.1 An employer should ensure that his employees or any other occupants at the place of work are not exposed to any of the contaminants listed in Table 1 exceeding the corresponding maximum limits.

3.1.2 Where the assessment report indicates that the indoor air quality is unacceptable, an employer should initiate to implement any of the following measures within one month after receiving the report: -

(a) elimination or relocation of the source of the air contaminants, and the appropriate location of the air supply or exhaust openings of the mechanical ventilation system;
(b) substitution of the building material or office chemicals with those that are less harmful;
(c) improving ventilation;
(d) installation of air cleaning devices;
(e) control of exposure to environmental tobacco smoke;

(f) administrative controls including work scheduling, provision of information, instruction and training; establishment of healthy work practices, procedure or policies; or

(g) a combination of the above measures.

4. COMPLAINTS AND INVESTIGATIONS

4.1 Complaints Procedure

4.1.1 An employer should establish a procedure to deal with complaints from employees and other occupants related to signs and symptoms related to poor indoor air quality. **Appendix 5** gives guidance on the establishment of the complaint procedures.

4.1.2 Upon receipt of a complaint, the employer must ensure that an investigation is conducted to ascertain the cause of the complaint, and a report prepared, without delay.

4.2 Actions on Complaints

4.2.1 Where a complaint is received in accordance with the procedures established under paragraph 4.1, the employer should ensure that:

(i) the complaint is communicated to the building owner; and

(ii) if the complaint is found to be valid, the employer or/and owner should take action to address the problem through the institution of the control measures spelled out under paragraph 3.1.

5. INFORMATION, INSTRUCTION AND TRAINING

5.1 Duty of Employer

5.1.1 An employer should ensure that all his employees are informed, instructed and trained on the –

(i) causes of poor indoor air quality and the effects to health arising from it;

(ii) detrimental effects from environmental tobacco smoke and its contribution to the overall indoor air quality; and

(iii) contents of this code of practice, the identification of signs and symptoms associated with the illnesses commonly associated with poor indoor air quality, and the identification of poor ventilation conditions and signs of deterioration in the air-conditioned or mechanical ventilation system.

6. RECORDKEEPING

6.1 Keeping of Records

6.1.1 All records that are generated under this code of practice should be kept for a period of not less than thirty years. **Appendix 6** explains the guidance on record keeping.

6.1.2 Whenever an employer ceases to carry on business and another person succeeds him, the employer ceasing business should handover, and the successor employer should retain all records to be maintained under this code of practice.

APPENDIX 1: INDOOR AIR QUALITY (IAQ)

A.1 BACKGROUND

Good indoor air quality is desired for a healthy indoor environment. Poor indoor air quality can cause a variety of short-term and long term health problems. Health problems commonly associated with poor IAQ include allergic reactions, respiratory problems, eye irritation, sinusitis, bronchitis and pneumonia.

IAQ problems arise in non-industrial buildings (an indoor or enclosed work space that is served by a common ventilating and/or air conditioning system where there are person at work, but does not include premises that are used primarily as manufacturing and production facilities and vehicles) when there is an inadequate quantity of ventilation air being provided for the amount of air contaminants present in that space. Hence, IAQ and heating, ventilation and air-conditioning systems (HVAC) are closely related.

A.2 SOURCES OF POOR IAQ

IAQ problems can be due to indoor air pollutants/contaminants or to inadequate pollution controls despite otherwise normal or baseline rates of ventilation. Sources of indoor air pollutions are from different origins:

a) the occupants themselves (such as exhaled carbon dioxide gas);
b) inadequate materials or materials with technical defects used in the construction of the building;
c) the work performed within (such as cleaning of carpet);
d) excessive or improper use of normal products (pesticides, disinfectants, products used for cleaning and polishing);
e) combustion gases (such as smoking); and
f) cross-contamination coming from other poorly ventilated zones.

A.3 PARAMETERS TO INDICATE IAQ

The parameters to indicate whether an indoor environment is comfortable and healthy or otherwise can be summarised as follows:

a) Chemical contaminants, such as carbon dioxide, carbon monoxide, formaldehyde and environmental tobacco smoke (ETS);

b) Physical conditions, such air temperature, air velocity and humidity;

c) Biological agents, such as mites, virus, and spores; and

d) Radiation such as radon.

A.4 HEALTH EFFECTS DUE TO POOR IAQ

The health effects due to IAQ can be categorized as follows:

a) Health effects due to environmental tobacco smoke (ETS) from passive smoking;
b) Sick building syndrome; and
c) Legionella disease.

Health effects of ETS

ETS is defined as substances in indoor air arising from tobacco smoke. The main source of ETS is cigarette smoking. ETS comprises smoke that is generated from the combustion of cigarette in between puff (main components) and also comprises smoke that is exhaled out by the smoker. ETS contains more than one thousand chemical substances and more than 20 toxic chemicals and carcinogens. Chemicals usually associated with ETS are nicotine, nitrosamines, polyaromatic hydrocarbons (PAHs), carbon monoxide, carbon dioxide, oxides of nitrogen, acrolein, formaldehyde and hydrogen cyanide.

The International Agency for Research on Cancer (IARC) had announced in 2002 that ETS is a human carcinogen and it increases the risk of coronary heart diseases.

Sick-Building Syndrome

"Sick building syndrome" is the name that has commonly been used for illnesses that occur among occupants as a result of poor indoor air quality in building.

Some of these buildings may be inadequately ventilated. For example, mechanical ventilation systems may not be designed or operated to provide adequate amounts of outdoor intake air. People generally have less control over the indoor environment in their offices than they do in their home. As a result, there has been an increase in the incidence of reported health problems.

Sometimes building occupants experience symptoms that do not fit the pattern of any particular illness and are difficult to trace to any specific source. This phenomenon has been labeled as *sick building syndrome*. Symptoms that have arisen among occupants of "sick building" have varied from eye and nose irritation, fatigue, cough, rhinitis, nausea, headache, sore throat or a combination of these.

A number of well-identified illnesses, such as Legionnaires' disease, asthma, hypersensitivity pneumonitis, and humidifier fever, have been directly traced to specific building problems. These are called building-related illnesses. Most of these diseases can be treated; nevertheless, some pose serious risks.

Legionnaires' disease

Legionnaires' disease is one of the building-related illnesses. Identification of the existence of this disease began in 1968 after an epidemic of illness characterized by fever, headache and muscular pains was found to be associated with the air conditioning system of a health department building in Pontiac, Michigan, USA.

The bacteria that cause Legionnaires' disease, legionella pneumophila will grow in any environmental reservoir in which its nutrient, water and temperature requirement are met, and enters the air when such sites are disturbed. Although this organism is ubiquitous in the environment, airborne concentrations only occasionally reach levels adequate to infect otherwise normal subjects.

Water-cooling towers and warm water systems in buildings have been identified as major sources of this organism. Without treatment of the water or without adequate maintenance of the system, legionella can proliferate and then be distributed throughout the building by the air-handling system.

APPENDIX 2: ASSESSMENT OF INDOOR AIR QUALITY

The purpose of conducting an assessment is to enable decisions to be made on appropriate control measures, the provision of information, and the necessity for air monitoring as may be required to protect the health of employees and occupants who may be exposed to air contaminants at the place of work.

Objective

Indoor air quality assessment is conducted with the following objectives:

a) To identify the sources of the air contaminants either within the place of work or from the outside air;
b) To evaluate the exposure of the occupants to the air contaminants;
c) To evaluate the adequacy of existing control measures;
d) To conclude the significance of the health risk posed by the air contaminants; and
e) To recommend further appropriate control measures to prevent or reduce risks.

Factors to be considered in an assessment

These are the factors to be considered in an assessment of indoor air quality:

(a) sources of indoor air contaminants, such as from furnishings, electrical equipment, etc. ;
(b) employees exposure to environment tobacco smoke, either directly or passively;
(c) employees exposure to air contaminants, either from indoor or outdoor sources;
(d) prescribed activities, such as changing of carpets, repainting, etc.;
(e) the adequacy of mechanical ventilation at the place of work, such determining the air change per hour and the fresh air supply rate, etc.;
(f) the necessity to monitor employees' exposure on a regular basis; and
(g) the necessary actions to be taken to improve indoor air quality at the workplace.

Method of Measurement

a. Sample position

The sampling probe should be located between 75 and 120 cm from the floor at the centre of the room or an occupied zone.

b. Number of sampling points

Indoor

At least one sample should be taken from each floor or from each area serviced by a separate air-handling unit. For large floor spaces, the recommended numbers of sampling points are as follows:

Area of building (m2)	Minimum number of sampling points
3,000 - 4,999	8
5,000 – 9,999	12
10,000 – 14,999	15
15,000 – 19,999	18
20,000 – 29,999	21
30,000 or more	25

Outdoor
At least two samples should be taken at the entrance to the building or at the entrance of the fresh air intake.

Equipment to be used

Use direct-reading instruments with accuracy better than ± 25%.

For respirable particulates, sampling is carried out using an instrument with a size selective device having a median cut size of 4 micrometer and the following penetration characteristics:

particle aerodynamic diameter (micrometer)	respirable particulate mass (%)
0	100
1	97
2	91
3	74
4	50
5	30
6	17
7	9
8	5
10	1

APPENDIX 3: REGISTRATION AS INDOOR AIR QUALITY ASSESSOR

Indoor air quality assessor should register with the Director General of Occupational Safety and Health.

Qualifications, experience and training

Those eligible for consideration for registration must possess the following qualifications, experience and training:

a) A certified occupational hygienist by the American Board of Industrial Hygiene;
b) An occupational hygienist who is a full member of the Malaysian Industrial Hygiene Association (MIHA);
c) A registered assessors under the USECHH Regulations 2000 who has attended training in indoor air quality assessment conducted by NIOSH or MIHA; or
d) A registered hygiene technician I under the USECHH Regulations 2000 who has attended training in indoor air quality assessment conducted by NIOSH or MIHA; or
e) A person with at least a Diploma in pure or applied sciences and has 1 year experience in measurement of airborne chemical and has attended training in indoor air quality assessment conducted by NIOSH or MIHA.

Registration Procedure

An applicant must apply in writing to be registered with the Director General and he must forward together the following items: -

a) a certified true copy of academic or professional qualifications;

b) a certified true copy of the National Registration Identity Card (for Malaysian citizen) or Passport (for foreign resident);

c) a certified true copy of work permit issued by the Malaysian Government (only for foreign resident);

d) details of working experience in occupational safety and health including the name of supervisor(s) & his qualifications;

e) a certified true copy of the certificate of attendance of relevant courses; and

f) a certified true copy of the results of relevant course examination.

The completed application shall be forwarded to: -

The Director General
Department of Occupational Safety and Health,
Level 2,3, & 4, Block D3, Parcel D
Federal Government Administrative Centre,
62502 Wilayah Persekutuan Putra Jaya

The prospective applicant may be asked to attend an interview or present the finding of an assessment he had conducted, if necessary.

Registration Validity

Successful applicants will be registered for a maximum period of three (3) years. The Director General may, however, prescribe a shorter duration. Notwithstanding, the Director General may revoke the registration of any person before its expiration date if:

a) his registration was obtained by fraud or misrepresentation; or

b) he has failed to discharge his duties as an indoor air quality assessor; or

c) he has been convicted of an offence under the Act or any regulations made there under.

Renewal of Registration

A person applying to renew registration with the Director General should: -

a) Show proof that he had been engaged in work activities of an indoor air quality assessor every year; and

b) Have undergone continuing education in the field of occupational safety and health.

Application for renewal of registration must be made at least three (3) months before the expiration date of the current registration, writing to the Director General.

APPENDIX 4: CHANGES AFFECTING ASSESSMENT VALIDITY

This refers to permanent changes that affect or may affect the result of an indoor air quality assessment such as but not limited to the following:

a) New air-conditioning or mechanical ventilation system installed;
b) Walls or ceilings applied with a new coat of paint;
c) New carpet or new flooring material used;
d) New set of the furnishing being used;
e) Additional photocopiers or laser jet printers being used;
f) Any additional machines or equipment, that is known to release chemical substances into the indoor air, being used; and
g) Use of air freshers.

APPENDIX 5: COMPLAINTS PROCEDURES

Every employer should establish a complaint procedure that includes:

(a) procedures for receiving and dealing with complaints including -

I. documentation of the occurrence of complaints including record of signs and symptoms of employees or occupants discomfort or affected by the indoor air quality,
II. alleged location of the source, and
III. date and time of the complaint;

(b) a description of the process or processes for response to a complaint;
(c) regular reviews of complaints by the employer or by the safety and health committee;
(d) identification of individuals responsible for administering the complaint process;
(e) procedures for communicating any remedial action to committee and the complainant; and
(f) follow-up procedures to ensure that the remedial action recommended, if any, has been taken.

APPENDIX 6: RECORDS TO BE KEPT

Records to be kept under this code include:

2. Assessment report including the results of indoor air contaminant measurement;
3. Complaints and investigation reports; and
4. Training records.

Contents of Reports

Assessment report

Should include the following:

a) potential sources of indoor air pollutants;
b) the measurement results for the five contaminants listed in Table 1;
c) the condition of the ventilation system, including the number of air changes per hour and the rate of fresh air changes;
d) health complaints as well as signs and symptoms related to indoor air quality problem;
e) the risk situation;
f) recommendations to improve indoor air quality;
g) recommendations on how to maintain good indoor air quality in the event of carrying out prescribed activities; and
h) the necessity to conduct further indoor air quality measurements.

Complaints and investigation report

Should include the following:

a. documentation of the occurrence of signs and symptoms of occupant discomfort or damage to health;
b. alleged location of the source;
c. date and time of the complaint;
d. the date of investigation and the name of the investigator(s);
e. the result of the investigation; and
f. the actions taken.

Training report

Should include the following:

a) the date of the training sessions and the name of the trainer;
b) the content of the training programme; and
c) the name and signature of trained persons.